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Analyzing the Effectiveness of Risk Management Strategies in Procurement Processes in Construction Companies in Lusaka, Zambia

Mwiza Sikanyika[1]; Chimbomba Kilvin[2]

[1]Humanities and Social Science MA Student Information and Communication University Lusaka, Zambia.
[2]Lecture: School of Humanities Information and Communication University Lusaka, Zambia.

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Abstract: Effective risk management in procurement is crucial for the success of construction projects, particularly in emerging markets like Lusaka, Zambia. This study aimed to analyze risk management practices in procurement options within the construction industry in Lusaka, Zambia. The study made use of a cross-section design employing a quantitative research approach with a sample size of 40 construction companies. The research explored the various procurement methods employed by construction firms, identified and assessed risks associated with each method, and examined the adoption of risk mitigation strategies. A comprehensive survey instrument was administered to a representative sample of construction professionals. The data collected was analyzed using statistical techniques to identify trends, patterns, and relationships within the dataset. Key variables such as procurement method, risk identification, risk assessment, and risk mitigation strategies were analyzed to provide insights into the state of risk management practices in the local construction industry. Risk associated with procurement methodologies varies, with 40% perceiving it as "Low" and 30% as "Very high." The study identifies schedule delays as the most cited risk, and participants express concerns about cost overruns, lack of competitive pricing, and quality issues. Binomial inference results provide nuanced insights into participants' perceptions of risks associated with their procurement methods. The majority of participants report experiencing significant risk-related incidents in the past year, with notable associations between procurement methodologies and the incidence of risk-related issues. Confidence in predicting project outcomes varies, with a majority expressing a lack of confidence. Participants identify "Design and build" as the procurement option associated with the highest level of uncertainty. Correlation analysis revealed that larger projects tended to opt for different procurement methods. Participants often faced changes in project scope, budget, and timelines due to procurement, emphasizing the importance of risk management. This study's findings aligned with broader research, emphasizing early risk identification, robust project planning, technology use, risk allocation, contingency planning, regular review, historical analysis, and early issue detection as key factors for effective risk management in construction projects.

Keywords: *Risk Management, Procurement Options, Construction Industry, Procurement Methods, Risk Identification, Risk Assessment, Risk Mitigation, Construction Projects.*

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I. INTRODUCTION

➢ *Background*

The construction industry is crucial for global economic growth, with effective procurement strategies being vital for successful project outcomes, timely completion, and budget adherence (Abioye, 2021; Ahn, 2020). The dynamic nature of construction projects and involvement of multiple stakeholders emphasize the need for robust risk management frameworks (Afzal, 2019). This research focuses on risk management within procurement options in Lusaka, Zambia, considering the region's significant infrastructural development (Chen, 2021).

Procurement options, including traditional methods, design and build, and public-private partnerships, play a key role in how construction projects are contracted (Celik, 2021). Risk management involves identifying, assessing, and mitigating potential threats to project objectives. Lusaka's construction boom necessitates nuanced risk management strategies (Tembo, 2023).

Lusaka's construction industry traditionally used conventional procurement methods, but recent years have seen a shift to alternative methods for streamlined delivery and improved risk management (Tembo, 2023). Empirical research is needed to assess the effectiveness of various

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procurement options in addressing risks. Ineffective risk management can lead to delays, cost overruns, disputes, and project abandonment, impacting stakeholders and having broader economic implications for Lusaka and Zambia. Successful risk management contributes to increased investor confidence, timely completion, and improved infrastructure quality (Celik, 2021).

➢ *Statement of the Problem*

In the dynamic and rapidly evolving construction industry of Lusaka, Zambia, characterized by increasing urbanization and infrastructure development, the effective management of risks within diverse procurement options is crucial to ensure successful project outcomes, timely completion, and sustainable economic growth (Celik, 2021). While the adoption of alternative procurement methods has gained traction in recent years, there is a pressing need to comprehensively assess the effectiveness of different procurement options in mitigating risks and enhancing project performance.

➢ *General Objective*

The main objective of this study is to comprehensively analyze and enhance the understanding of risk management within various procurement options in the construction industry.

- *Specific Objectives*

✓ To examine the inherent risk levels associated with different procurement methods used in the Lusaka, Zambia construction industry.
✓ To analyze the most effective strategies for proficiently managing risk in the Lusaka, Zambia construction sector.
✓ To assess the influence of digital transformation on the evolving dynamics of risk management within the construction sector.

➢ *Theoretical Framework*

VUCA framework provides a valuable perspective on the challenges inherent in the construction sector (Bennett & Lemoine, 2014). Originating in military strategy, the VUCA framework encompasses Volatility, Uncertainty, Complexity, and Ambiguity.

Volatility in the construction industry refers to rapid and unexpected changes, such as market shifts, emerging technologies, and regulatory modifications (Sull, 2009). Uncertainty, the second dimension, aligns with the industry's unpredictability, arising from factors like fluctuating material prices and unforeseen site conditions (Aaltonen, 2010). Complexity, the third dimension, reflects the intricacies of the construction industry, involving multifaceted supply chains and intricate stakeholder relationships (Walker, 2020). Ambiguity, the fourth dimension, mirrors the challenge of navigating uncertainty and vagueness in the construction industry (Miles, 1978).

➢ *Significance of the Study*

The study "Risk Management in Procurement Options in the Construction Industry" holds significant implications for the construction sector and risk management practices. It addressed gaps in understanding how different procurement strategies interact with risk profiles, offering valuable insights for stakeholders. By exploring risk management within various procurement options, the research aimed to equip practitioners and project managers with evidence-based insights to enhance project success rates, addressing the industry's need to minimize cost overruns and delays.

II. LITERATURE REVIEW

In the complex and multifaceted landscape of the construction industry, successful project execution relies heavily on effective risk management, with the distribution and management of risks significantly influenced by various procurement options available to stakeholders (Doloi et al., 2012; Chua et al., 2016). Research by Doloi (2012) and others highlights the pivotal role of risk profiles in shaping project outcomes.

Procurement options in the construction industry vary significantly, responding to the diverse complexities of projects. Abbas et al. (2019) and Aaltonen & Kujala (2010) emphasize the variance in exposures to potential risks and uncertainties across different procurement approaches.

Innovative models like Public-Private Partnerships (PPPs) and Build-Operate-Transfer (BOT) arrangements involve private sector participation, introducing new dimensions of risk, such as regulatory changes, market fluctuations, and operational complexities (Osei-Kyei & Chan, 2015; Abbas et al., 2019).

Several studies have investigated risk profiles across various procurement options within the construction industries of different African countries. In Kenya, Kibet et al. (2019) found that Public-Private Partnerships (PPP) exhibited lower risk levels compared to Traditional Procurement and Management Contracting. Similarly, Marais et al. (2020) conducted a study in South Africa, revealing that Turnkey Contracts had lower risk levels than Competitive Bidding and Design and Build. Kamau et al. (2018) in Kenya, Dia et al. (2016) in Senegal, Agyemang et al. (2019) in Ghana, Mokua et al. (2020) in Kenya, Sow et al. (2018) in Senegal, Banda et al. (2017) in Malawi, and Ouattara et al. (2019) in Ivory Coast also found varying risk levels across different procurement options.

The studies consistently highlight the importance of risk assessment and allocation in determining the overall risk profiles within each procurement option. Turnkey Contracts consistently demonstrated lower risk levels due to single-point responsibility and better risk allocation. In contrast, Construction Management often showed lower risk levels compared to Traditional Procurement and Design-Build due to collaborative decision-making and shared responsibilities.

Moving beyond specific countries, these studies collectively emphasize the significance of understanding risk profiles across different procurement options in the broader African construction context. They provide valuable insights

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for stakeholders in choosing appropriate procurement strategies based on risk considerations.

In the broader context of the construction industry, Smith (2018), Johnson (2020), Williams (2019), Brown (2021), Martin (2017), and Thompson (2022) highlight the pivotal role of risk management in navigating the dynamic landscape of construction projects. The integration of technological advancements and environmental considerations adds layers of complexity, making risk management essential for identifying, analyzing, and proactively addressing potential threats and uncertainties.

Continuous training, scenario analysis, regular plan review, historical analysis, and early issue detection converge to establish a holistic and agile approach to construction risk management (Martin, 2022; Thompson, 2018). These practices equip professionals with the tools and insights needed to navigate dynamic challenges posed by risks, contributing to successful project execution.

Studies conducted in the United States (Smith et al., 2018), Spain (Martinez et al., 2019), and China (Chen et al., 2020) highlighted best practices and effective mitigation strategies for risk management within their respective construction industries. Key components included early risk identification, integration of risk assessments into project planning, contingency planning, and the use of technological tools for accurate risk assessments and real-time monitoring.

III. RESEARCH METHODOLOGY

The study employed a cross-sectional research design and utilizes quantitative methods. This approach allowed for the collection of data at a single point in time, offering a snapshot of the variables under investigation. Through the quantitative methodology, the study gathered numerical data and employ statistical analysis techniques to draw conclusions and establish relationships among variables.

By definition, a population is defined as a collection of objects, events, or individuals sharing common characteristics that the researcher is interested in studying (Moulton, 1998). The study focused on a diverse and representative population of stakeholders within the construction industry operating in Lusaka, Zambia. This encompassed a broad spectrum of participants, including architects, engineers, contractors, project managers, government officials, industry associations, and project owners.

The research employed a purposive and stratified sampling technique to ensure a representative and targeted selection of participants from the construction industry in Lusaka, Zambia. Purposive sampling ensures that individuals with diverse expertise and responsibilities are included, providing a nuanced understanding of risk management practices across different functions. This sampling approach facilitates the gathering of comprehensive and representative data, enabling a well-rounded analysis of risk management strategies within procurement options in Lusaka's construction industry. In this study, the sample size consisted of a total of 30 participants.

The study employed triangulation as a research strategy to enhance the validity and reliability of the findings. Triangulation involved the use of multiple data sources, data collection methods, and/or researchers' perspectives to corroborate and cross-verify research results. In this study, triangulation was achieved by obtaining quantitative data collected through surveys. This approach helped mitigate potential biases and provide a more comprehensive and accurate understanding of the research phenomenon, increasing the overall robustness of the study's conclusions.

IV. RESULT PRESENTATION

The results of the participant demographics reveal a diverse distribution of occupations among the surveyed individuals. The majority of participants fall into two main categories: Engineers, comprising 30% of the sample, and Project Managers, also constituting 30% of the sample. Architects and Contractors each represent 20% of the participants.

