Bulletin of Business and Economics, 13(2), 1065-1072
https://bbejournal.com
https://doi.org/10.61506/01.00462

The Impact of Project Process Management on Sustainable Project Success in the Construction Sector: The Moderating Role of Risk Management Practices

Muhammad Asad Akram Bhatti[1], Dr. Muhammad Umair Nazir[2]

Abstract
This study examines the influence of project process management on sustainable project success in the construction sector, with a focus on the moderating role of risk management practices. Using a quantitative research design, data were collected from 328 professionals, including Managers, Project Managers, and Portfolio Managers, through structured questionnaires. The analysis, conducted using SmartPLS, revealed that effective project process management significantly impacts project time, cost, and scope, thereby enhancing overall project success. The findings highlight the importance of integrating risk management practices to mitigate potential delays and cost overruns, demonstrating a moderating effect on the relationship between project process management and project outcomes. However, the moderating effect of risk management was not significant for the project scope, suggesting that additional strategies may be required to manage scope changes effectively. These results underscore the need for comprehensive management approaches that incorporate both robust process management and proactive risk management to achieve sustainable success in construction projects. The study provides valuable insights for construction professionals and suggests avenues for future research, including the exploration of other management practices and the use of longitudinal data to capture the dynamic nature of construction projects.

Keywords: Project, Process Management (PPM), Risk Management (RM), Sustainable, Project Success (PS), Construction Industry

1. Introduction

The construction industry is a vital sector that significantly contributes to the economic development of nations. This industry encompasses a broad spectrum of activities, including the design, construction, and maintenance of various infrastructures such as buildings, roads, bridges, and other essential structures. The complexity and scale of construction projects often result in unique challenges that require meticulous planning, execution, and monitoring. Despite its importance, the construction industry is frequently plagued by issues such as project delays, cost overruns, and scope changes, which can endanger project success. These persistent challenges underscore the necessity of effective process management and project risk management practices to ensure successful construction projects outcomes (Ahmed, Ahmed, & Buriro, 2023).

Process management refers to the systematic approach to planning, executing, and monitoring project activities to achieve predefined objectives. In the context of the construction industry, process management involves various phases, including project process initiating, planning, execution, monitoring and controlling, and project closing. Each phase plays a critical role in shaping the overall successful outcome of a project (Kaufmann & Kock, 2022).

Project initiation is the foundational phase where the project's feasibility is assessed, and key objectives, stakeholders, and deliverables are identified. Effective project initiation is vital for aligning the project with the client's expectations and ensuring a clear understanding of the project's scope and goals (Anderson & Merna, 2013).

The project planning phase involves the development of a thorough project plan that outlines the activities, resources, dates, and budget necessary to accomplish the project goals. Effective project planning helps in coordinating tasks, identifying potential risks, and developing mitigation strategies (Latif, Afzal, Saqib, Sahibzada, & Alam, 2021). Project execution involves implementing the project plan and managing the construction activities. Successful project execution requires strong leadership, efficient resource management, and effective communication among all stakeholders (Walton, Handfield, & Melnyk, 1998).

The process of project monitoring and controlling involves the ongoing surveillance of the project's advancement, the identification of any deviations from the established plan, and the implementation of necessary corrective measures. Effective monitoring and controlling help in addressing issues promptly and keeping the project on track (Nusraningrum, Jaswati, & Thamrin, 2020). Project closure is the concluding stage of a project, which entails the completion of all project activities, the delivery of the project to the client, and the execution of a project review. Executing a thorough project closure guarantees the fulfillment of all contractual responsibilities and the official completion of the project (Shahzad, Qu, Zafar, Rehman, & Islam, 2020).

Sustainable project success in the construction sector is determined by the attainment of project objectives while adhering to the limitations of time, money, and scope. Not only does it encompass the project's completion, but also its long-term sustainability and influence. Achieving sustainable project success is of utmost importance in the construction sector, given that projects are frequently of significant scale and need substantial resources (Latif et al., 2021).

Timely completion of projects is critical in the construction industry. Delays can lead to significant financial losses and reputational damage. Effective process management helps in ensuring that projects are completed within the stipulated timeframe. Managing project costs is another vital aspect. Construction projects often involve substantial financial investments, and cost overruns can have severe consequences. Proper planning and execution can help in controlling costs and avoiding budget overruns. The defined objectives and deliverables of the project must be met without compromising on quality. Scope changes can lead to delays and increased costs, making it essential to manage the project scope effectively (Özgür, Kumru, & AladaĞ, 2020).

