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Linking Green Project Planning, Stakeholder Engagement, and Technological Capability to Sustainable Project Performance: The Mediating Role of Sustainable Risk Management in Lahore, Pakistan

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ABSTRACT

Sustainability has become a strategic priority for project-based organizations in Pakistan, especially in major urban centers such as Lahore where development activities continue to expand. This study examines how Green Project Planning, Stakeholder Engagement, and Technological Capability influence Sustainable Project Performance within project-driven organizations. It further investigates the mediating role of Sustainable Risk Management, proposing that effective identification, assessment, and mitigation of environmental and social risks strengthen the pathway between project capabilities and sustainability outcomes. Data were collected from 300 project professionals working in public and private sector organizations in Lahore, selected using structured sampling procedures. The findings reveal that all three antecedents significantly enhance sustainable project performance, both directly and indirectly through sustainable risk management. These results highlight the importance of integrating sustainability-focused risk practices into project workflows to ensure responsible, resilient, and high-performing project outcomes. The study contributes to the growing body of literature on sustainable project management and offers practical implications for managers seeking to embed sustainability into project planning and execution in the Pakistani context.

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1.0 Introduction

The expanding global focus on sustainability has pushed project-based organizations to reconsider conventional methods of planning, implementation, and assessment and shift more towards technical measures of success to the more widespread standards of environmental performance, social performance, and performance in the long term. This change is now becoming more apparent in big cities like Lahore one of the fastest growing cities in Pakistan where the rapid growth of infrastructure, transport projects, and urban regeneration projects require project models that safeguard ecological resources and socially responsible projects. The pressures of urbanization, environmental degradation, mismanagement of waste, and scarcity of resources have increased the need to incorporate the principle of sustainability in the mainstream project management practices (Almulhim et al., 2022). With increased scrutiny of both the public and the private sector organizations by the regulators, the civil societies and the local community, the idea of sustainable project performance has risen to become one of the main criteria in judging the overall effects of the development projects. In this regard, project managers will be required to portray an enhanced ability to match project operations to the concept of sustainability, including reduction in the environmental imprint, stakeholder inclusivity, resilience, and technological innovation. Regardless of these expectations, the vast majority of Pakistani organizations still tend to use traditional approaches to project planning that do not take into account the complexities of the contemporary sustainability issues, contributing to inefficiencies and exposing the organizations to the risks of environmental and social issues (Bibia et al., 2025).

The management of sustainability in the projects cannot be achieved through mere fervent technical skills but through strategic incorporation of the green-based management practices. Green project planning has become a sore need as a basis of sustainable project performance as it entails instilling environmental concerns in the initial phases of project conception, design, scheduling, and resource establishment. Compared to the traditional planning which focuses on cost, scope and time, green project planning focuses on energy efficiency, waste reduction, sustainable procurement and selection of materials that do not harm the environment. This move considers the reality that issues to do with the environment can best be handled proactively as opposed to the reactive approach. Simultaneously, stakeholder engagement has acquired significant popularity as an important tool to guarantee the attainment of sustainability under especially dense urban settings like the one in Lahore where different communities, regulatory organizations, contractors, and interest groups shape the decision-making of projects (Farooq et al., 2024). This leads to a good interaction that ensures transparency, trust, minimization of conflict, and integration of stakeholder views into project strategies to make it more viable and legitimate. In the meantime, technological capability has become an inseparable contributor to sustainable project performance because the further development of digital tools, monitoring tools, automation, and green technologies can help companies to optimize the utilization of resources, simplify processes, and enhance the quality of decision-making. Combined, the three constructs are the complementary capabilities that determine the strategic position of organizations that aim to provide sustainable results in a project environment that is becoming more volatile (Zheng et

al., 2025).

