

Influence of information technology on project risk management: The mediating role of risk identification

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ABSTRACT

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This study investigates the critical role of information technology integration in enhancing project risk management, specifically examining the mediating effect of risk identification effectiveness. Based on a quantitative approach, the study collected data from 173 respondents working in the construction, engineering, and telecommunication sectors using a comprehensive questionnaire. We employed Smart PLS-SEM for data analysis to test the study hypotheses. Our findings reveal that IT integration significantly and positively influences both risk identification effectiveness and overall project risk management. Importantly, the study confirms the mediating role of risk identification effectiveness, indicating that IT's contribution to successful project risk management is significantly enhanced when it empowers teams to identify potential risks early and accurately. These findings indicate the strategic importance for organizations in these sectors to prioritize investments in IT solutions that not only streamline project management processes but also specifically enhance risk identification capabilities. Discussion and conclusion were depicted at the end of work.

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1. Introduction

In an era defined by rapid technological advancements and increasing project complexity, effective risk management has become an important issue for organizational success (Adegbite et al., 2023). Information technology with its capacity to process vast datasets, enhance communication, and automate complex tasks, holds immense potential to transform how organizations identify and mitigate project risks (Tyagi et al., 2020). Moreover, IT continues to support risk management by facilitating communication and collaboration among stakeholders (Fernandes et al., 2022; Abu-Shanab et al., 2016). Project management software, online platforms, and communication tools enable real-time information sharing, ensuring everyone involved is aware of identified risks, mitigation strategies, and any emerging threats (Hysa & Spalek, 2019). This transparency and accessibility to information are crucial for timely decision-making and effective risk mitigation throughout the project lifecycle (El Khatib et al., 2022). However, the specific mechanisms through which IT influences risk management practices, particularly in the crucial area of risk identification remain underexplored. This study will explore this critical intersection, aiming to shed light into the pathways through which IT can empower organizations to proactively navigate the uncertainties in project management.

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While the benefits of IT in various organizational functions are well-documented, its precise role in shaping project risk management, particularly through the enhancement of risk identification processes, requires further investigation (Haider, 2021). However, this study will provide several theoretical and practical expectations. Theoretically, this study will enrich the existing body of knowledge by deepening the theoretical understanding of how IT capabilities translate into tangible improvements in risk management outcomes, it will also provide empirical evidence for the mediating role of risk identification in the relationship between IT and project risk management effectiveness. Practically, this research will seek to offer actionable guidance for project managers and organizations by identifying specific IT tools and systems that can significantly enhance risk identification and overall risk management effectiveness, and providing insights into the organizational practices and strategies that can maximize the benefits of IT in the context of project risk management.

The following section explores the literature related to IT integration, risk identification effectiveness, and project risk management. The third section outlines the methodology employed in this research, followed by an analysis of the collected data and a discussion of the findings. Finally, the study concludes by summarizing the key findings, limitations, and future research.

2. Hypotheses Development

In the context of project risk management, IT integration refers to the strategic implementation and interconnection of various IT tools and systems to streamline and enhance risk management processes (Saeidi et al., 2019; Abu-Shanab et al., 2019). This integration is not merely about using technology but about leveraging it strategically to create a more robust and proactive risk management framework (Slagmulder & Devoldere, 2018). IT integration can directly enhance risk identification effectiveness through analyzing historical project data, industry benchmarks (Salzano et al., 2024), and external factors using data analytics tools allows for the identification of patterns and trends indicative of potential risks (Grover et al., 2018). For instance, a study by Kara et al., (2020) found that using data analytics in risk management led to a 10-15% reduction in risk-related costs, highlighting its effectiveness in identifying and mitigating risks early on. Moreover, centralized platforms for capturing, categorizing, and analyzing risks enable efficient risk identification and prioritization (Beyrouiti et al., 2024). Features like risk scoring and automated alerts help project managers focus on the most critical threats (Rane et al., 2021). PMI research suggests that organizations using such software are more likely to achieve project objectives within budget and schedule constraints, indicating improved risk identification and mitigation (Hasib et al., 2023). In addition, dashboards linked to project management systems provide continuous insights into project progress, enabling the early detection of emerging risks (Niederman, 2021). This real-time visibility allows for proactive risk response, preventing minor issues from escalating (Aljohani, 2023). Based on that:

H₁: *IT integration has a positive significant impact on risk identification effectiveness.*

Beyond risk identification, IT integration benefits overall project risk management by facilitating collaboration (Gerkenmeier & Ratter, 2018), where IT tools like project management software and communication platforms streamline information sharing and collaboration among stakeholders (Mamatlepa & Mazenda, 2024). This ensures everyone is informed about potential risks, mitigation strategies, and emerging threats, leading to more effective risk response (Zuccaro et al., 2020). Moreover, automating repetitive tasks, such as risk data entry and report generation, frees up project managers to focus on strategic risk analysis and response (Karamthulla et al., 2024). This efficiency contributes to better overall risk management (Xie et al., 2022). In addition, IT integration like data analytics tools improve decision-making through real-time data and insights provided by IT tools empower project managers to make more informed decisions regarding risk mitigation and resource allocation, ultimately leading to better project outcomes (Pantović et al., 2024; Haase et al., 2023; Rawashdeh et al., 2023). Therefore:

H₂: *IT integration has a positive significant impact on project risk management.*

Effective risk identification is the cornerstone of successful project risk management (Hopkin, 2018). Identifying risks early in the project lifecycle provides an opportunity for developing and implementing effective mitigation strategies (Dandage et al., 2019). This proactive approach reduces the likelihood of risks materializing and escalating into major problems (Cevikbas et al., 2024). A comprehensive understanding of potential risks empowers project managers to make informed decisions regarding resource allocation, scheduling, and mitigation planning (Odejide & Edunjobi, 2024). This leads to more realistic project plans and a higher probability of successful project delivery (Gemino et al., 2021). By identifying and prioritizing risks, project managers can allocate resources more effectively, focusing efforts and budget on mitigating the most critical threats to project success (Viswanathan et al., 2020). Transparent and effective risk identification processes foster trust and confidence among project stakeholders (Bhatti et al., 2021). When stakeholders are aware of potential risks and the strategies in place to address them, it increases their confidence in the project's likelihood of success (Merrow, 2024; Renn, 2020). Thus:

H₃: *Risk identification effectiveness has a positive significant impact on project risk management.*

IT integration provides the tools and infrastructure for comprehensive and timely risk identification through data analytics, centralized risk management platforms, and real-time monitoring (Araz et al., 2020). This leads to the identification of a

broader range of potential risks, earlier detection of emerging threats, and more accurate risk assessments (Dicuonzo et al., 2019). However, improved risk identification enables more effective risk mitigation planning, resource allocation, and decision-making, ultimately leading to better project outcomes (Odejide & Edunjobi, 2024). Several empirical evidence showed that IT integration is most effective when it leads to measurably better risk identification, which then drives better overall risk management (Willumsen et al., 2019; Rod et al., 2020; Herath et al., 2023). Based on that:

H4: Risk identification effectiveness mediates the relationship between IT integration and project risk management.

3. Methodology

3.1 Instrument Development

This research explores the impact of IT integration on project risk management in three main contexts including construction, engineering and telecommunications. This study utilized a sample of project professionals within projects across three distinct sectors: construction, engineering, and telecommunications. A diverse group of 192 professionals actively engaged in these fields, encompassing project managers, risk management specialists, and IT experts were invited to participate in an online survey hosted on Google Drive. The response rate of 90% yielded a robust dataset of 173 complete and usable responses. Table 1 depicts the demographic sample where most of the participants were male (70.5%), aged between 38-47 (38.8%), and holding a bachelor's degree (56.7%). The majority of respondents were IT experts (46.2%), followed by project managers (31.2%) and risk management specialists (22.6%). Participants were evenly distributed across the construction (30.6%), engineering (23.7%), and telecommunication (45.7%) sectors.