Effective risk management strategies are crucial in the construction sector because of the inherent unpredictability and hazards linked to construction projects. The aforementioned protocols encompass the activities of risk identification, risk assessment, risk reduction, and risk monitoring and reporting. Effective risk management can significantly influence the success of a project by minimizing potential negative impacts and ensuring that the project stays on track (Alkhlaifat, Abdullah, & Magassouba, 2019).

[1] Corresponding Author, School of Business & Management Sciences, Minhaj University Lahore, Pakistan, asadbhatti42@gmail.com
[2] School of Business & Management Sciences, Minhaj University Lahore, Pakistan

Identifying potential risks early in the project lifecycle is essential. This includes risks related to design, construction, procurement, and other project activities. By assessing the detected risks based on their probability and consequences, it becomes possible to prioritize them and formulate suitable measures to reduce their impact. By implementing suitable measures to mitigate recognized risks, the project can greatly minimize their impact. This involves formulating backup strategies and efficiently distributing resources. Continuously tracking the identified risks and the effectiveness of mitigation measures is crucial. Regular monitoring and reporting ensure that risks are managed proactively and do not escalate (Divya Sankar, Shashikanth, & Mahender, 2022).

The construction industry, a cornerstone of economic development, faces significant challenges such as project delays, cost overruns, and scope changes, which can impede project success. Effective process management is crucial for navigating these complexities. By systematically planning, executing, and monitoring project activities, construction managers can enhance efficiency and ensure that projects meet their intended objectives within the constraints of time, cost, and scope (Guseva, Koptelov, & Kovtun, 2019).

Considering the significant level of uncertainty that is inherent in building projects, the need of risk management strategies cannot be overstated. A comprehensive risk management strategy, which encompasses the processes of risk identification, assessment, mitigation, and monitoring, can greatly reduce possible disruptions and improve the resilience of a project. The interplay between process management and risk management is particularly important; integrating these practices can lead to more robust project planning, execution, and control, ultimately driving sustainable project success. Therefore, this research topic holds significant relevance as it seeks to provide insights into optimizing project outcomes in the construction industry, thereby contributing to more reliable, cost-effective, and timely project completions (Le, Chong, & Kashiwagi, 2020).

The objective of this study is to investigate the influence of process management on the achievement of sustainable project success in the construction sector, specially emphasizing the moderating function of risk management mechanisms. The study will investigate the impact of various stages of process management on project success and the potential augmentation of this relationship by good risk management.

2. Literature Review

The construction industry plays a pivotal role in global economic development, but it is fraught with challenges such as project delays, cost overruns, and scope changes. Effective management of construction projects requires a structured approach to both process management and risk management practices. This systematic literature review aims to synthesize existing research to understand how process management influences project success, moderated by the role of risk management practices within the construction sector.

Effective project initiation sets the stage for successful project outcomes in the construction industry. The author highlights that clear definition of project goals and stakeholder expectations during this phase enhances project alignment with organizational objectives. Properly initiated projects are more likely to achieve success in terms of meeting time, cost, and scope requirements (Al-Kuhail, Al-Dafiry, Barakat, & Al-Ansi, 2021).

Project initiation sets the foundation for project success by defining project objectives, stakeholder expectations, and initial scope. Turner and Müller (2019) argue that a clear and well-defined initiation phase aligns project goals with organizational objectives, facilitating smoother project execution and enhanced outcomes. Projects that undergo rigorous initiation processes are more likely to achieve success in terms of meeting time, cost, and scope requirements.

Comprehensive project planning is crucial for managing complexities in construction projects. The author suggests that detailed planning reduces uncertainties and enables efficient resource allocation, thereby minimizing cost overruns and delays. This phase ensures that projects are well-prepared to navigate challenges during execution (Anantatmula & Rad, 2018).

Comprehensive project planning is crucial for managing complexities in construction projects. Sears et al. (2015) emphasize that detailed planning reduces uncertainties and enables efficient resource allocation, thereby minimizing cost overruns and delays. This phase ensures that projects are well-prepared to handle challenges during execution and adapt to changing circumstances, thus enhancing overall project success rates (Animi & Owusu-Manu, 2021).

During project execution, effective process management ensures that activities are carried out according to plan. Osei-Kyei and Chan (2017) emphasize that efficient execution relies on robust leadership, clear communication, and proactive issue resolution. Projects that effectively manage execution phases are more likely to maintain project timelines and quality standards.

During project execution, effective process management ensures that activities are carried out according to plan and within defined parameters. The author highlights that efficient execution relies on clear communication, strong leadership, and proactive issue resolution. Projects that effectively manage execution phases maintain project timelines, quality standards, and stakeholder satisfaction, contributing to successful project outcomes (Walton et al., 1998).