The interrelationship between these constructs is of great concern in the backdrop of the increasing consciousness of the fact that sustainability is impossible without effective risk management mechanisms. Sustainable risk management has changed its approach on the basic level of operational and financial risks to include environmental, social, regulatory, and reputational risks that threaten the project sustainability in the long-term. Because environmental dangers like air pollution, water contamination, urban flooding, ecological degradation and community displacement continue to be on the rise in Lahore and face interdependence, risk management activities should consider the interrelativeness of these risks. Sustainable risk management is therefore a structured process of identifying, evaluating and reducing risks in a way that is sustainability oriented. It supplements green project planning by allowing organizations to anticipate environmental effects, assess alternative resolutions, and impose mitigation measures in the initial phase of the planning (Khalilzadeh et al., 2025). On the same note, it will improve the stakeholder engagement because it understands the risks that would arise due to community dissatisfaction, social inequities or lack of proper communication and thus it enhances more active stakeholder participation. Furthermore, the sustainable risk management is enhanced by technological capability, which offers some of the most sophisticated tools, including predictive analytics, the environmental monitoring system, building information modeling, and digital collaboration platforms, which enhance the accuracy and efficiency of risk-based decision-making. In the case of organizations that are interested in project performance that is sustainable, sustainable risk management therefore serves as a background integrative practice, which converts proactive planning, collaborative interaction and technological innovation into quantifiable sustainability results (Anton et al., 2025).

These relationships are theoretically underpinned by the Resource-Based View (RBV) and the stakeholder theories, both of which offer an impressive ability to explain why some organizational capabilities are beneficial to sustainable performance. According to RBV, competitive and performance advantage is enjoyed in an organization when the resources that a firm owns are valuable, rare, inimitable, and non-substitutable. Green project planning is an asset and a relatively uncommon asset in the Pakistani environment since, in most cases, organizations are only beginning to embrace systematic environmental planning systems. The participation of stakeholders is a relational resource that builds trust, decreases resistance and increases social legitimacy which competitor can hardly replicate (Osei et al., 2025). Technological capability is a measure of tangible and intangible resources that facilitate excellent execution of projects, learning, innovation and flexibility. As RBV implies, these capabilities should be well exploited by means of supporting processes to produce the high performance, and the sustainable risk management offers just such a tool by means of the coordination of these sources and their adjustment to the sustainability objectives. Stakeholder theory also strengthens the applicability of stakeholder engagement and sustainable risk management because it highlights the interdependence of organizational activities and those who have an interest, expectation, and concern in their activities, which states that firms can be more successful when they consider the

needs, expectation, and concerns of the parties involved. Collectively, these theoretical backgrounds demonstrate how project capabilities can be converted into sustainable results and why sustainable risk management becomes an important mechanism in this conversion process (Gomes et al., 2025).

Although the issue of sustainability has become a major concern in project management, there are still a number of research gaps that still stand unfulfilled especially when it comes to developing countries such as Pakistan. To begin with, despite other works internationally on the role of green planning, stakeholder participation, and adoption of technology in the attainment of sustainability, there is paucity of empirical evidence regarding such aspects in South Asian urban settings. Pakistan is a country with distinct socio-political, cultural, and infrastructural peculiarities that cannot be directly compared with the Western project management contexts, which implies that the results of other regions may not be directly applicable. Second, there is very little research studies that investigate these three antecedents in a single integrative framework even though their joint impact is crucial in explaining the multidimensionality of sustainable projects performance (He et al., 2025). Third, sustainable risk management studies have not been well cultivated in the Pakistani project management literature and most bodies continue to use traditional or improvised risk management procedures. There are just a few studies that have considered the mediating role of sustainable risk management even as evidence continues to mount that decisions related to risks are at the center in attaining the outcome of environmental, social, and economic projects. Fourth, whereas most literature captures the concept of sustainability in general, not many clearly conceptualize sustainability as project performance, the quantifiable effects of sustainability behavior on the efficiency of a project, environmental responsibility, social well-being, and the viability of the project in the long run. This is where the gap lies that empirical research is needed that will relate organizational capabilities to sustainability outcomes using structured mediation pathways (Wang et al., 2023).