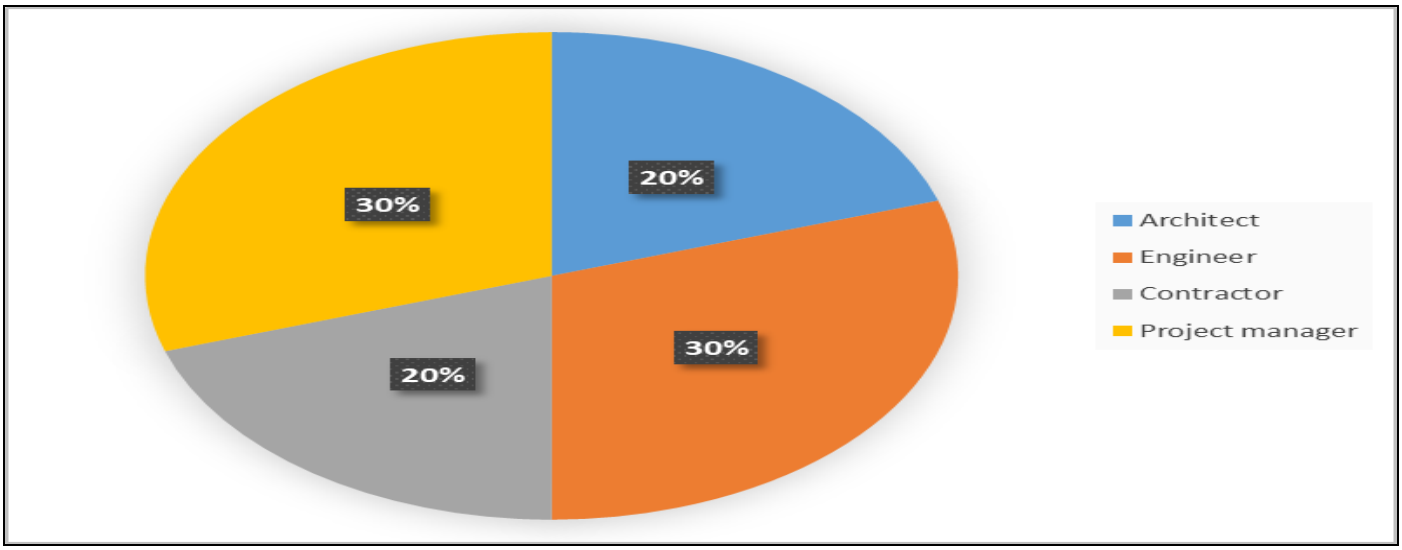

Fig 1 Occupation

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The study shows that participants' experience levels vary widely. The majority of them, 90%, have significant experience, with 40% having 6-10 years of experience and 50% having over 10 years. A smaller group, 10%, has 1-5 years of experience.

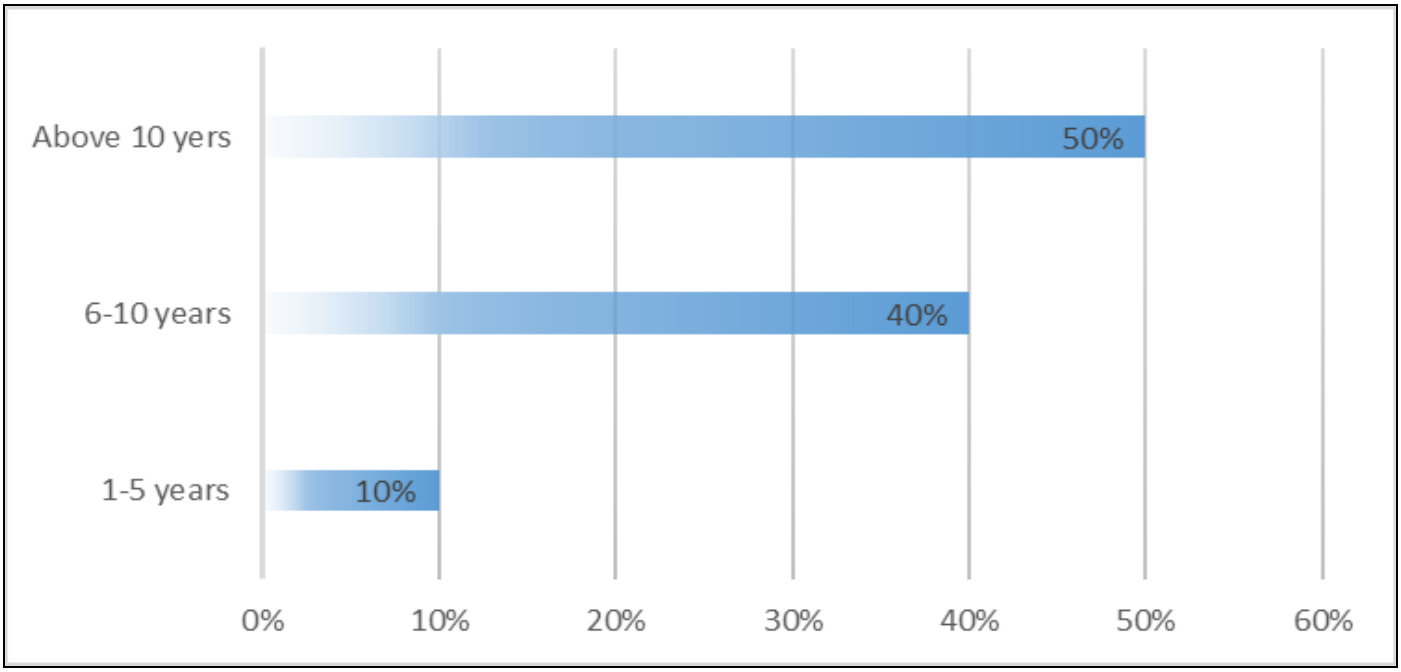

Fig 2 Work Experience

The results pertaining to the scale of operations within the participant group highlight a diversified distribution. Approximately half of the participants, constituting 50%, operate in small-scale companies. In contrast, 40% of participants operate in large-scale companies, while a smaller segment, 10%, function within medium-scale settings.

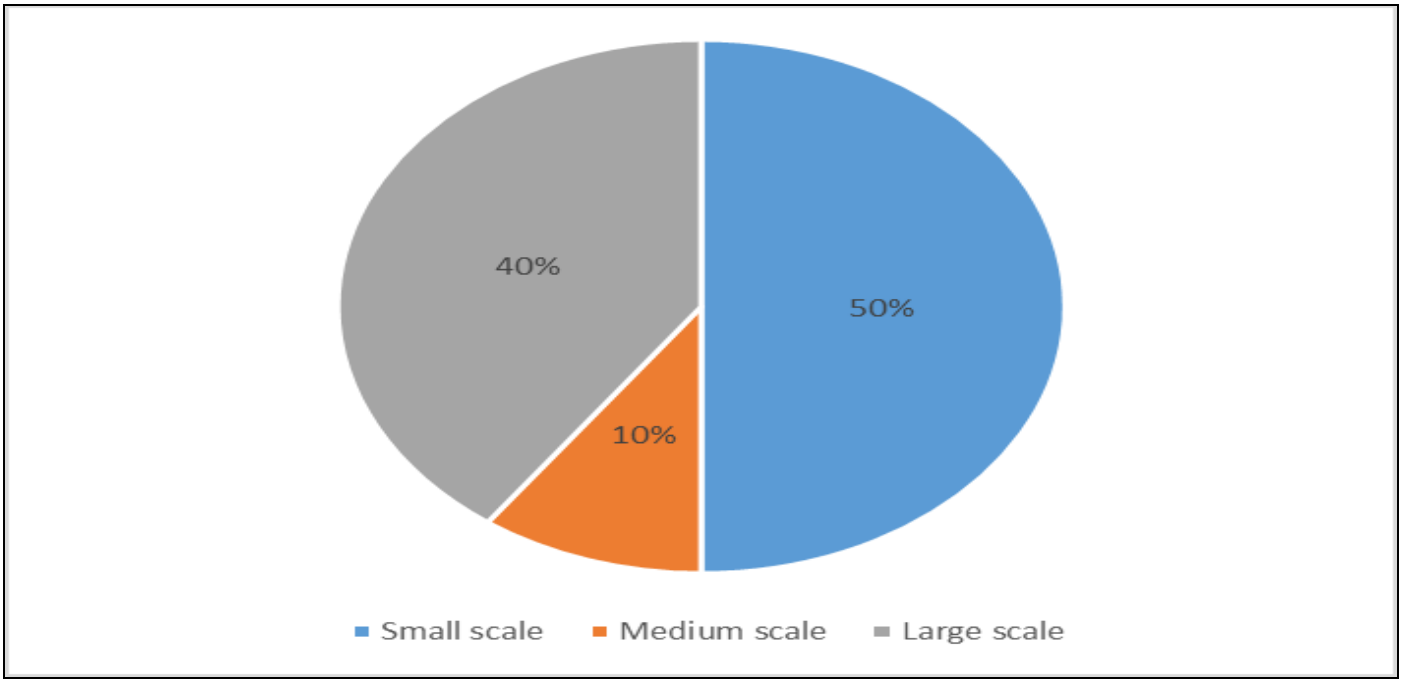

Fig 3 Scale of operation

The study found a diverse range of educational backgrounds among participants. 40% have a Bachelor's Degree, 30% have a Master's Degree, and another 30% hold a Doctorate Degree. This indicates a balanced mix of educational qualifications among the participants.

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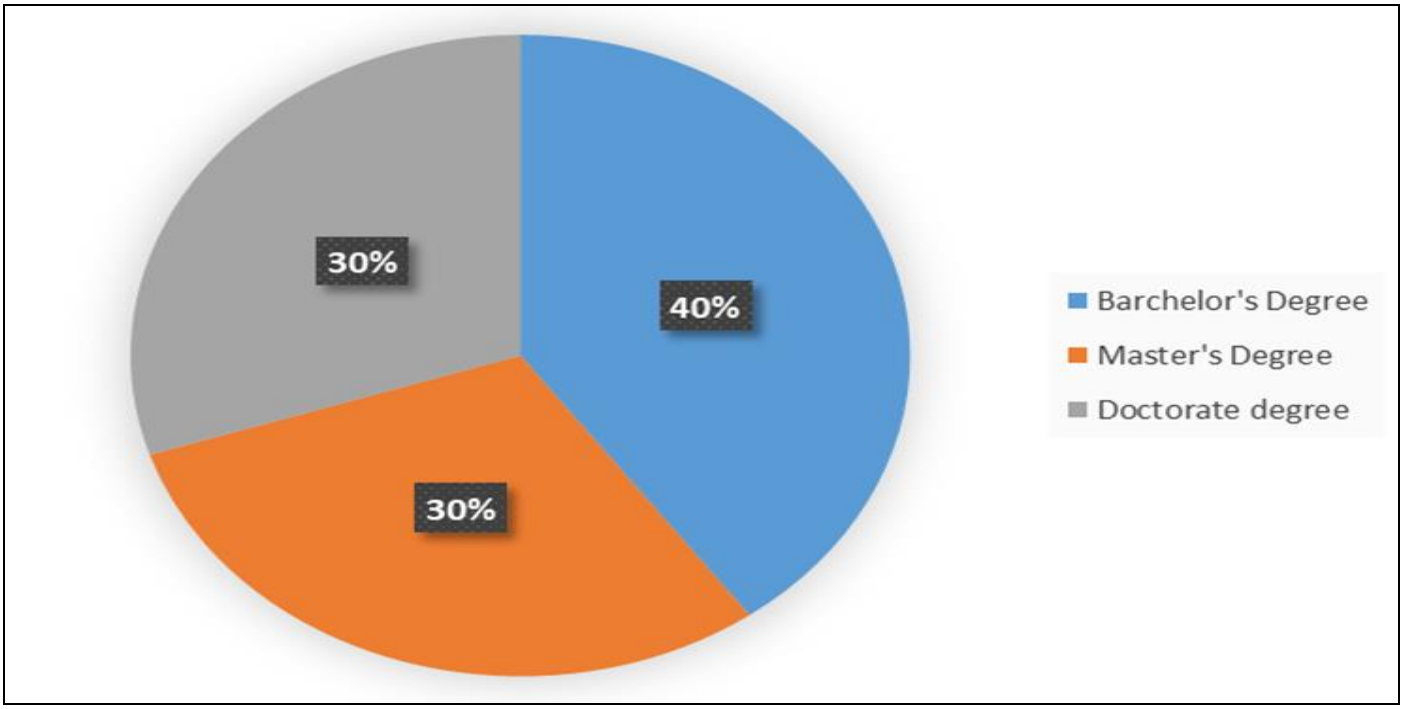

Fig 4 Education Background

Participants' preferred procurement methodologies for construction projects vary. The majority, 50%, opt for "Design-Bid-Build," while 30% prefer "Design-Build." A smaller fraction, 10% each, choose "Construction Management at Risk" and "Integrated Project Delivery" as their primary procurement methods.