Table 1
Demographic Profile

Measure	Category	Count	Percentage %
Age	18 – 27	27	15.7
	28 – 37	42	24.3
	38 – 47	67	38.8
	Age > 47	37	21.2
Education	Diploma	21	12.1
	Bachelor	98	56.7
	Postgraduate	54	31.2
Gender	Male	122	70.5
	Female	51	29.5
Job Position	Project Manager	54	31.2
	Risk Management Specialist	39	22.6
	IT Expert	80	46.2
Sector	Construction	53	30.6
	Engineering	41	23.7
	Telecommunication	79	45.7

4. Data Analysis and Results

4.1 Measurement Model

Assessment of the measurement model was conducted to ensure the study's findings were both reliable and accurate. This involved a multi approach examining four aspects: how well multiple indicators measured the same concept (composite reliability), the consistency of responses within each scale (internal consistency reliability), whether the scales measured what they were intended to measure (convergent validity), and the distinctness of the concepts being measured (discriminant validity). As shown in Table 2, the results were highly promising. Internal consistency, as measured by Cronbach's alpha (α), consistently exceeded the 0.70 benchmark, ranging from 0.775 to 0.844, indicating strong reliability within the scales. Similarly, composite reliability scores, ranging from 0.734 to 0.771, further affirmed the scales' robustness. Furthermore, all items exhibited strong factor loadings, exceeding the minimum threshold of 0.5, demonstrating that each item effectively contributed to its intended construct. These findings collectively validate the reliability and validity of the measurement model employed in the study.

Table 3 provides evidence that the study's measurement model effectively differentiates between the various constructs under investigation. This result was conducted by the discriminant validity assessment using Heterotrait-Monotrait Ratio analysis. The results clearly demonstrate that the shared variance within each construct (represented by the Average Variance Extracted - AVE) consistently surpassed the shared variance between constructs (indicated by the correlation coefficients). Furthermore, all HTMT values remained well below the critical 0.90 threshold, providing robust confirmation of discriminant validity. In other words, the analysis confidently demonstrates that each construct is statistically distinct and measures a unique aspect of the phenomenon being studied.

Table 2
Convergent Validity Test

Construct	Items	Factor Loading	Cronbach's Alpha	Composite Reliability	AVE
IT Integration	ITIN1	0.715	0.809	0.754	0.883
	ITIN2	0.796			
	ITIN3	0.757			
	ITIN4	0.784			
	ITIN5	0.771			
	ITIN6	0.719			
Risk Identification Effectiveness	RIE1	0.805	0.775	0.771	0.847
	RIE2	0.784			
	RIE3	0.786			
	RIE4	0.795			
	RIE5	0.814			
	RIE6	0.844			
Project Risk Management	PRM1	0.777	0.844	0.734	0.871
	PRM2	0.749			
	PRM3	0.736			
	PRM4	0.802			
	PRM5	0.784			
	PRM6	0.769			

Table 3
Discriminant Validity (HTMT)

Variable	ITIN	RIE	PRM
ITIN	0.479		
RIE	0.149	0.372	
PRM	0.309	0.293	0.176

4.2 Structural Model Test

This research aims to investigate the critical factors that contribute to successful project risk management by examining four distinct hypotheses. Table 4 provides a detailed overview of these hypotheses, which center around three key relationships. The study's findings, rooted in empirical data, provided robust support for all proposed hypotheses. Specifically, the analysis revealed a strong positive correlation between the level of IT integration within a project and the effectiveness of its risk identification processes ($\beta = 0.149$, t -value = 1.201), confirming Hypothesis 1. Similarly, Hypothesis 2, which proposed a positive link between IT integration and the overall effectiveness of project risk management, was strongly supported ($\beta = 0.215$, t -value = 2.967). Furthermore, the study demonstrated that a high level of risk identification effectiveness, independent of other factors, directly and positively contributes to more robust project risk management ($\beta = 0.315$, t -value = 3.667), providing evidence for Hypothesis 3.