The gaps lead to a research problem that involves the paucity of knowledge regarding how green planning, stakeholder involvement, and technological competency can be effectively utilized by project based organization in Lahore to attain sustainable project performance. Despite more and more policy makers and industry leadership promoting the use of sustainability based project models, organizations are still grappling with significant issues regarding the implementation of sustainability promise into the day to day operations and quantifiable results. The absence of combined frameworks and empirical data limits the potential of organizations to determine what capabilities are most important, how they interrelate, and in what circumstances they enable sustainability (Karman & Savanevičienė, 2021). It is through lack of a comprehensive knowledge of these relations that the project teams are likely to adopt fragmented or superficial sustainability initiatives that would not take into account the environmental and social risks of development projects. The issue is especially acute in Lahore where the accelerated urbanization, overloading of the infrastructure, and environmental insecurity require strong and evidence-based sustainability measures beyond the rhetoric. The lack of empirical knowledge related to the mediating through sustainable risk management also complicates the decision making process in

the fact that organizations are not given a clue on how the risk processes can convert strategic capabilities into sustainable performance (Huy & Phuc, 2025).

Considering these issues, this study is important to further the theoretical and practical knowledge in the field of project management. The research offers an integrated insight on the interaction of green project planning, stakeholder engagement, technological capability, and sustainable project performance, which is lacking in the Pakistani context to date. The fact that sustainable risk management is a mediating factor is an addition to the growing body of research on the sustainability-based risk frameworks and provides a small twist to how organizations can improve the project outcomes by instilling the sustainability principles into the risk processes. The research also has a practical importance to the project managers, policymakers, consultants and development authorities in Lahore and other parts of the world. The insights produced can be used to create effective planning protocols in organizations, improve stakeholder cooperation, invest in technology in a strategic way, and create risk management systems that are oriented to the requirements of sustainability (Salamzadeh et al., 2022). Moreover, the results can be used to facilitate the making of policies regarding sustainable urban development, environmental conservation as well as infrastructure planning and also to inform regulatory frameworks that promote sustainable project deliverables. Finally, the current study offers a contextual, and timely contribution to the field of sustainability operationalization in the context of project management in Pakistan, which provides a direction in the organizations that have to comply with the current development goals and, at the same time, guarantee responsible and resilient project outcomes (Shamas et al., 2025).

2.0 Literature Review

The theoretical frameworks that the research is going to be based on are predominantly based on the Resource-Based View (RBV) and the stakeholder theory, which offer very valid explanations as to how the organizational capabilities can be transformed into sustainable project results. According to RBV, the firms that have and utilize valuable, rare, inimitable, and non-substitutable resources perform better. In the context of project, green project planning can be conceptualized as a strategic resource, which improves the quality of environmental and operation of a project by incorporating sustainability aspects into the initial stages of decision-making. Likewise, stakeholder engagement is a relational resource that enhances trust, collaboration and legitimacy and thus competitor may not easily imitate this resource because it is socially and contextually unique. Technological capability is a type of tangible and intangible asset that allows organizations to be innovative, enhance processes, and advance decision quality based on risk (Lianto, 2023). RBV also indicates that the resources do not give rise automatically to performance advantages unless they are incorporated successfully in the processes of the organization. Sustainable risk management thus emerges as a supportive capacity that will help organizations to transform strategic resources to quantifiable sustainability outcomes through the identification, assessment and reduction of environmental and social risks. These relationships are strengthened by the stakeholder theory which states that sustainable organizational performance is more likely to occur when various voices are added to the planning and execution of projects. Combined, these

intellectual prismatic frames hold that green project planning, stakeholder participation and technological competency should work through systematic risk management protocols to result in the generation of the significant sustainability effects in project-based settings (Yamamura, 2022).

There is a substantial amount of empirical literature that has investigated the concept of green project planning as a factor in sustainable performance that emphasizes how green project planning contributes to incorporating environmental considerations in the design, timeline, procurement, and resource planning of a project. Both developed and developing economy research indicates that organizations that embrace green planning activities lessen their wastage, increase energy conservation, and attain higher sustainability indicators. Recent studies of Asian settings indicate that green planning is a vastly better approach to ecological protection and operational efficiency of infrastructure and building projects (Karamoozian & Zhang, 2025). Specifically, by making green plans of projects, the firms are able to predict the environmental risks and proactively engage in mitigation measures, a factor that is highly important in highly urbanizing areas where environmental damage is becoming a growing problem. Although it is a significant issue, it has been shown that, in most South Asian project settings, such as Pakistan, green planning is not well institutionalized because of the lack of training, enforcement of regulations, and resources. This empirical scenery emphasizes the development of the necessity to explore the role of green project planning in sustainable project performance in areas with high growth strains, including Lahore (ud Din et al., 2025).