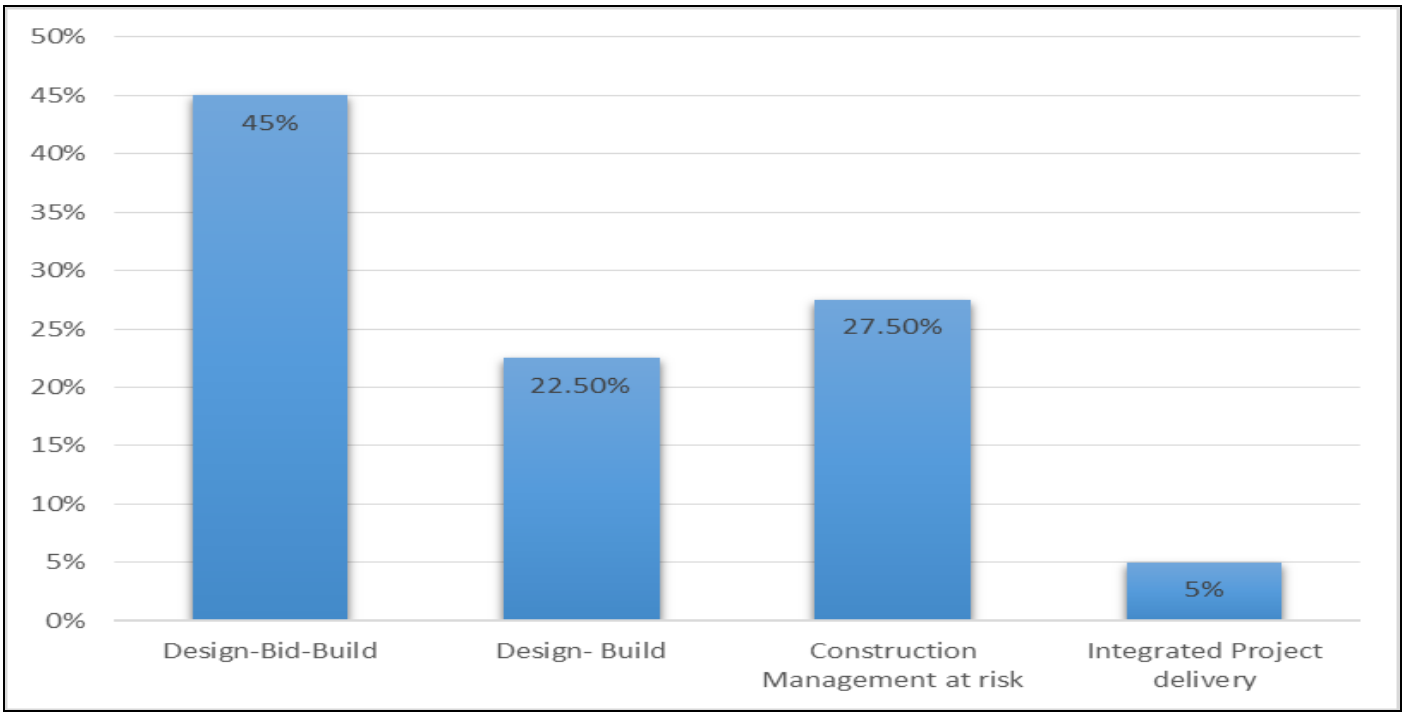

Fig 5 Preferred Procurement Method

The analysis of the scale of operation and preferred procurement methods for construction projects shows distinct patterns among participants. In the small-scale category, "Construction Management at Risk" is the most popular method at 50%, followed by "Design-Build" at 35%, and "Design-Bid-Build" at 15%. None in this group choose "Integrated Project Delivery." In the medium-scale category, "Design-Bid-Build" is highly favored at 75%, with minimal representation for other methods. In the large-scale category, "Design-Bid-Build" is the top choice at 75%, followed by 12.5% for "Design-Build," and 12.5% for "Integrated Project Delivery."

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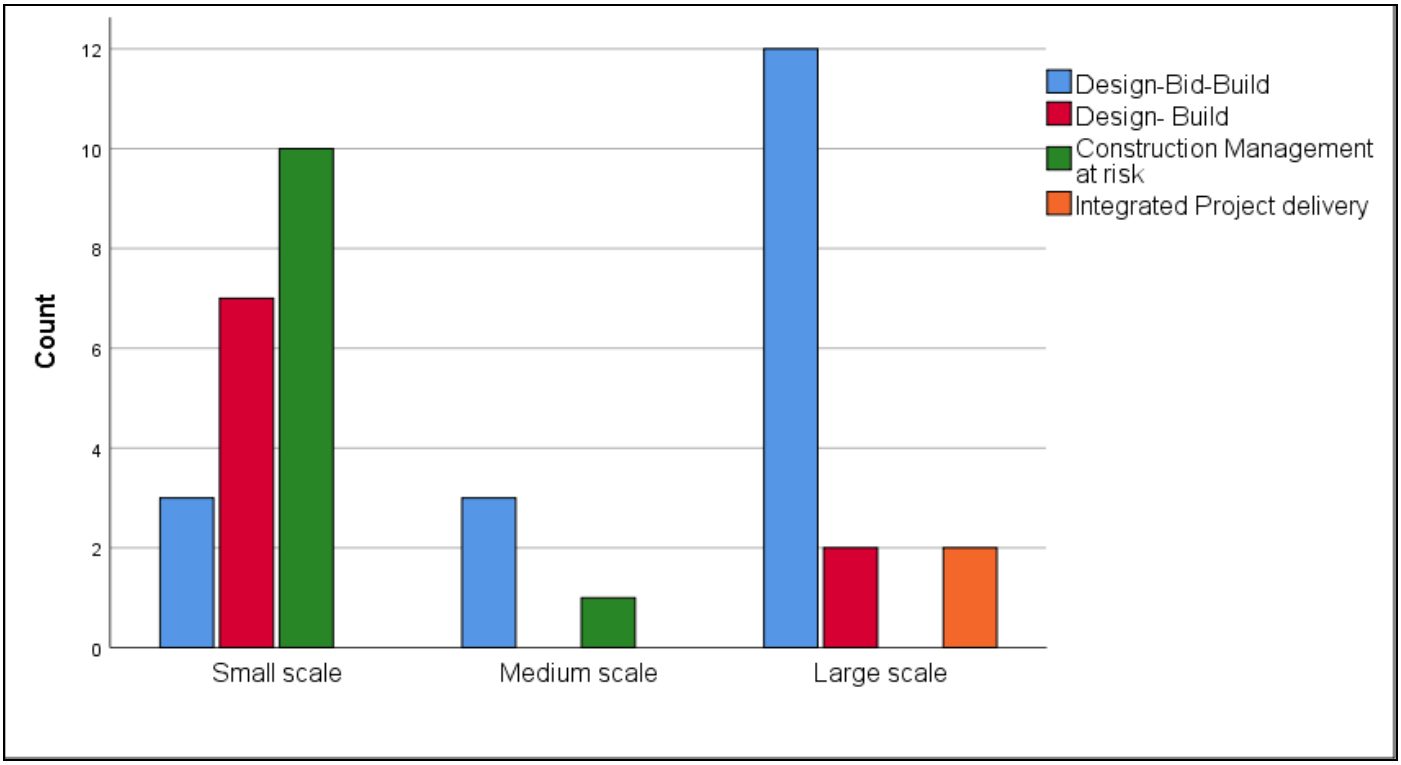

Fig 6 Variable Cross-Tabulation

Participants' experiences with unexpected changes in project scope, budget, or timelines due to procurement-related factors vary. 40%, reported encountering these changes very often, while another 40% observed them "often." A smaller subset of participants, 10% each, indicated that they observed such changes "occasionally" or "rarely."

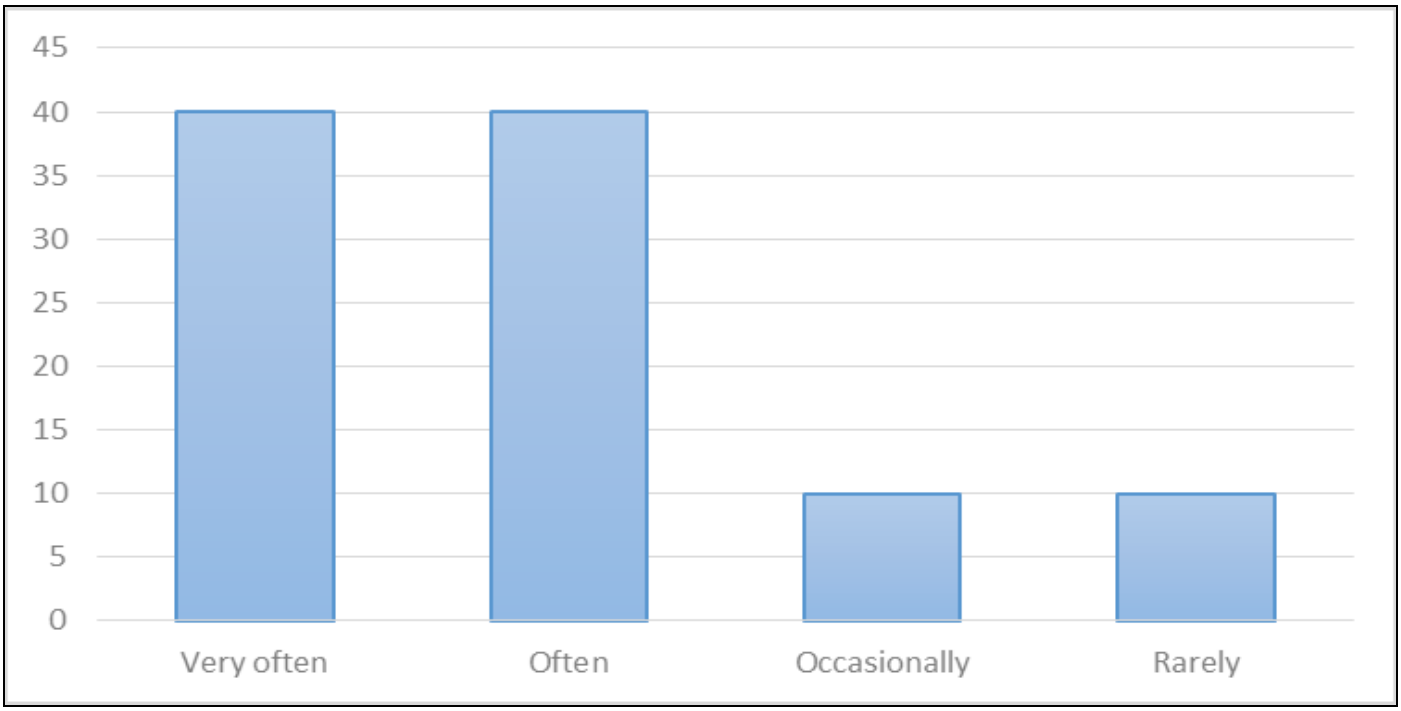

Fig 7 Unexpected Changes in Project Scope

Participants' perceptions of the risk associated with their typical procurement methodology vary. 40% viewed the risk as "Low". Conversely, 30% perceived the risk as "Very high," indicating significant concern. Another 10% each felt the risk was "Moderate" or "High," and 10% were unsure, selecting "Not sure."