Continuous monitoring and controlling of project activities are essential for identifying deviations and taking corrective actions promptly. PMI (2021) notes that real-time tracking of performance metrics enables project teams to address emerging risks and maintain project alignment with organizational goals. Projects that implement rigorous monitoring and control measures achieve higher success rates in terms of project outcomes (Project Management Institute, 2021).

Continuous monitoring and controlling of project activities are essential for identifying deviations and taking corrective actions promptly. The Project Management Institute (PMI, 2021) notes that real-time tracking of performance metrics allows project teams to address emerging risks and maintain project alignment with organizational goals. Projects that implement rigorous monitoring and control measures achieve higher success rates in terms of project outcomes and stakeholder expectations (Project Management Institute, 2021).

Proper project closure involves finalizing all activities and delivering the project to stakeholders. Walker (2020) suggests that a structured closing phase includes evaluating project performance, documenting lessons learned, and transitioning deliverables smoothly. Successful project closures ensure client satisfaction and lay the groundwork for future project successes.

Proper project closure involves finalizing all activities and delivering the project to stakeholders while ensuring compliance with contractual obligations. A structured closing phase includes evaluating project performance, documenting lessons learned, and

transitioning deliverables smoothly. Successful project closures enhance organizational reputation, client satisfaction, and set the stage for future project successes (Wen & Qiang, 2019).

Early identification of risks is critical for proactive risk management in construction projects. The author argues that comprehensive risk identification involves stakeholders across project phases, ensuring that potential threats are anticipated and addressed before they impact project objectives. Projects that systematically identify risks are better equipped to implement targeted mitigation strategies (Westland, 2007).

Early identification of risks is fundamental for proactive risk management in construction projects. The comprehensive risk identification involves engaging stakeholders across project phases to anticipate potential threats and develop mitigation strategies. Projects that systematically identify risks are better prepared to proactively manage uncertainties and minimize their impact on project outcomes (Ammar Ahmed, 2007).

The evaluation of the consequences and probability of recognized hazards aids in the prioritization of mitigation initiatives. According to Kendrick (2015), thorough risk assessment contributes to decision-making processes by enabling project teams to efficiently allocate resources and concentrate on risks that have the greatest expected impact. The resilience of projects to unforeseen obstacles is enhanced by the implementation of comprehensive risk assessments.

Assessing the impact and probability of identified risks enables prioritization of mitigation efforts. George (2020) emphasizes that thorough risk assessment guides decision-making processes, enabling project teams to efficiently allocate resources and concentrate on risks with the greatest possible impact. Projects that do comprehensive risk assessments enhance their ability to withstand unforeseen obstacles and sustain project performance in challenging circumstances.

Implementing mitigation strategies reduces the impact of identified risks on project outcomes. Ajibike et al. (2022) emphasize that proactive risk mitigation involves developing contingency plans, allocating resources, and monitoring mitigation effectiveness throughout project lifecycles. Projects that integrate robust mitigation practices demonstrate greater resilience and maintain project performance under varying conditions.

Implementing effective mitigation strategies reduces the impact of identified risks on project outcomes. Haider (2021) highlight that proactive risk mitigation involves developing contingency plans, allocating resources, and monitoring mitigation effectiveness throughout project lifecycles. Projects that integrate robust mitigation practices demonstrate greater resilience and achieve more predictable project outcomes, thereby enhancing stakeholder confidence and satisfaction.

Continuous monitoring and reporting of risks ensure that mitigation strategies remain effective over time. Khurramov and GANIEV (2021) suggests that regular risk reviews and status updates enable project teams to adapt to changing circumstances and maintain proactive risk management practices. Projects that prioritize ongoing risk monitoring achieve sustained project success by addressing emerging threats promptly.

Continuous monitoring and reporting of risks ensure that mitigation strategies remain effective over time. Le et al. (2020) suggests that regular risk reviews and status updates enable project teams to adapt to changing circumstances and maintain proactive risk management practices. Projects that prioritize ongoing risk monitoring improve their ability to anticipate and address emerging threats, thereby sustaining project success and minimizing potential disruptions.

The moderating role of risk management practices enhances the effectiveness of process management in achieving project success. Mohsin (2021) argue that integrating risk management throughout project phases ensures that potential disruptions are identified and addressed proactively. Projects that align process and risk management practices achieve higher levels of project success by minimizing uncertainties and optimizing resource utilization.

Effective risk management practices contribute to improved project success metrics, including adherence to schedules, budget compliance, and scope achievement. Nguyen, Do, and Macchion (2023) demonstrate that projects that effectively manage risks throughout their lifecycle consistently meet or exceed stakeholder expectations, leading to enhanced project outcomes and client satisfaction.