There has also been a lot of empirical focus on stakeholder engagement as a factor in determining the sustainability results. It has been shown that the participation of stakeholders can be associated with increased transparency, minimization of conflicts, and the project decision making process that is more aligned with the needs and expectations of communities that are impacted. Stakeholders tend to have an effect on the project priorities, flow of resources and risk perceptions in complex project environments, and they therefore need to be engaged so as to attain a sustainable outcome. Infrastructure analysis and the work in the public sector demonstrates that stakeholder involvement leads to high levels of social acceptance, better environmental stewardship, and greater governance mechanisms (Khan et al., 2021). The recent studies in developing nations depict that stakeholder participation is more essential in environments where regulation is ineffective, where community expectations are great, and the social-political relations influence the project results. There is a paucity of empirical studies in the context of Pakistan in reliance to the contribution of stakeholder engagement towards sustainable project performance; though increasing studies suggest that poor engagement leads to delays of projects, social conflicts, and environmental degradation. The gap requires more studies in the manner the stakeholder engagement operates as a strategic capacity that improves sustainability in an urban project setting (Gonzalez-Porras et al., 2021).

The empirical importance of technological capability in the sustainability studies has been growing because of its transformational effects on both the project planning, the monitoring and execution. Research indicates that highly technologically competent organizations use high-end technology including building information modeling (BIM), geographic information system

(GIS), automation, and environmental sensors, which contribute to accuracy of project, less waste, and sustainability reporting. Experienced results in construction and infrastructure industries prove that technological capability contributes to efficiency, accuracy of monitoring, and real-time decision-making and helps organizations act efficiently to the sustainability risks. The more technologically mature organizations are more likely to consider environmental and social indicators into their working processes, as well as to adhere to the international sustainability standards (Eisner et al., 2022). However, in Pakistan, the implementation of the modern technology system is unequal with a large number of organizations not having the tools and expertise that are necessary to incorporate technology-based sustainability practices. This imbalance highlights the importance of empirical studies, which examine the effect of technological capability on sustainable project performance in the situations, which are marked by the scarcity of resources and rapid urban growth (Bergougui & Meziane, 2025).

Risk management mechanism often mediate the relationship between these organizational capabilities and sustainable project performance. Sustainable risk management is a modification of the existing approaches and methods of risk identification, risk assessment and mitigation to include the environmental, social and long-term sustainability into the process. Recent empirical research states that sustainable risk management enhances resilience of projects, minimizes environmental effects, guarantees regulatory adherence, and long-term performance. Companies that have sustainability-based risk management frameworks have a stronger response mechanism to environmental uncertainties like climate change, resistance by communities, and environmental pollution (Deslatte et al., 2025). When applied to the construction and infrastructure projects, sustainable risk management has been proven to increase cost-effectiveness, environmental performance, and satisfaction among the stakeholders. However, empirical studies in Pakistan are few, regardless of the increasing understanding that it becomes increasingly significant. Most organizations use the old system of risk management which is more focused on financial and operational risks but not on the environmental and social aspects. This gap signifies a serious necessity to examine how sustainable risk management mediates between variable organizational capabilities as well as sustainable project performance in the project sector in Pakistan, especially in such a city as Lahore where the process of rapid urbanization increases the environmental and social risks (Ullah et al., 2023).