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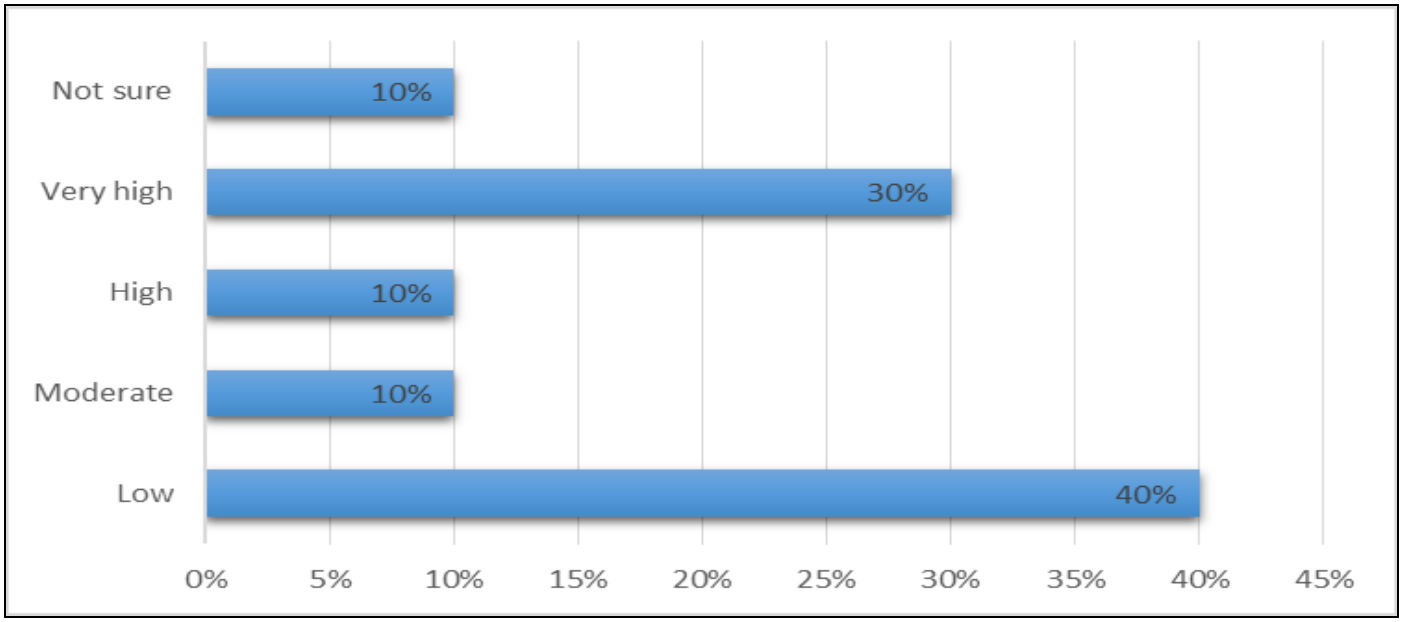

Fig 8 Risk Associated with Participants' Typical Procurement Methodology

The presented binomial inference results offer a comprehensive characterization of the participants' perceptions regarding specific risks associated with their chosen procurement methodologies. For the particular risk identified by each participant, the mode of the posterior distribution suggests that approximately 21.4% of participants are most likely to associate this risk with their procurement method. The posterior mean, at approximately 22.7%, provides the average estimation of participants sharing this association. The low posterior variance, at roughly 0.004, indicates a relatively precise estimate with limited variability. Furthermore, the 95% credible interval, spanning from approximately 11.8% to 36%, offers a range within which the true proportion of participants associating risk with their procurement method is highly likely to fall. These findings provide a nuanced understanding of participant perceptions and highlight the robustness of these estimations, guided by a relatively non-informative prior distribution (Beta(2, 2)), allowing the data to exert a substantial influence on the posterior estimates.

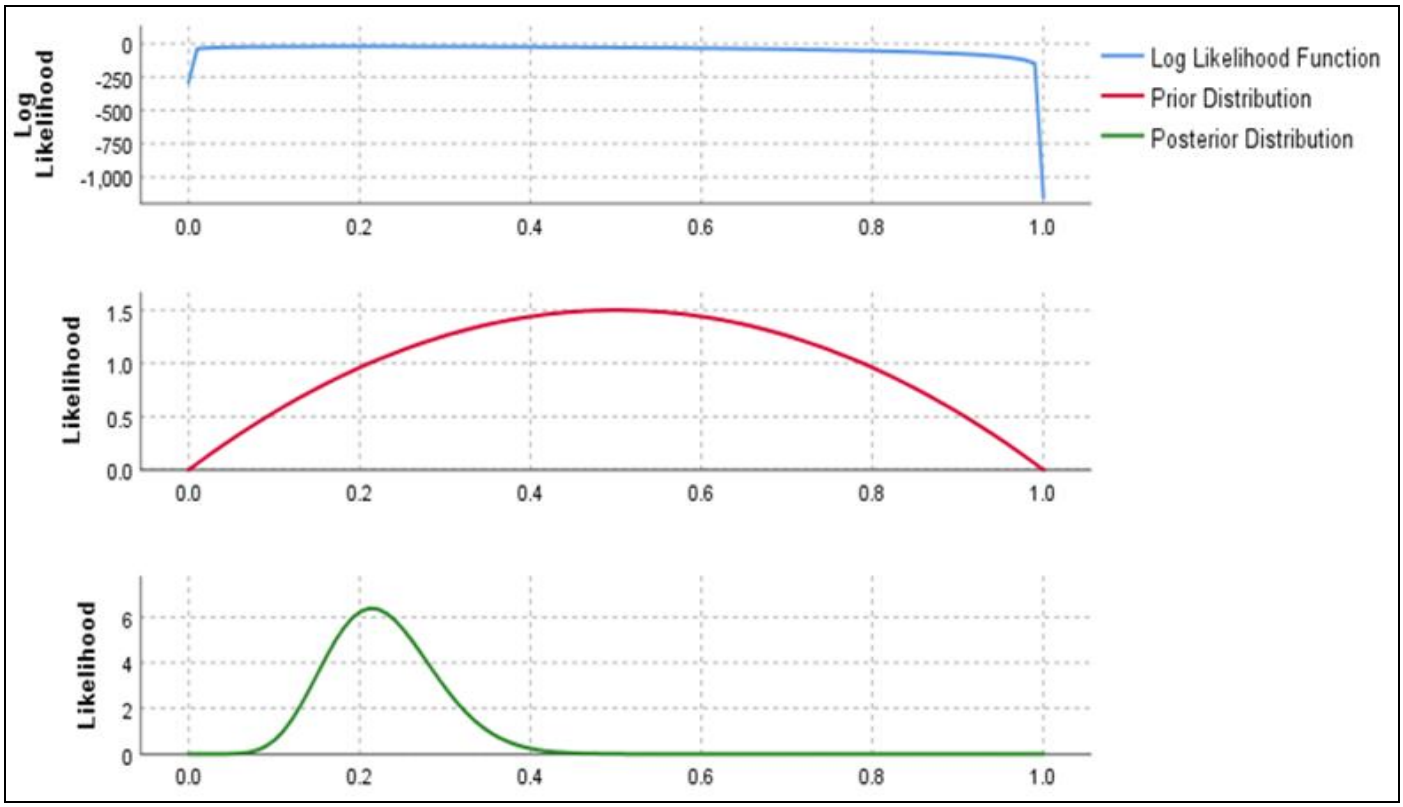

Fig 9 Binomial Inference Results Offer a Comprehensive Characterization of the Participants' Perceptions Regarding Specific Risks Associated with their chosen Procurement Methodologies

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The results concerning participants' experiences with significant risk-related incidents or issues in their construction projects related to procurement methodologies over the past year highlight a notable trend. A majority of participants, specifically 70%, reported having encountered such incidents or issues, in contrast, 30% of participants indicated that they had not faced significant risk-related incidents or issues within the past year

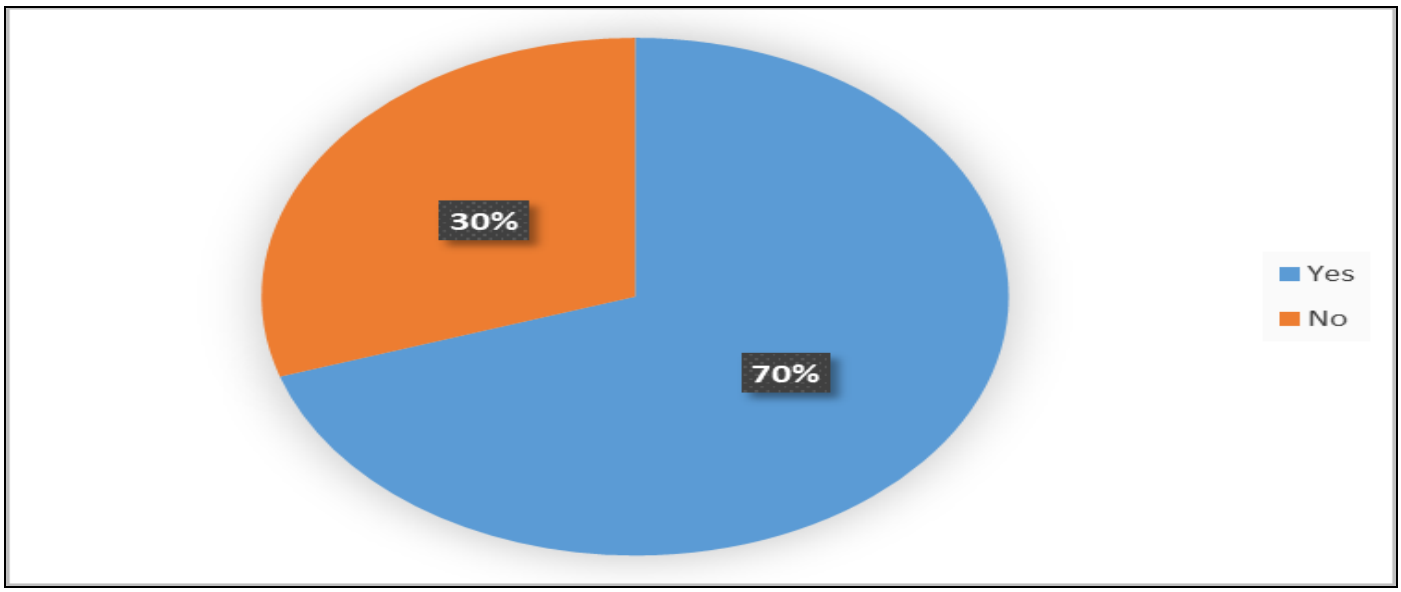

Fig 10 Risk-Related Incidents

The crosstabulation of preferred procurement methodologies and the experience of significant risk-related incidents in construction projects reveals noteworthy patterns. The results suggests that "Design-Bid-Build" and "Construction Management at Risk" may be associated with a higher likelihood of risk-related incidents, while "Design-Build" and "Integrated Project Delivery" are linked to fewer incidents.