Risk management practices play a crucial moderating role in enhancing the effectiveness of process management in achieving project success. Integrating risk management throughout project phases ensures that potential disruptions are identified and addressed proactively, thereby optimizing resource utilization and project outcomes. Projects that align process and risk management practices achieve higher levels of project success by mitigating uncertainties and maintaining project performance under dynamic conditions (Moeuf et al., 2020).

The moderating role of risk management practices enhances the effectiveness of process management in achieving project success. The integration of risk management throughout project phases ensures that potential disruptions are identified and addressed proactively. Projects that align process and risk management practices achieve higher levels of project success by minimizing uncertainties and optimizing resource utilization (Rodríguez-Espíndola, Chowdhury, Dey, Albores, & Emrouznejad, 2022).

Effective risk management practices contribute to improved project success metrics, including schedule adherence, budget compliance, and scope achievement. Anantatmula and Rad (2018) demonstrate that projects that effectively manage risks throughout their lifecycle consistently meet or exceed stakeholder expectations, leading to enhanced project outcomes and client satisfaction. By systematically addressing risks, construction projects can optimize performance, minimize project disruptions, and achieve sustainable project success.

Effective risk management practices contribute to improved project success metrics, including adherence to schedules, budget compliance, and scope achievement. Buniya et al. (2023) demonstrate that projects that effectively manage risks throughout their lifecycle consistently meet or exceed stakeholder expectations, leading to enhanced project outcomes and client satisfaction.

3. Research Framework

3.1. Hypothesis

H1: Project process management has a significant impact on the project's timeline, with risk management practices serving as a moderating factor.
H2: Project process management significantly affects project costs, moderated by the application of risk management practices.
H3: There is a significant impact of project process management on the project scope, moderated by risk management practices.
H4: Project process management has a significant impact on the project's timeline.
H5: There is a significant impact of project process management on the project's cost.
H6: Project process management significantly affects the project's scope.
H7: Project process management significantly influences overall project success, with risk management practices acting as a moderating variable.
H8: There is a significant impact of project process management on overall project success.

4. Methodology

The present study utilizes a quantitative research methodology to investigate the influence of project process management on the achievement of sustainable project success within the construction sector. The study specifically emphasizes the moderating function of risk management methods. The quantitative methodology is suitable for this study since it enables the gathering of numerical data and the application of statistical techniques to establish correlations between variables. The data for this study were obtained using a well-organized questionnaire that was uniquely created to collect information on project process management, sustainable project success, and risk management techniques within the construction industry. The survey was disseminated to professionals employed in the construction sector, encompassing Managers, Project Managers, and Portfolio Managers. Among the 360 replies obtained, 32 were incomplete and so not included in the study. The complete dataset has 328 valid responses (Wong, 2013).
The study used a non-probability selection method, namely purposive sampling, to carefully select those who have relevant experience and expertise in project management within the construction industry. Through this method, the sample was guaranteed to include respondents who are very likely to provide well-informed and pertinent data. An analysis of the data obtained from the valid surveys was conducted using SmartPLS, a software program designed for partial least squares structural equation modeling (PLS-SEM). The selection of SmartPLS was based on its capacity to effectively manage intricate models, especially those that provide moderating effects, and its appropriateness for empirical investigation. The investigation included evaluating the measurement model to determine its reliability and validity, as well as testing the structural model to investigate the connections between project process management, sustainable project success, and the moderating impact of risk management methods (Wong, 2016).

5. Results of the Survey

5.1. Descriptive Statistics

Table 1: Descriptive Statistics of Variables

Variables	N	Minimum	Maximum	Mean	Std. Deviation	Skewness
Gender	328	1.00	2.00	1.0790	.27014	3.134
Job Position	328	1.00	3.00	1.3106	.56440	1.656
Qualification	328	2.00	3.00	2.3243	.46873	.754
Job Experience	328	1.00	2.00	1.3733	.48434	.526
PMP Certification	328	2.00	2.00	2.0000	.00000	.
Age	328	2.00	5.00	2.7875	.70016	.752
Project Process Management	328	2.80	14.00	11.1324	1.65242	-1.237
Project Risk Management	328	3.00	15.00	11.7439	1.71824	-1.015
Sustainable Project Success	328	3.40	17.00	13.4234	1.95210	-1.095

The table provides descriptive statistics for the variables used in this study, including demographic variables (Gender, Job Position, Qualification, Job Experience, PMP Certification, and Age) and key study variables (Project Process Management, Project Risk Management, and Sustainable Project Success). For each variable, the table presents the sample size (N), minimum and maximum values, mean, standard deviation, and skewness.
The demographic variables show that the sample consists of a diverse range of respondents. For example, the mean value for Gender is 1.0790, indicating a slightly higher proportion of one gender over the other. Job Position has a mean of 1.3106, reflecting a

distribution of respondents across different job roles in the construction industry. The mean values for the key study variables (Project Process Management: 11.1324, Project Risk Management: 11.7439, Sustainable Project Success: 13.4234) suggest a generally high level of engagement with these aspects within the sample.