Empirical research is pointing to the jointness of the relationship between green project planning and sustainable risk management. Studies show that green planning procedures expect sustainability risks at initial stages of the project, which allows the firms to develop environmentally friendly projects that have minimum ecological impacts and consume less resources in addition to meeting the environmental requirements. The researches carried out in the developing countries indicate that green planning does not only lead to better environmental performance but also to the skills of the organizations to detect new threats and put in place mitigation measures, which makes it more sustainable. In areas there is a high level of environmental hazards like pollution, flooding, and shortage of resources, green project planning serves as a competency capacity that minimizes vulnerability and increases resilience (Muoghalu,

2025). Thus, empirical evidence proves the concept that sustainable risk management is the mechanism, which increases the worth of the green project planning and transforms it into the sustainable project performance.

This relationship between sustainable risk management and stakeholder engagement is also a recent subject of empirical research. It is indicated that involving stakeholders may help in a more in-depth discovery of environmental and social risks since stakeholders usually present crucial information that would otherwise go unnoticed by project teams. Research indicates that involvement of stakeholders increases risk transparency, minimizes conflicts, and makes risk mitigation strategies to meet community expectations, which increases project legitimacy and sustainability. In developing nations, as the empirical evidence suggests, stakeholder engagement can be viewed as a cushion against socio-political risks and as a reinforcer of environmental governance, which results into more sustainable project outcomes (Shiau et al., 2025). The results of these findings are that sustainable risk management can be the mediating variable that enables better sustainability performance when stakeholders are engaged. However, in Pakistan, where citizens have not yet engaged much in the decision-making process of a project, there are few empirical results, which support the necessity of project-specific research (Khan et al., 2025).

The technological capability has also been found to impact on sustainable risk management. It is shown that sophisticated technological systems can assist in identifying risks and monitoring them through the provision of precise real-time information on the environmental indicators, project processes, and the use of resources. The new technologies of BIM, drones, IoT devices, and predictive analytics lead to greater accuracy of risk identification and the opportunity of the organization to work out specific mitigation measures. Empirical studies demonstrate that the organizations that are technologically capable have fewer environmental risks, enhanced safety results, and increased adherence to sustainability principles (Xiufan & Yunqiao, 2025). These results indicate that technological capability reinforces sustainable risk management through the ability to make sustainable decisions on the basis of data, through improvements in the monitoring capabilities, and the effectiveness of sustainability interventions. The situation is different in developing nations where little investment in technology and low adoption rates limit firms to maximize the use of these tools which explains the need to conduct more empirical research in the project sector in Pakistan (Jamil et al., 2025).

3.0 Methodology

This study approach was aimed at giving a rigid and methodical approach in analyzing how the Green Project Planning, Stakeholder Engagement, and Technological Capability affect Sustainable Project Performance and another moderating factor of Sustainable risk management in the project-based setting in Pakistan. The study was conducted under a quantitative research design, which was deemed suitable due to the fact that it enables the testing of the theoretical relationships through the use of numerical data and statistical tests and, in this way, increases the objectivity, reliability, and generalizability of the results. This design is based on the positivist research philosophy that presupposes that social phenomena are quantifiable, observable, and measurable in a similar way to natural sciences (Sohail, Ullah, et al., 2023). This philosophical

stance advocates the employment of systematic data collection tools, uniformity scales of measurement, and statistical models to accept the theory-pleasing hypotheses. The positivist position also concurs with the aim of this research, which aims at confirming conceptual relationships and also testing the mediating role of sustainable risk management by empirical testing as opposed to interpretive inquiry (Sohail, Saeed, et al., 2023).

The aim population of the study was project professionals in Pakistan with special attention to the organizations in the public and private sector that are involved in construction, infrastructure development, and energy projects and other project based activities. The country of Pakistan is an appropriate setting because cities are rapidly urbanizing, the sustainability issues are increasing, and the project management practices are changing. In this geographical and industries context, Lahore was chosen as the main data collection location as it is one of the largest metropolis centres in the country with the high concentration of the current development projects, multiple stakeholders, and growing interest in sustainable practices (Sohail, Hussain, & Hussain, 2022). The sample was comprised of project managers, engineers, sustainability officers, risk analysts, planners, and any other personnel identified to be engaged in planning, execution or monitoring of projects. As far as there was no central database of the project professionals in Pakistan, it was not possible to employ probability sampling. Thus, non-probability sampling technique was used; that is, purposive sampling, whereby only the persons with appropriate knowledge and experience were included in the research study. This tactic was supported with a systematic sampling method where respondents were picked depending on the set out criteria like job position, minimum level of experience and participation in sustainability or risk-associated project work (Sohail, Hussain, & Abbas, 2022).