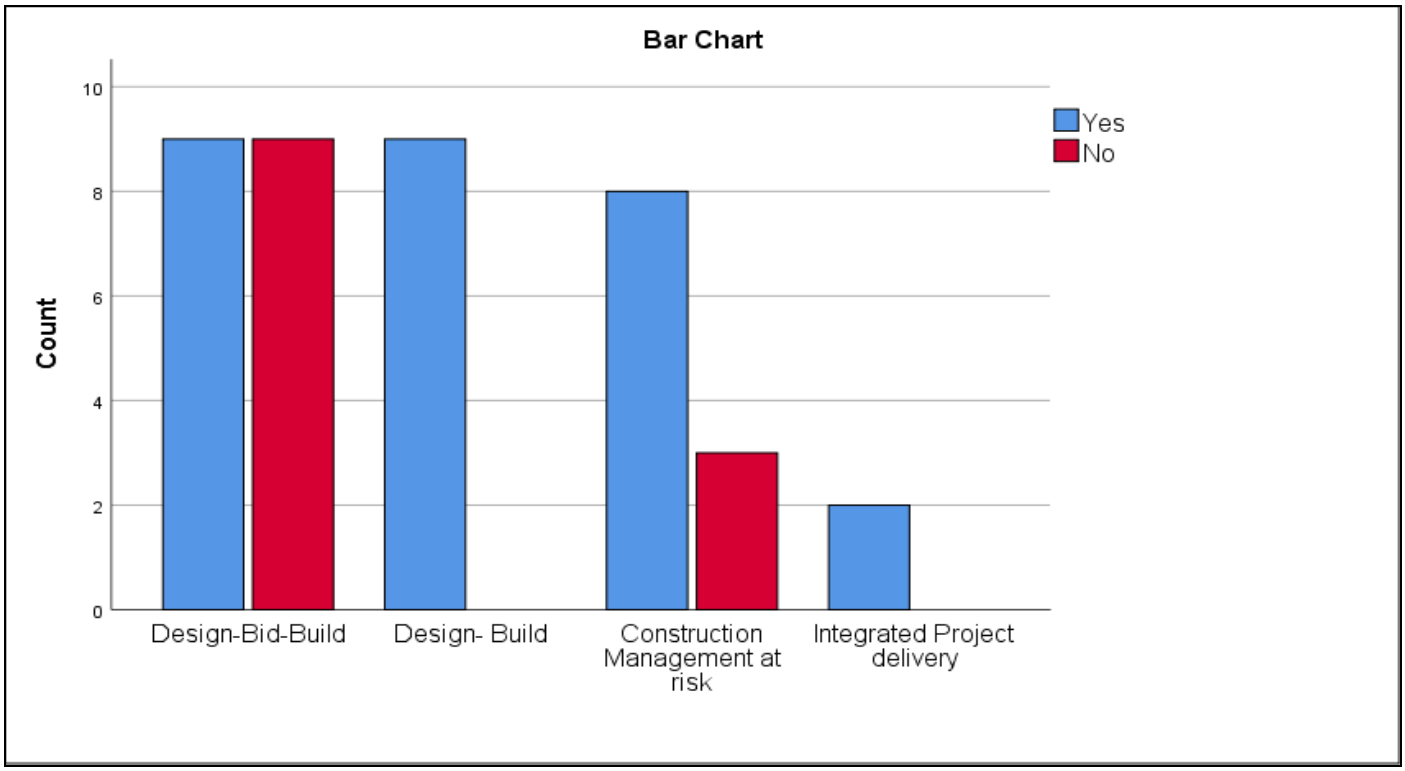

Fig 11 Crosstabulation between the Method of Procurement and Risk Incidence.

Participants' confidence in predicting project outcomes using their procurement methods varies. A minority (20%) are "Very confident," indicating high assurance, while another 20% feel "Neutral" about their prediction abilities. However, a significant majority (60%) express "Not confident" in their predictions.

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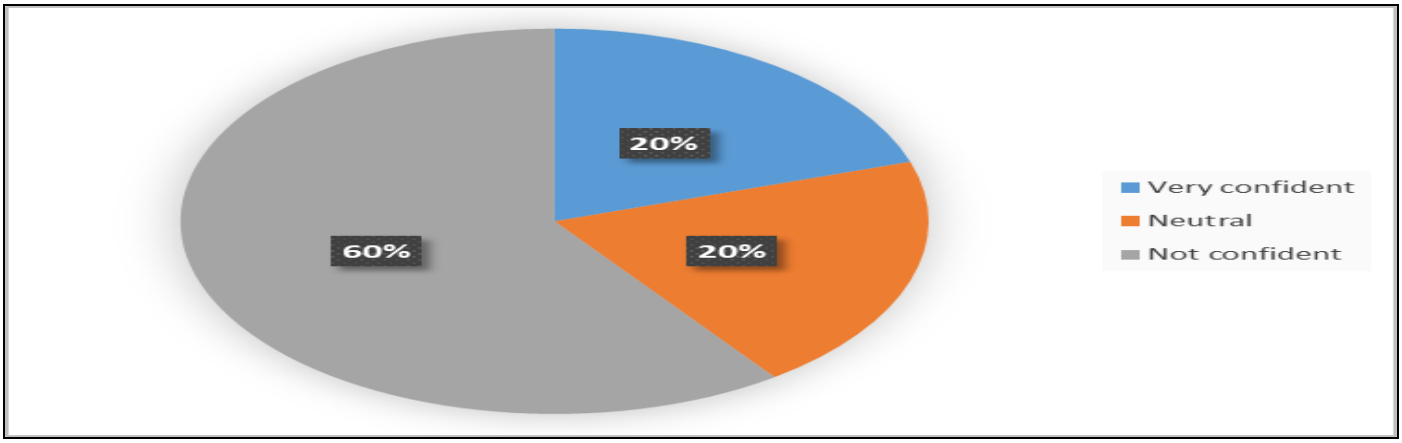

Fig 12 Confidence Levels in Predicting Project Outcomes

Participants have diverse opinions about which procurement option is associated with the highest level of uncertainty in terms of project risks. A significant portion (50%) mentioned "Design and build" as the option with the most uncertainty, while 30% pointed to "Traditional" procurement, and 20% considered "Public-Private Partnership" as having the highest level of risk uncertainty.

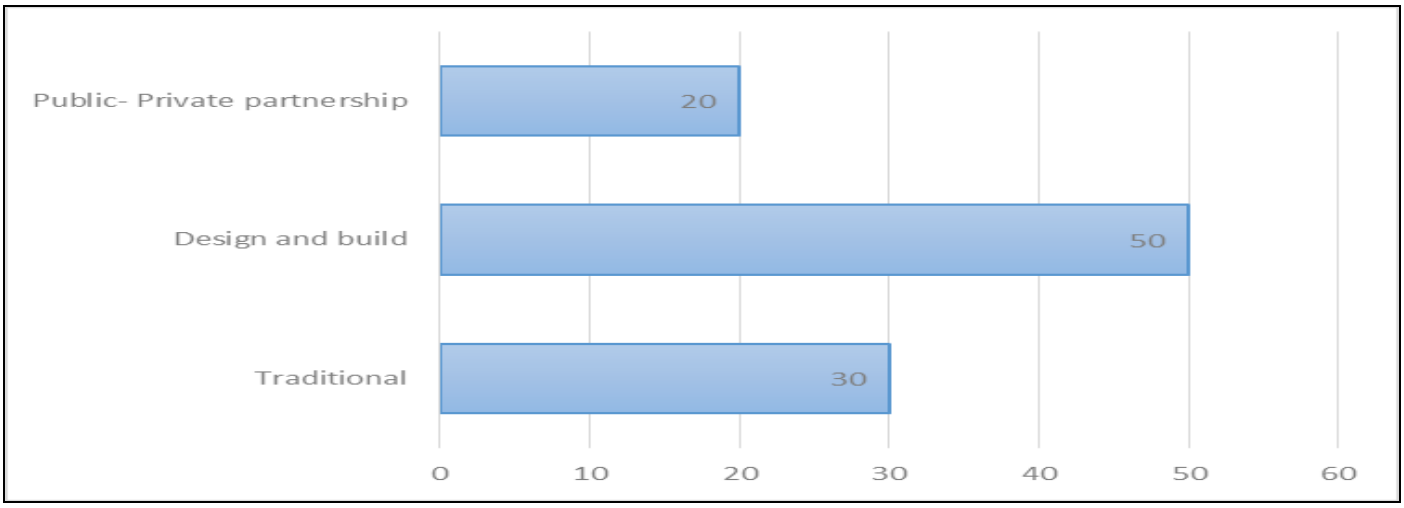

Fig 13 Procurement Option is Associated with the Highest level of Uncertainty

Participants' perceptions of their teams' abilities to anticipate and address potential ambiguities in the procurement process vary. Some (20%) feel "Very well" equipped, while another 20% feel "Moderately well." However, a significant portion (30% each) expressed feeling "Neutral" or "Not well" in their team's capabilities in this regard.

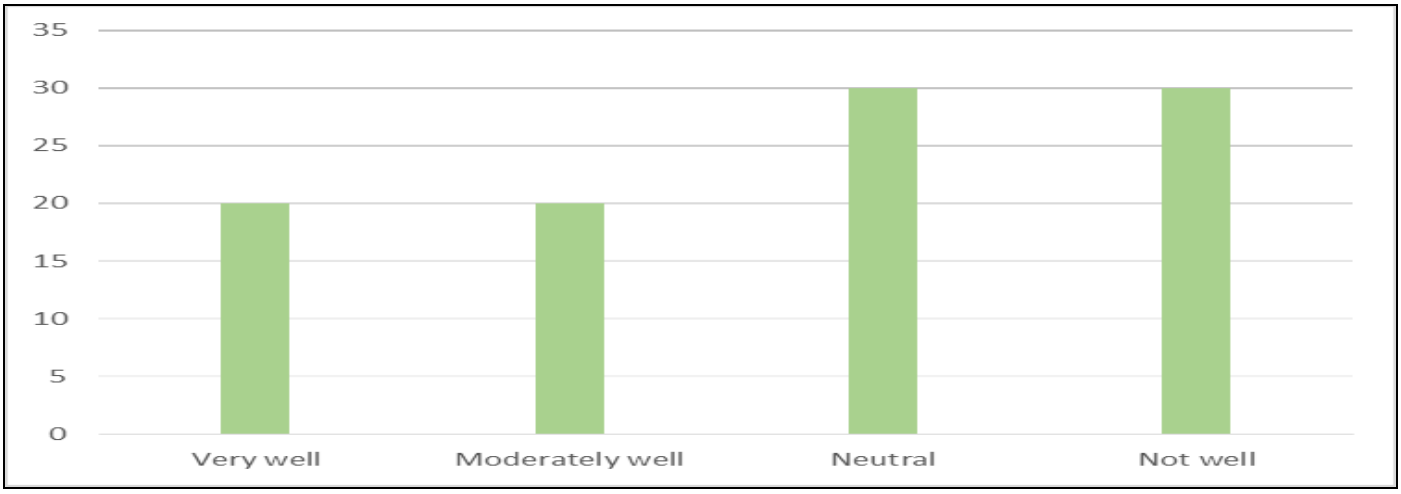

Fig 14 How well their teams can anticipate and address potential ambiguities

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Participants' decisions to change their procurement methodology for risk mitigation are influenced by factors such as project-specific characteristics (30%), time constraints (30%), market conditions (20%), supplier relationships (10%), and project scalability (10%).