Table 2: Construct Reliability and Validity

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
Project Process Management	0.834	0.899	0.869	0.511
Project Risk Management	0.950	0.963	0.954	0.591
Sustainable Project Success	0.916	0.918	0.937	0.749

The table presents several reliability and validity metrics for the study's key constructs: Project Process Management, Project Risk Management, and Sustainable Project Success. Cronbach's alpha values for all constructs are above the commonly accepted threshold of 0.70, indicating good internal consistency. Specifically, Project Process Management has a Cronbach's alpha of 0.834, Project Risk Management has a value of 0.950, and Sustainable Project Success has a value of 0.916. These high values suggest that the items within each construct are reliably measuring the same underlying concept (Kamis et al., 2020).

Composite reliability (rho_a and rho_c) values for each construct are also well above the recommended level of 0.70, further confirming the reliability of the measurement model. For instance, Project Process Management has composite reliability values of 0.899 (rho_a) and 0.869 (rho_c), while Project Risk Management and Sustainable Project Success show even higher composite reliability values, reflecting strong consistency among the indicators for each construct. The Average Variance Extracted (AVE) values are 0.511 for Project Process Management, 0.591 for Project Risk Management, and 0.749 for Sustainable Project Success. These AVE values indicate that more than 50% of the variance in each construct's indicators is explained by the construct itself, demonstrating adequate convergent validity for all constructs (Yaacob, Ab Latif, Mutalib, & Ismail, 2021).

Table 3: Discriminant Validity

	Project Process Management	Project Risk Management	Sustainable Project Success
Project Process Management			
Project Risk Management	0.822		
Sustainable Project Success	0.773	0.798	

The study provides the evaluation of the discriminant validity for three main constructs: Project Process Management, Project Risk Management, and Sustainable Project Success. The assessment of discriminant validity involves the comparison of correlations among constructs. Typically, the diagonal values, which reflect the square root of the Average Variance Extracted (AVE) for each construct, should exceed the off-diagonal correlations in their respective rows and columns to show discriminant validity (Beldiq, Callula, Yusuf, & Zahra, 2024).

In this table, the correlation between Project Process Management and Project Risk Management is 0.822, and the correlation between Project Process Management and Sustainable Project Success is 0.773. Similarly, the correlation between Project Risk Management and Sustainable Project Success is 0.798. These correlation values are moderately high but still allow us to assess if each construct is sufficiently distinct from the others, which would be more evident with the square root of the AVE values.

Table 4: R Square

	R-square	R-square adjusted
Project Risk Management	0.664	0.663
Sustainable Project Success	0.669	0.667

R-squared and adjusted R-squared values for the Project Risk Management and Sustainable Project Success constructs are presented in the table. The coefficient of determination, or R-squared value, shows how much of a dependent variable's variance can be predicted from the independent factors. The study found that the predictors in the model explained 66.4% of the variance in Project Risk Management, with an R-square value of 0.664 for Project Risk Management. The model also accounts for 66.9% of the variation in Sustainable Project Success, as shown by its R-squared value of 0.669 (Permata, 2023).

The R-square adjusted values, which account for the number of predictors in the model and adjust for potential overfitting, are very close to the R-square values (0.663 for Project Risk Management and 0.667 for Sustainable Project Success). This suggests that the model is robust, with a good fit, and that the predictors contribute significantly to explaining the variance in both constructs (Hoshino, 2024).

High R-square and R-square adjusted values indicate that the independent variables, like project process management practices, successfully account for a considerable amount of the variation in project risk management practices and sustainable project success. This validates the theoretical model being tested and gives confidence in the relationships being investigated in the context of the construction industry, which is why these findings are important for the study.

According to Hypothesis 1 (H1), the path coefficient ($\beta = 0.406$) is both positive and statistically significant ($T = 15.953$, $P = 0.000$), suggesting a robust and positive correlation between the independent and dependent variables. Thus, hypothesis H1 is confirmed. Similarly, Hypothesis 2 (H2) has a path coefficient of 0.398 with a statistically significant T statistic ($T = 10.463$, $P = 0.000$), which confirms a substantial positive causal association. Therefore, H2 is supported.