The target sample was determined as 300 project professionals, which is sufficient to perform Structural Equation Modeling (SEM), as traditionally a sample that is large enough to have consistent and reliable estimates of the parameters. The reason is that the final sample consisted of 300 valid responses and it is a good response rate taking into account professional commitments of people. An organized survey questionnaire was used as a method of data collection, as it is one of the most common survey methods used in quantitative research to produce standardized data that can be analyzed statistically. The questionnaire was designed using validated measurement scales taken over previous studies, which guaranteed the content and relevancy of context. It contained close-ended questions assigning a five-point Likert scale to strong disagreement to strong agreement to elicit the perceptions of the respondents towards the study constructs. Before actual data collection commenced, a pilot study on a small sample of project professionals was done to determine the questionnaire item clarity, dependability and suitability. The changes were made based on the feedback in minor ways to make the survey more comprehensible and closer to the Pakistani context.

The process of data collection assumed online and personal distribution of the survey questionnaire to make participation of the varied organizations and professionals possible. Secure online platforms were used to conduct the online surveys where respondents could fill the questionnaire on their own time, physical copies of the questionnaires were sent to specific

organizations to which there was no access to digital and where organizational rules favored use of paper-based survey. The study was purely voluntary and the respondents were made aware of the objective of the research, time commitment, confidentiality and the fact that he or she could pull out of participation whenever it seemed right without any repercussions. In order to have accuracy and consistency, missing values, the outliers and inconsistency of the data were screened before analysis. The final dataset contained only the complete and valid responses.

To conduct data analysis, the Partial Least Squares Structural Equation Modeling (PLS-SEM) was utilized with the help of SmartPLS that is especially effective when the researcher has to predict and explore the relationships between multiple latent constructs. The choice of PLS-SEM is based on the fact that it allows working with smaller sample sizes, non-normal data distribution, and more complex mediation models, which is why it was used in this study. The two-step methodology was applied to analyze the measurement model (to determine the reliability, validity, and internal consistency of constructs) and structural model analysis (to determine the relationships between the variables, the path coefficients, and influence sizes). This method of analysis provided a thorough review of the constructs and the structural relationship hypotheses presented in the conceptual model, hence, increasing the strength and believability of the results.

4.0 Findings and Results

4.1.Reliability Analysis (Cronbach's Alpha & Composite Reliability)

Table 4.1 Reliability Analysis

Construct	Cronbach's Alpha	Composite Reliability (CR)	Interpretation
Green Project Planning (GPP)	0.873	0.903	Reliable
Stakeholder Engagement (SE)	0.889	0.918	Reliable
Technological Capability (TC)	0.861	0.901	Reliable
Sustainable Risk Management (SRM)	0.897	0.926	Reliable
Sustainable Project Performance (SPP)	0.902	0.931	Reliable

The reliability findings show that all constructs exhibit good and acceptable internal consistency, which proves the effectiveness of the measurement model. In particular, the Alpha values of Green Project Planning (0.873), Stakeholder Engagement (0.889), Technological Capability (0.861), Sustainable Risk Management (0.897), and Sustainable Project Performance (0.902) are larger than the suggested absolute threshold of 0.70 indicating that the items under each construct are always gauging the same underlying concept. The Composite Reliability (CR) values are also in the range of 0.901-0.931, which further supports the reliability of each construct by out of the range of 0.70 which is the generally accepted mark. All these findings imply that the

scales applied to each variable are very reliable to be used in further structural analysis in PLS-SEM framework.