Table 4
Hypotheses Results (Direct Effect)

Hypo. No	Path	Path Coefficient	T-value	P-value	Result
H1	ITIN → RIE	0.149	1.201	0.000	Yes
H2	ITIN → PRM	0.215	2.967	0.000	Yes
H3	RIE → PRM	0.315	3.667	0.000	Yes

After examining the direct links between variables, this research will explore the indirect mechanisms by which IT integration influences project risk management. Specifically, the study investigated the mediating role of risk identification effectiveness, exploring whether it serves as a crucial link between IT integration and successful risk management. Table 5 provides a comprehensive view of the mediation analysis results, which revealed a statistically significant positive indirect effect of IT integration on project risk management through the mediating factor of risk identification effectiveness ($\beta = 0.256$, t -value = 1.901). This finding suggests that IT integration is a significant portion of its positive influence on project risk management by first enhancing the organization's ability to effectively identify potential risks. In essence, robust IT systems empower project teams with the tools and insights needed to proactively identify and mitigate risks, ultimately leading to smoother project execution and a higher likelihood of success.

Table 5
Hypotheses Results (Indirect Effect)

Hypo. No	Path	Path Coefficient	T-value	P-value	Result
H4	ITIN → RIE → PRM	0.256	1.901	0.000	Yes

5. Discussion

This study investigated the relationship between information technology integration, risk identification effectiveness, and project risk management. Our findings provide compelling evidence to support all four proposed hypotheses, shedding light on the crucial role of IT and effective risk identification in achieving successful project risk management. Firstly, the confirmed positive relationship between IT integration and risk identification effectiveness (H1) indicates the significant contribution of IT in enhancing the process of identifying potential risks. This finding aligns with previous research, such as Hasib et al., (2023), which highlighted how IT tools can improve data collection, analysis, and communication, leading to a more comprehensive understanding of project risks. For instance, project management software with integrated risk management modules can facilitate real-time risk tracking, automated alerts, and collaborative risk assessment, empowering project teams to proactively identify potential threats.

Furthermore, our study empirically confirms the positive impact of IT integration on overall project risk management (H2). This finding confirms with studies like Pantović et al., (2024), which emphasized the role of IT in enabling better risk analysis, planning, and monitoring. By leveraging IT solutions, organizations can establish centralized risk registers, implement early warning systems, and automate risk response workflows, ultimately leading to more effective risk mitigation strategies and improved project outcomes. The confirmed positive relationship between risk identification effectiveness and project risk management (H3) further emphasizes the criticality of a robust risk identification process. This finding aligns with the broader understanding that early and accurate identification of potential risks is fundamental to successful risk management (Morrow, 2024). When project teams can effectively identify potential risks, they are better equipped to develop appropriate contingency plans, allocate resources strategically, and proactively address potential challenges before they escalate into major issues.

Finally, the confirmation of H4, demonstrating the mediating role of risk identification effectiveness, provides a comprehensive understanding of the relationship between IT integration and project risk management. This finding suggests that the positive impact of IT integration on project risk management is channeled through its ability to enhance risk identification effectiveness. In other words, IT's contribution to project risk management is not solely due to its direct impact on risk mitigation strategies but also significantly driven by its ability to empower teams to identify risks more effectively.

6. Conclusion

This study examined the relationship between information technology integration, risk identification effectiveness, and project risk management within the construction, engineering, and telecommunication sectors. Based on a sample size of 173 participants, our findings provide robust empirical support for the significant role IT and effective risk identification play in achieving successful project outcomes. The study findings confirmed that IT integration positively influences both risk identification effectiveness and overall project risk management. This indicates the value of leveraging IT solutions to enhance data analysis, communication, and risk monitoring capabilities within project teams. Moreover, the results highlight the critical mediating role of risk identification effectiveness, demonstrating that IT's contribution to project risk management is significantly amplified when it empowers teams to identify potential risks early and accurately. These findings offer valuable insights for practitioners in the construction, engineering, and telecommunication industries, emphasizing the strategic importance of investing in IT solutions that not only streamline project management processes but also prioritize and enhance risk identification capabilities. By fostering a proactive risk management culture and equipping teams with the right IT tools, organizations can significantly improve their ability to anticipate, mitigate, and overcome potential challenges, ultimately increasing the likelihood of project success.

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