Nevertheless, Hypothesis 3 (H3) exhibits a minuscule path coefficient ($\beta = 0.009$), and the T statistic lacks statistical significance ($T = 0.161$, $P = 0.872$), therefore suggesting the absence of considerable association between the variables. Thus, the hypothesis H3

is not supported. Hypotheses H4, H5, H6, H7, and H8 all have positive and significant route coefficients ranging from β = 0.370 to β = 0.817. These coefficients are associated with high T statistics ranging from T = 7.185 to T = 38.047) and P values of 0.000. Each of these assumptions is supported by robust and statistically significant correlations.

Table 5: Hypothesis Testing

	β	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values	Results
H1	0.406	0.025	15.953	0.000	Supported
H2	0.398	0.038	10.463	0.000	Supported
H3	0.009	0.058	0.161	0.872	Not Supported
H4	0.459	0.033	13.717	0.000	Supported
H5	0.370	0.051	7.185	0.000	Supported
H6	0.759	0.077	9.911	0.000	Supported
H7	0.497	0.032	15.410	0.000	Supported
H8	0.817	0.021	38.047	0.000	Supported

The significance of these findings is in the validation of the theoretical model of the study and the demonstration of the robustness and importance of the majority of the suggested connections between project process management, risk management techniques, and sustainable project success in the construction sector. The results provide empirical data that confirms the accuracy of the model, with the exception of H3, which indicates that more research may be necessary to comprehend the absence of a substantial impact in this particular relationship.

6. Conclusion

In the context of the construction industry, this research aimed to investigate the effects of project process management on various aspects of project success, including time, cost, and scope, with a particular focus on the moderating role of risk management practices. The results of the hypotheses tested provide valuable insights into how project management practices can influence project outcomes.

Hypothesis 1 (H1): This hypothesis examined whether project process management significantly impacts the project timeline when moderated by risk management practices. The results supported H1, indicating that effective project process management, when combined with robust risk management, can significantly improve project timelines. This suggests that risk management practices help mitigate potential delays by proactively identifying and addressing risks that could affect the schedule. For construction projects, where delays can lead to substantial cost overruns and contractual penalties, integrating risk management with process management is crucial for maintaining project timelines.

Hypothesis 2 (H2): H2 explored the impact of project process management on project costs with the moderating effect of risk management. The hypothesis was supported, showing that comprehensive project process management, along with active risk management practices, can significantly reduce project costs. This outcome highlights the importance of systematically managing processes and risks in construction projects, which often face unexpected challenges that can inflate costs. By anticipating and mitigating risks early in the project, managers can avoid or minimize cost overruns, thereby ensuring that projects remain within budget.

Hypothesis 3 (H3): This hypothesis investigated whether project process management significantly affects the project scope when moderated by risk management practices. Unlike the other hypotheses, H3 was not supported. This result suggests that while project process management and risk management are crucial, their combined effect may not significantly influence changes in project scope. In the construction industry, the project scope can often be influenced by external factors such as client demands, regulatory changes, or unforeseen site conditions, which might not be fully mitigated through standard process management or risk management strategies alone. Therefore, scope management might require additional or different approaches beyond what was covered in this study.

Hypothesis 4 (H4): H4 tested the direct impact of project process management on the project timeline. The results were supportive, indicating that strong project process management alone, without the explicit moderating effect of risk management, positively influences the project timeline. This underscores the importance of well-structured project management practices in ensuring that construction projects are completed on schedule. Efficient planning, execution, and monitoring of project processes can significantly reduce delays, highlighting the value of traditional project management practices.

Hypothesis 5 (H5): This hypothesis addressed the direct impact of project process management on project costs. The findings supported H5, demonstrating that effective project process management directly contributes to cost efficiency. In the construction industry, where cost control is a significant concern, having a robust process management framework helps in managing resources effectively, avoiding waste, and ensuring that the project is executed within the financial constraints set at the onset.

Hypothesis 6 (H6): H6 explored the direct relationship between project process management and project scope. The hypothesis was supported, indicating that effective project process management practices can help in maintaining the defined project scope. This finding suggests that structured process management enables better control over scope changes, which is critical in construction projects to avoid scope creep and ensure that the deliverables align with the initial project objectives.

Hypothesis 7 (H7): This hypothesis investigated the overarching influence of project process management on the achievement of sustained project success, while considering risk management as a moderating element. The results corroborated hypothesis H7, indicating that the integration of risk management approaches with project process management increases the probability of attaining sustained project success. This discovery has significant relevance for building projects that strive for enduring value and

sustainability, underscoring the significance of adopting a comprehensive strategy that integrates both management and risk mitigation techniques.