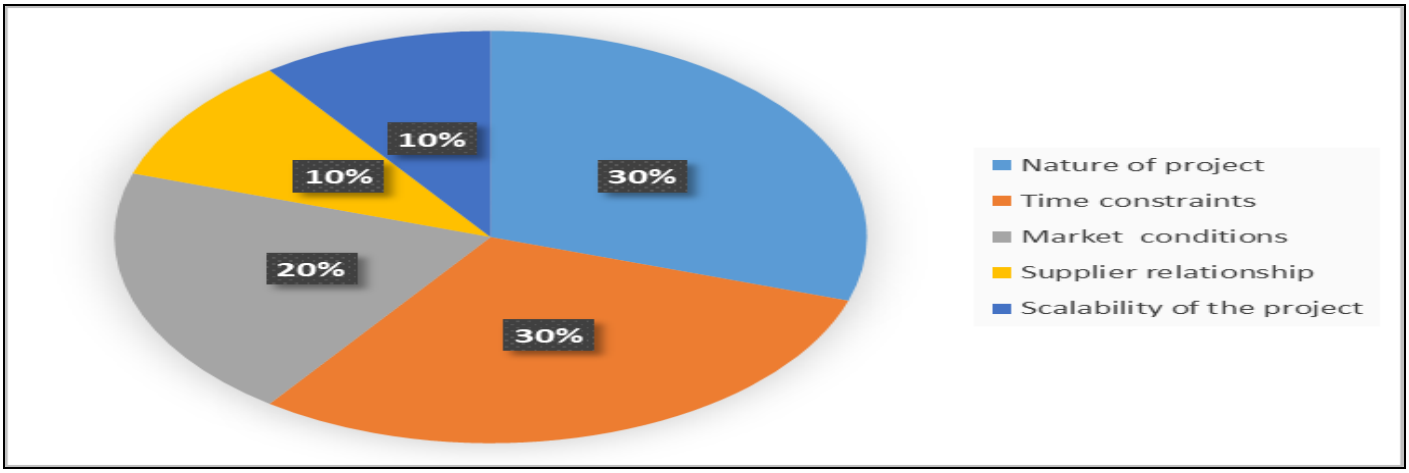

Fig 15 Factors Influencing Participants' Decisions to Change Procurement Methodology

Participants' familiarity with common risk management strategies in the construction industry shows a significant trend. A minority (20%) are familiar with these strategies, while a substantial majority (80%) are not, indicating a potential lack of knowledge or exposure to these standard risk management practices in the construction sector.

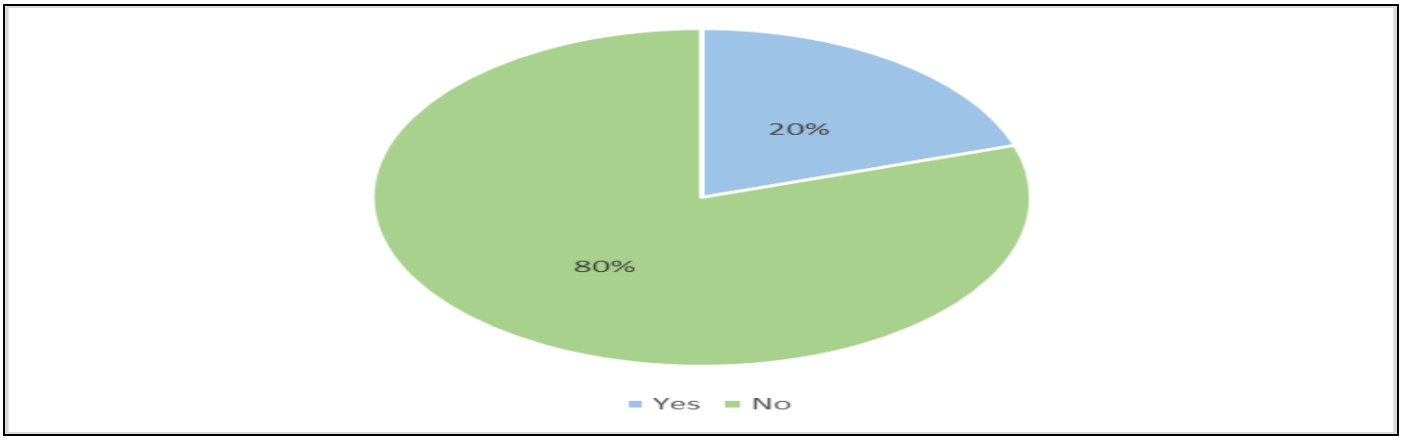

Fig 16 Familiarity with Various Risk Management Strategies

Participants in the construction industry have diverse opinions about the most effective risk management strategy. 40% identified "Risk transfer" as the most effective, 30% favored "Risk avoidance," 20% chose "Risk mitigation," and 10% mentioned "Risk acceptance" as their preferred strategy, indicating a willingness to manage risks as they occur.

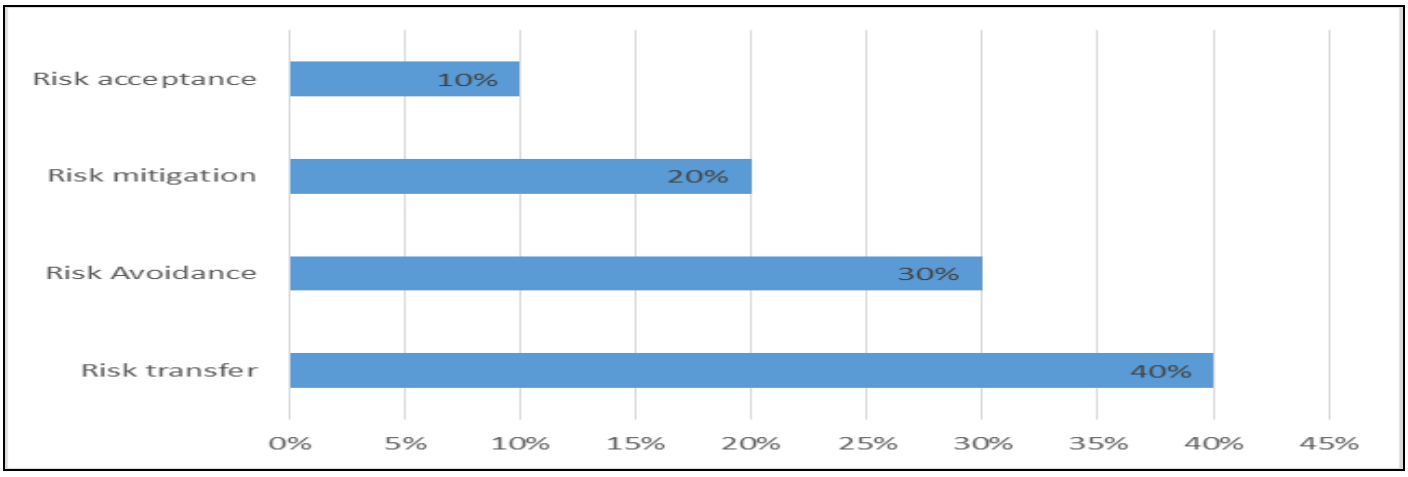

Fig 17 Risk Management Strategy Considered the most Effective

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Participants' ratings of the overall effectiveness of risk management practices in the construction industry, on a scale of 1 to 5, vary. A significant portion (33%) rated it as "1," indicating very low effectiveness. Another 13% rated it as "2," signifying low confidence in current risk management approaches. 20% rated it as "3."

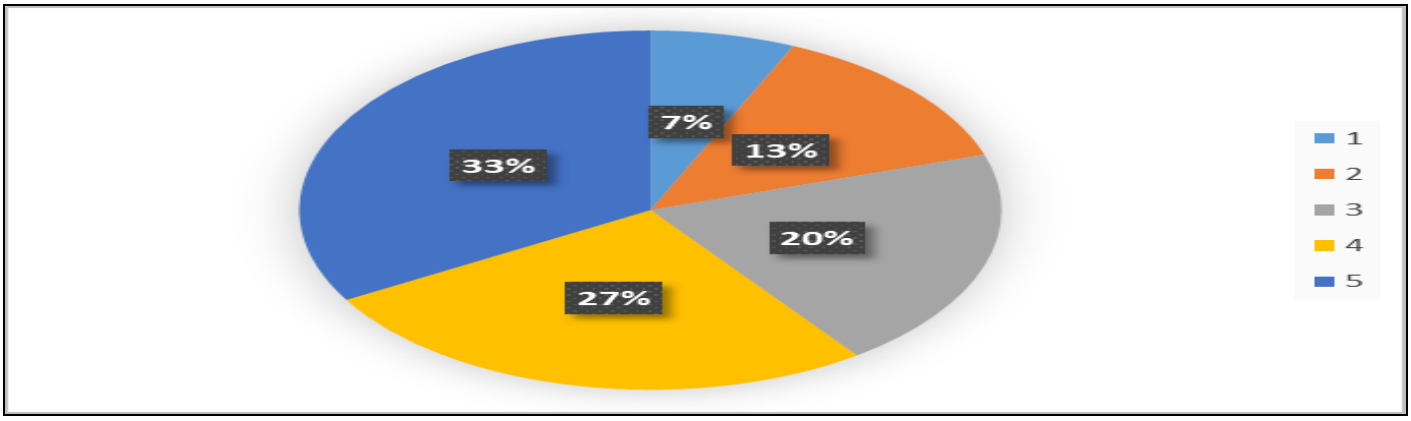

Fig 18 Effectiveness of Risk Management Practices

Participants attribute the overall effectiveness of risk management practices to several key factors. 30% identified "Adequate financial planning," while another 30% emphasized "Comprehensive risk assessment." Additionally, 20% pointed to "Experience and expertise," and 10% each mentioned "Regular project monitoring" and "Effective communication" as contributing to overall risk management effectiveness.

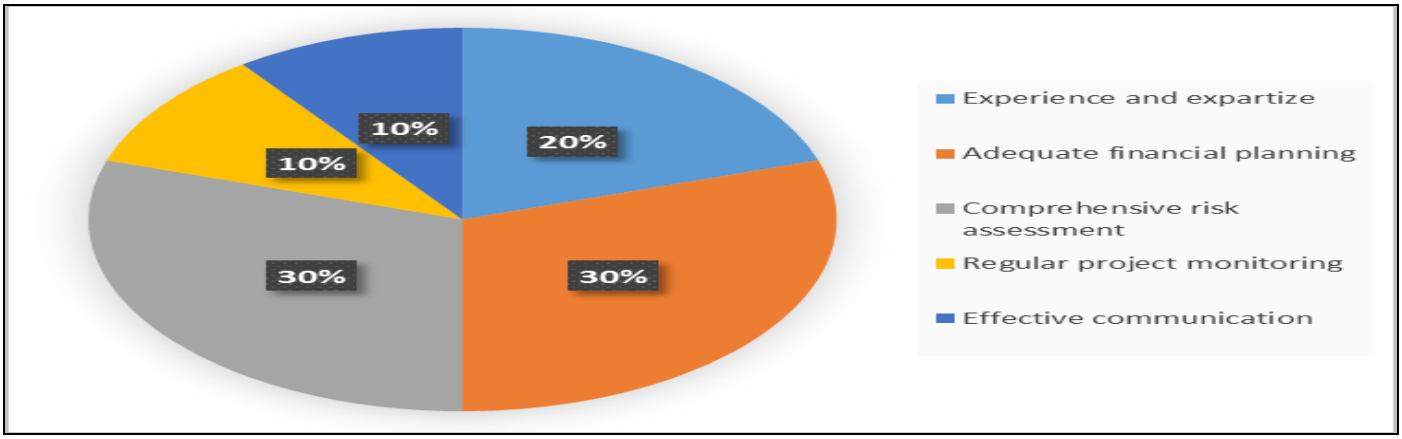

Fig 19 Effectiveness of Risk Management Practices

Participants' experiences with the frequency of unexpected risks in construction projects that were not adequately accounted for in the planning stages vary. 40% reported experiencing these unexpected risks "Very often", 40% encountered them "Rarely". A smaller subset (10% each) mentioned experiencing such risks "Occasionally" or "Never."