Hypothesis 8 (H8): Analysis H8 examined the direct influence of project process management on the long-term success of projects, without considering the moderating influence of risk management. Supporting the theory, it was shown that efficient project process management alone plays a substantial role in attaining sustained project success. These findings emphasize that well controlled procedures are essential for achieving successful projects, since they guarantee compliance with time, cost, and quality limitations, which are the key pillars of project success in the construction sector.

Overall, the findings of this research emphasize the importance of robust project process management in achieving various aspects of project success in the construction industry. While risk management plays a crucial moderating role in some areas, its influence may vary depending on specific project outcomes such as scope. These insights suggest that construction project managers should focus on both strong process management and tailored risk management strategies to enhance project performance and sustainability.

6.1. Future Recommendations

For future research, it is recommended to expand the scope of this study by including a wider array of factors, such as stakeholder management, project communication techniques, and technological integration, to examine their influence on project success within the construction sector. Furthermore, future research might employ a longitudinal methodology to capture the dynamic characteristics of project management across time and examine the changing influence of risk management strategies during various project stages. To improve the generalizability of the findings, future study should also include a comparison analysis across various areas or sectors within the construction industry to clarify contextual variations. Ultimately, qualitative methodologies, such as interviews and case studies, can be utilized to acquire a more profound understanding of the actual obstacles and tactics adopted by project managers to handle procedures and hazards efficiently.

References

Ahmed, S., Ahmed, S., & Buriro, A. (2023). Strategies and Best Practices for Managing Cost Overruns in the Construction Industry of Pakistan. *Propel Journal of Academic Research, 3*(1), 28-55.

Ajibike, W. A., Adeleke, A. Q., Muuka, G. N., Bamgbade, J. A., Darun, M. R., & Moshood, T. D. (2022). Impacts of oil and gas internal risk factors on project success: Moderating role of government support. *Construction Economics and Building, 22*(1), 47-69.

Al-Kuhail, M. Y., Al-Dafiry, H. A., Barakat, T. A., & Al-Ansi, A. (2021). Developing a Diamond Framework Model Based on "Integration" of Project Success Measures for Construction Project Management in Yemen. *Pertanika Journal of Science & Technology, 29*(3).

Alkhlaifat, B., Abdullah, A. A., & Magassouba, S. M. (2019). Modeling Impact of Project Management Performance with Among Roles of Project Risk Management and Organizational Culture on Project Success. *European Journal of Business and, 11*(36).

Ammar Ahmed, B. K., Sataporn Amornsawadwatana. (2007). A review of techniques for risk management in projects. *Benchmarking: An International Journal, 14*(1), 22-36.

Anantatmula, V. S., & Rad, P. F. (2018). Role of organizational project management maturity factors on project success. *Engineering Management Journal, 30*(3), 165-178.

Anderson, D. K., & Merna, T. (2013). Project management strategy—project management represented as a process based set of management domains and the consequences for project management strategy. *International Journal of Project Management, 21*(6), 387-393.

Animi, C., & Owusu-Manu, D. G. (2021). *The influence of key performance indicators (kpis) on project success: Case study of Selected infrastructure projects in Sekondi-Takoradi metropolitan area*. (Doctorate). Kwame Nkrumah University of Science and Technology,

Beldiq, E. A., Callula, B., Yusuf, N. A., & Zahra, A. R. A. (2024). Unlocking Organizational Potential: Assessing the Impact of Technology through SmartPLS in Advancing Management Excellence. *APTISI Transactions on Management, 8*(1), 40-48.

Buniya, M. K., Othman, I., Sunindijo, R. Y., Karakhan, A. A., Kineber, A. F., & Durdyev, S. (2023). Contributions of safety critical success factors and safety program elements to overall project success. *International journal of occupational safety and ergonomics, 29*(1), 129-140.

Divya Sankar, S., Shashikanth, K., & Mahender, S. (2022). *Risk management in construction industry.* Paper presented at the Sustainable Cities and Resilience: Select Proceedings of VCDRR 2021.

George, C. (2020). The essence of risk identification in project risk management: An overview. *International Journal of Science and Research (IJSR), 9*(2), 1553-1557.

Guseva, A., Koptelov, M., & Kovtun, D. (2019). *Decision support for project risk management using the information-semantic field.* Paper presented at the 2019 1st International Conference on Control Systems, Mathematical Modelling, Automation and Energy Efficiency (SUMMA).

Haider, S. F. (2021). *The Impact of Participative Leadership on Project Success with Mediating Role of Coworker Knowledge Sharing and Moderating Role of Project Risk Management.* (Master of Sciences). Capital University of Science and Technology,

Hoshino, T. (2024). Factors Influencing SME Growth a Structural Analysis Using SmartPLS. *Modern Advances in Business, Economics, and Finance, 1*(1), 96-107.

Kamis, A., Saibon, R. A., Yunus, F., Rahim, M. B., Herrera, L. M., & Montenegro, P. (2020). The SmartPLS analyzes approach in validity and reliability of graduate marketability instrument. *Social Psychology of Education, 57*(8), 987-1001.

Kaufmann, C., & Kock, A. (2022). Does process management matter? The relationship between project management effort, complexity, and profitability. *International Journal of Project Management, 40*(6), 624-633.

Khurramov, A., & GANIEV, I. M. (2021). The Economic Effectiveness of Using Effective Risk Management Techniques in Project Management. *Development Issues Of Innovative Economy In The Agricultural Sector*, 13-18.

Latif, K. F., Afzal, O., Saqib, A., Sahibzada, U. F., & Alam, W. (2021). Direct and configurational paths of knowledge-oriented leadership, entrepreneurial orientation, and knowledge management processes to project success. *Journal of Intellectual Capital*, *22*(1), 149-170.

Le, N., Chong, O., & Kashiwagi, D. (2020). Success factors for project risk management in construction projects: A Vietnam case study. *Journal for the Advancement of Performance Information and Value*, *12*(2), 63.

Moeuf, A., Lamouri, S., Pellerin, R., Tamayo-Giraldo, S., Tobon-Valencia, E., & Eburdy, R. (2020). Identification of critical success factors, risks and opportunities of Industry 4.0 in SMEs. *International Journal of Production Research*, *58*(5), 1384-1400.

Mohsin, A. U. (2021). *Impact of Project Planning on Project Success: Moderating Role of Transformational Leadership & Mediating effect of Risk Management.* (Master of Sciences). Capital University,

Nguyen, H. D., Do, Q. N. H., & Macchion, L. (2023). Influence of practitioners' characteristics on risk assessment in Green Building projects in emerging economies: a case of Vietnam. *Engineering, construction and architectural management*, *30*(2), 833-852.

Nusraningrum, D., Jaswati, J., & Thamrin, H. (2020). The Quality of IT Project Management: The Business Process and The Go Project Lean Aplication. *Manajemen Bisnis*, *10*(1), 10-23.

Özgür, G., Kumru, P. Y., & AladaĞ, Z. (2020). Developing a Model for Measuring Project Performance with Software Life Cycle Process Metrics and Calculating Project Success Score. *Sakarya University Journal of Science*, *24*(3), 536-554.

Permata, R. A. (2023). Analisis Data Penelitian Kesehatan: Perbandingan Hasil antara SmartPLS, R dan IBM SPSS untuk Jumlah Sampel Kecil. *JSN: Jurnal Sains Natural*, *1*(1), 17-22.

Project Management Institute, P. (2021). *A Guide to the Project Management Body of Knowledge (PMBOK Guide)* (6th ed.): Project Management Institute, PMI.

Rodríguez-Espíndola, O., Chowdhury, S., Dey, P. K., Albores, P., & Emrouznejad, A. (2022). Analysis of the adoption of emergent technologies for risk management in the era of digital manufacturing. *Technological Forecasting and Social Change*, *178*, 121562.

Shahzad, M., Qu, Y., Zafar, A. U., Rehman, S. U., & Islam, T. (2020). Exploring the influence of knowledge management process on corporate sustainable performance through green innovation. *Journal of Knowledge Management*, *24*(9), 2079-2106.

Walton, S. V., Handfield, R. B., & Melnyk, S. A. (1998). The green supply chain: integrating suppliers into environmental management processes. *International journal of purchasing and materials management*, *34*(1), 2-11.

Wen, Q., & Qiang, M. (2019). Project managers' competences in managing project closing. *Project Management Journal*, *50*(3), 361-375.

Westland, J. (2007). *The project management life cycle: A complete step-by-step methodology for initiating planning executing and closing the project*. United Kingdom: Kogan Page Publishers.

Wong, K. K.-K. (2013). Partial least squares structural equation modeling (PLS-SEM) techniques using SmartPLS. *Marketing bulletin*, *24*(1), 1-32.

Wong, K. K.-K. (2016). Mediation analysis, categorical moderation analysis, and higher-order constructs modeling in Partial Least Squares Structural Equation Modeling (PLS-SEM): A B2B Example using SmartPLS. *Marketing bulletin*, *26*(1), 1-22.

Yaacob, N. A., Ab Latif, Z., Mutalib, A. A., & Ismail, Z. (2021). Farmers' intention in applying food waste as fertilizer: Reliability and validity using Smart-PLS. *Asian Journal of Vocational Education and Humanities*, *2*(2), 27-34.