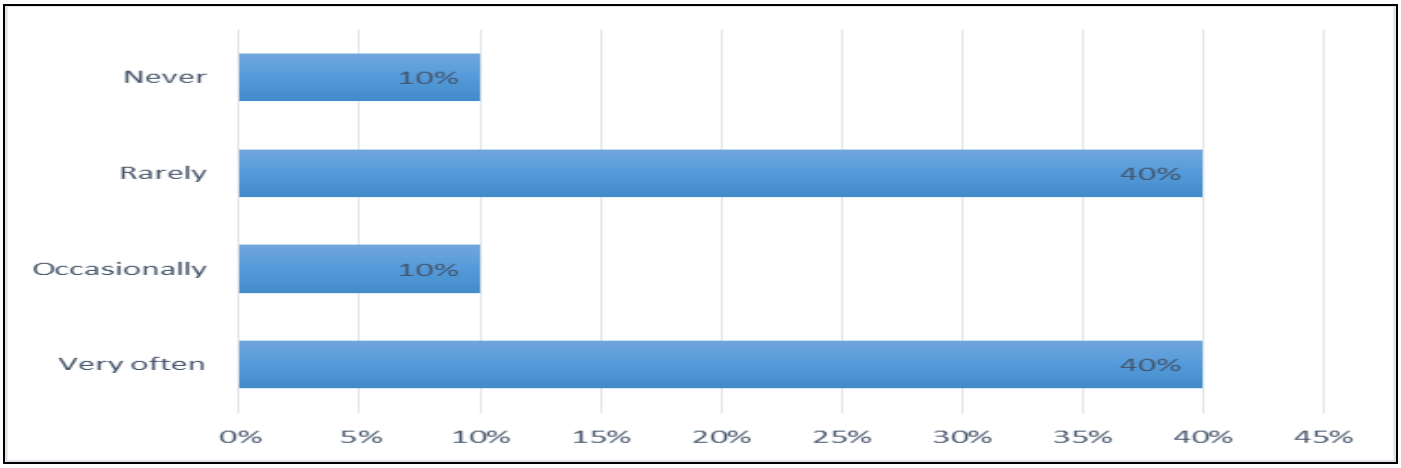

Fig 20 Frequency of Risks

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Participants identified challenges to effective risk management. 30% mentioned the "Lack of skilled personnel" as a key challenge, 30% emphasized the "Inadequate risk assessment tools." Budget constraints were noted by 20%, and 10% each cited "Poor project planning" and "Insufficient training" as factors hindering effective risk management.

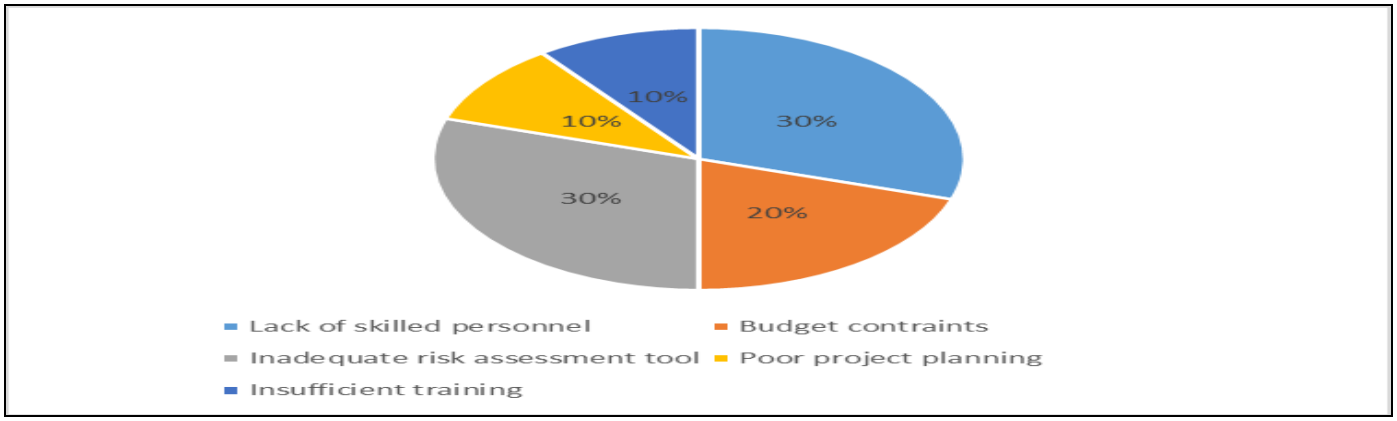

Fig 21 Barriers that Impede Effective Risk Management

Participants share a strong consensus regarding the relationship between improved risk management practices and cost savings in construction projects. 60% "Strongly agree" that enhanced risk management can lead to cost savings, 20% "Agree" with this assertion. However, 10% of participants each expressed a "Neutral" stance or "Disagreement".

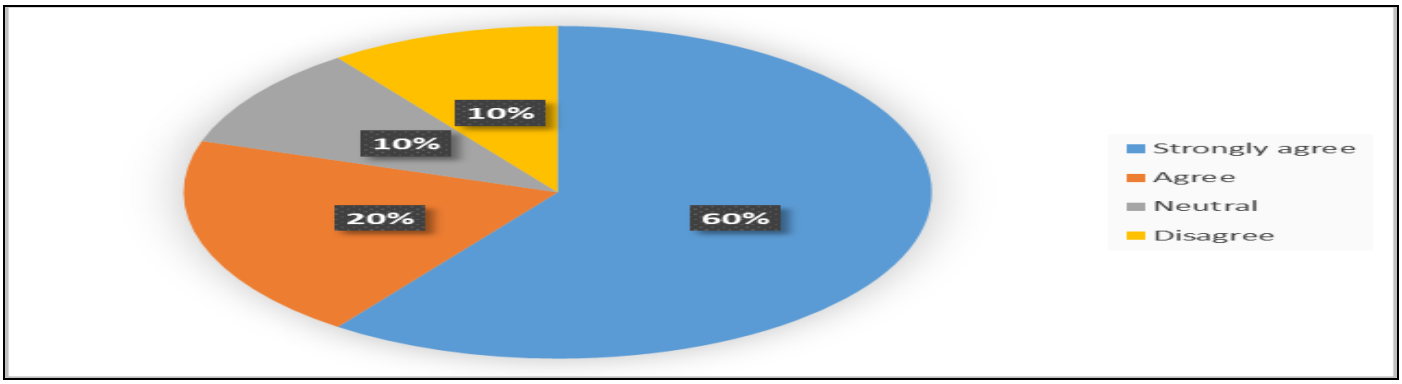

Fig 22 Relationship between Improved Risk Management Practices and Cost Savings

The chi-square tests examining the relationship between participants' familiarity with risk management strategies and their belief in potential cost savings through improved risk management in construction projects did not show statistically significant associations. The p-values from the Pearson Chi-Square test, the Likelihood Ratio test, and the Linear-by-Linear Association test were all greater than the threshold of 0.05, indicating a lack of statistical significance.

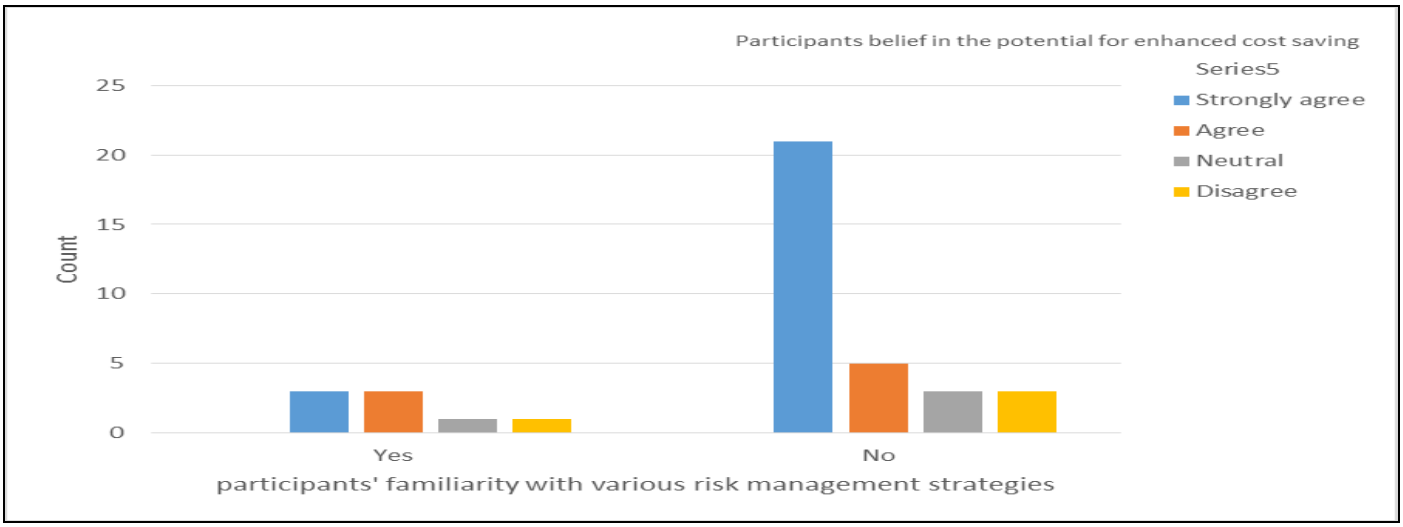

Fig 23 Relationship between Familiarity with Risk Management Strategies and Belief in Cost Savings in Construction Projects.

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Participants' familiarity with the concept of digital transformation in the construction industry shows a clear trend. 30% are familiar with this concept and its implications. In contrast, 70% responded with "No," indicating a potential lack of knowledge or exposure to the concept of digital transformation within the construction sector.

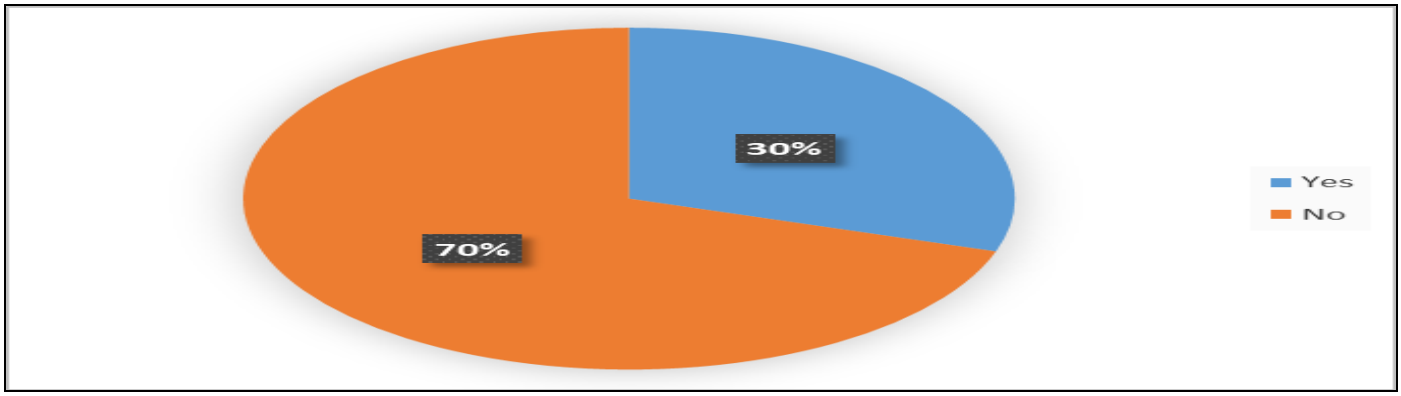

Fig 24 Familiarity with the Concept of Digital Transformation

The integration of digital technologies, like BIM and project management software, in participants' construction projects varies. 30% have actively incorporated these tools. 10% have not adopted them, possibly due to resource limitations or lack of awareness. 60% responded with "I do not know," suggesting uncertainty.

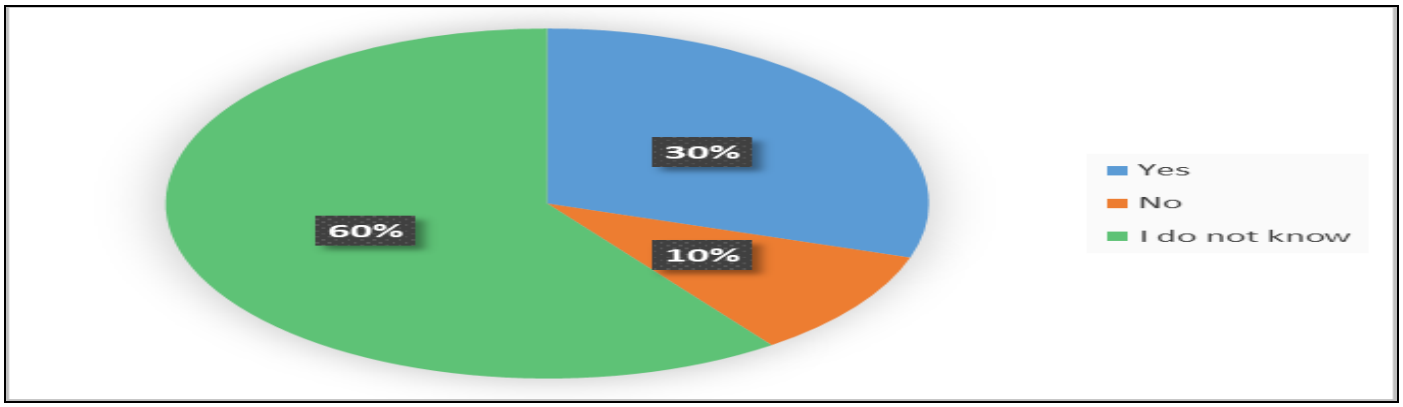

Fig 25 Integration of Digital Technologies,

Participants' perception about the impact of digital transformation on project coordination, communication, and risk reduction in construction projects vary. 50% agree that digital transformation has had a positive impact. 40% responded with "Neutral," indicating uncertainty or mixed views, 10% disagreed.

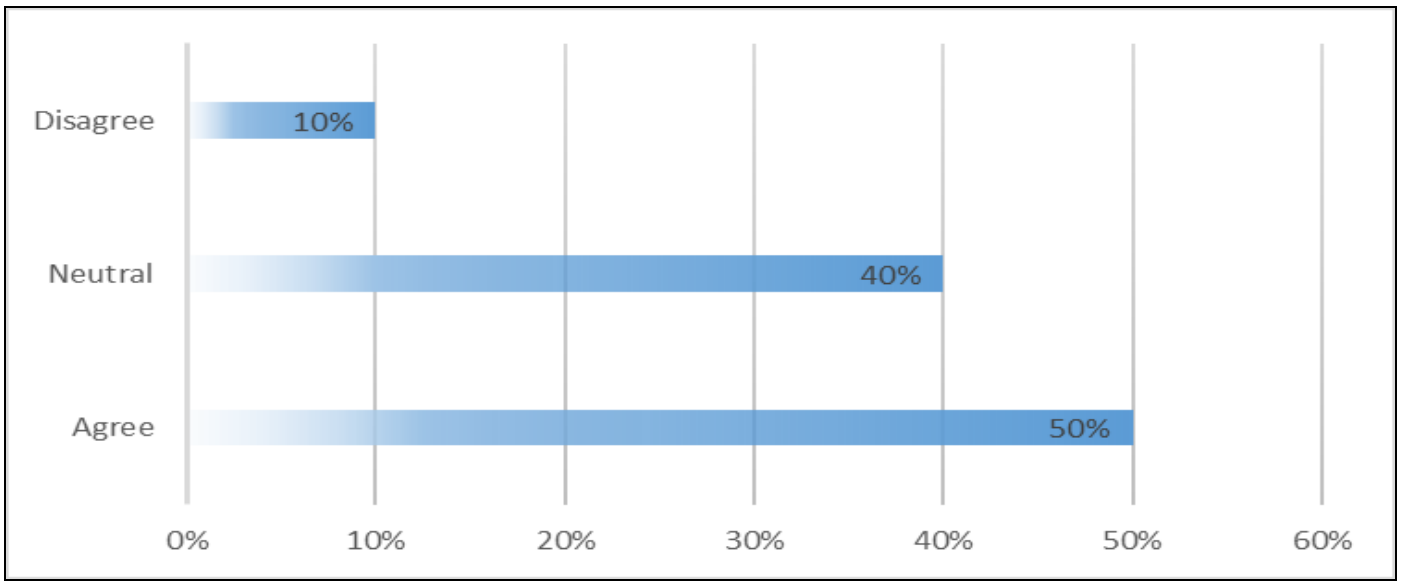

Fig 26 Impact of Digital Transformation on Project Coordination

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However, 70% of the participants acknowledged experiencing specific challenges or drawbacks related to the incorporation of digital technologies into risk management practices in construction, while the remaining 30 percent did not report any such issues.

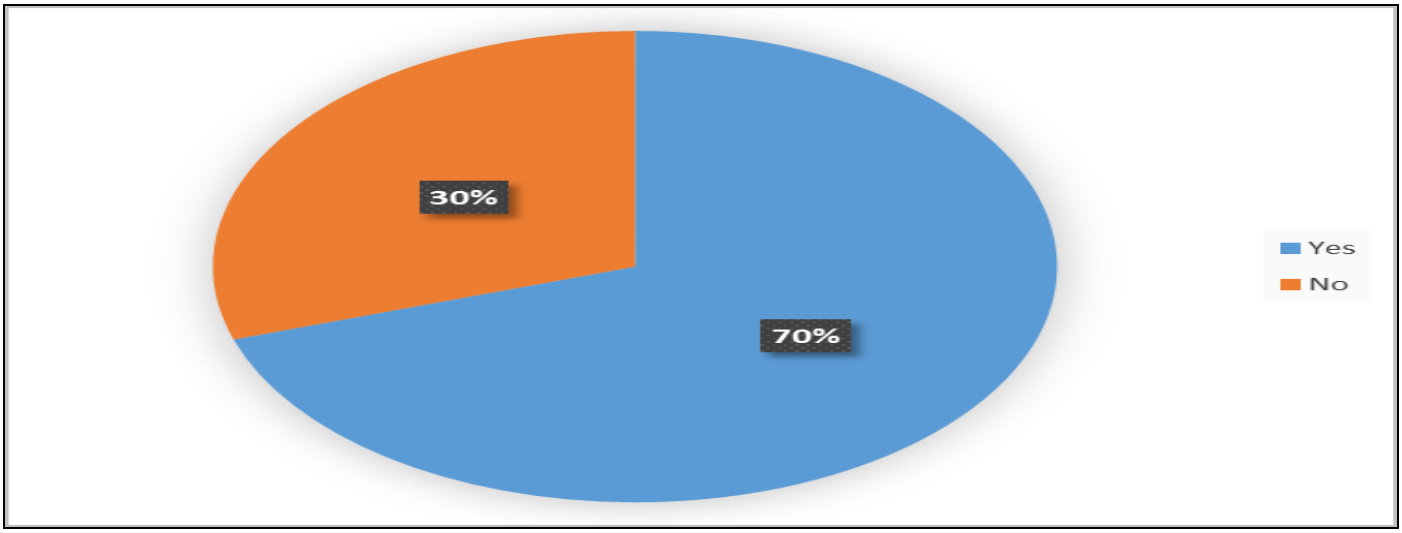

Fig 27 Participants Experiencing Specific Challenges.

The chi-square tests examining the relationship between participants' familiarity with digital transformation in the construction industry and the challenges or drawbacks associated with the integration of digital technologies yielded statistically significant results.

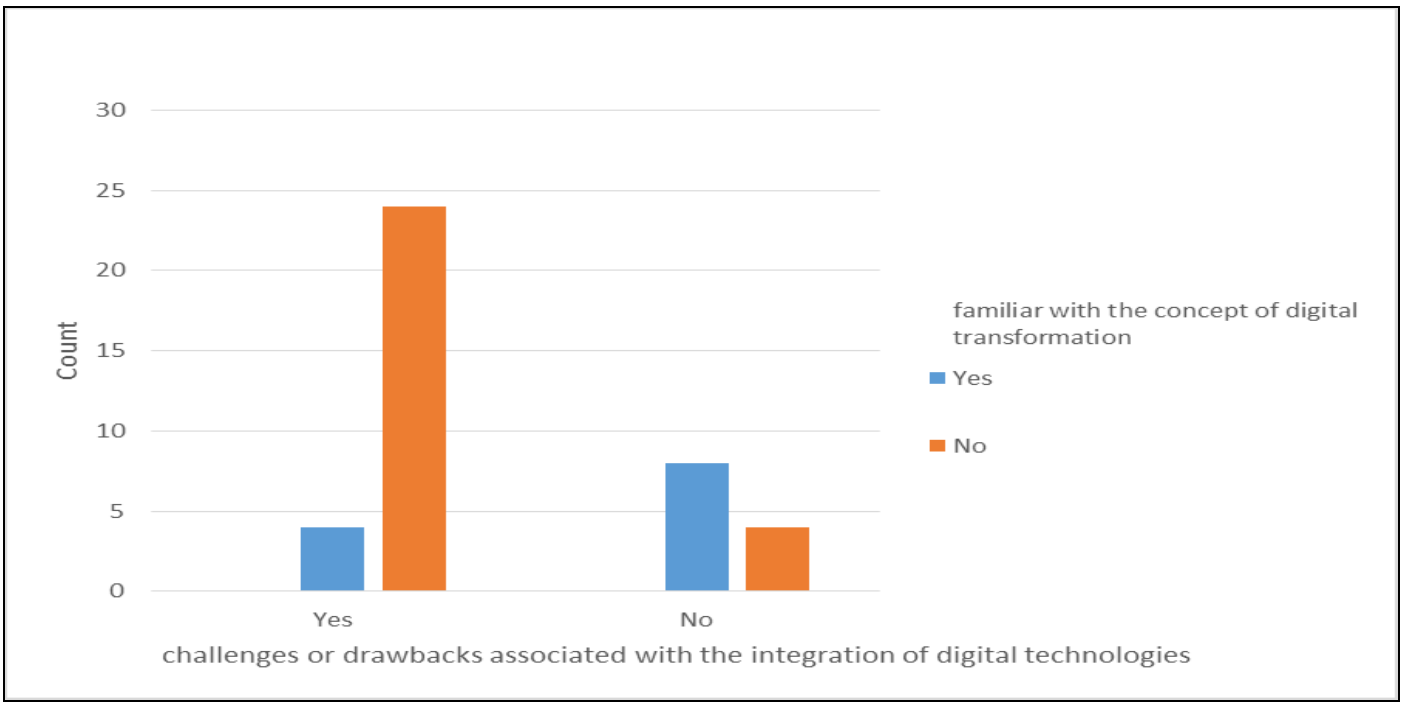

Fig 28 Relationship between Familiarity with Digital Transformation and Integration Challenges in Construction Industry.

V. DISCUSSION

The study identified distinct patterns in perceived risk levels associated with various procurement methods, including "Design-Bid-Build," "Design-Build," "Construction Management at Risk," and "Integrated Project Delivery." Despite global trends favoring "Design-Bid-Build," the majority of participants in Lusaka preferred it, perceiving it as carrying lower inherent risk. A noteworthy deviation from international literature emerged, indicating higher perceived risks for "Design-Build" and "Construction Management at Risk" in Lusaka. The study correlated the scale of operation with procurement methods, revealing a statistically significant negative correlation, suggesting larger-scale projects in Lusaka tend to opt for different procurement methods. The research emphasized the influence of project scale on procurement choices and risk perceptions, contributing valuable insights specific to the regional context. The findings underscore the need for tailored risk management strategies in Lusaka's construction sector and

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emphasize the importance of addressing regional variations in risk perceptions and procurement challenges. The study successfully achieved its first objective, providing valuable insights for industry professionals and policymakers in the region, while also suggesting avenues for further research into contextual factors influencing risk perceptions and strategies for mitigating perceived risks associated with different procurement methods.

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