4.2 Convergent Validity (AVE)

Table 4.2 Convergent Validity

Construct	AVE	Threshold	Interpretation
GPP	0.652	>0.50	Good
SE	0.689	>0.50	Good
TC	0.672	>0.50	Good
SRM	0.713	>0.50	Good
SPP	0.701	>0.50	Good

The convergent validity findings indicate that all constructs have the suggested threshold, which proves that each group of indicators is adequate to explain the latent construct. It is in the values of the Average Variance Extracted (AVE): the Green Project Planning (0.652), Stakeholder Engagement (0.689), Technological Capability (0.672), Sustainable Risk Management (0.713), and Sustainable Project Performance (0.701) that the values are above the minimum of 0.50, and thus above the substantial threshold of 0.60, which suggests that the construct itself rather than measurement error explains more than half of the variance in each of the indicators. This indicates high convergent validity and implies that the items employed in the study are theoretically and empirically strong measures of the measures that they are intended to represent, and thus can be included as an element in the structural equation.

4.3 Discriminant Validity (HTMT Ratio)

Table 4.3 Discriminant Validity

Constructs	GPP	SE	TC	SRM	SPP
GPP	—	0.712	0.684	0.651	0.623
SE	0.712	—	0.731	0.698	0.669
TC	0.684	0.731	—	0.704	0.658
SRM	0.651	0.698	0.704	—	0.745
SPP	0.623	0.669	0.658	0.745	—

According to the HTMT results, the discriminant validity has been properly established among all the constructs in the model, all the values are less than the normally regarded threshold of 0.85 which shows that each construct is empirically different to the other. The correlations are moderate to high between the Green Project Planning and the Stakeholder Engagement (0.712), Technological Capability and Sustainable Risk Management (0.704), and Sustainable Risk Management and Sustainable Project Performance (0.745), which is anticipated in the context of

sustainability-based project, but is still low enough to ensure that both constructs are not conceptually redundant. On the same note, the correlations among Stakeholder Engagement and Sustainable Project Performance (0.669) and Technological Capability and Sustainable Project Performance (0.658) also show that even though the constructs have meaningful associations in project sustainability model, the constructs represent different aspects of the general theoretical model. All in all, the conducted analyses of the values of the HTMT prove that the measurement model exhibits a high level of discriminant validity, and each of the constructs reflects a unique feature of sustainable project management.

4.4 Multicollinearity (VIF) Values

Table 4.4 Multicollinearity

Construct	VIF	Interpretation
GPP	2.104	Acceptable
SE	2.268	Acceptable
TC	2.326	Acceptable
SRM	1.997	Acceptable

According to the VIF outcomes, multicollinearity is not an issue in the structural model because all the values are significantly below the generally accepted mark, 5. In particular, the VIF scores of Green Project Planning (2.104), Stakeholder Engagement (2.268), Technological Capability (2.326), and Sustainable Risk Management (1.997) indicate the acceptable level of collinearity, which proves that no predictor variable has an excessive inflationary impact on the variance of another one. These values indicate that the constructs are not redundant in terms of their contribution to the model since none of them overlap with others too much to support the stability and reliability of the estimated path coefficients in the further structural analysis.

4.5 Model Fit Indices

Table 4.5 Model Fit Indices

Fit Index	Value	Threshold	Interpretation
SRMR	0.046	<0.08	Good Fit
NFI	0.936	>0.90	Good Fit
RMS Theta	0.109	<0.12	Acceptable Fit

The VIF outcome shows that the structural model does not have multicollinearity because all the values are far less than the generally proposed value of 5. In particular, the VIF statistics of

Green Project Planning (2.104), Stakeholder Engagement (2.268), Technological Capability (2.326), and Sustainable Risk Management (1.997) show that all of them have acceptable levels of collinearity, and any of them does not have an undue inflationary influence on the variance of the other. The above values imply that any construct will make a unique contribution to the model that will not excessively overlap with any other hence justifying the stability and reliability of the estimated path coefficients in the following structural analysis.

4.6 Structural Equation Model (Path Coefficients)

Hypothesis	Path	β	t-value	p-value	f²	Decision
H1	GPP → SPP	0.241	4.883	<0.001	0.067	Supported
H2	SE → SPP	0.268	5.144	<0.001	0.074	Supported
H3	TC → SPP	0.213	4.322	<0.001	0.058	Supported
H4	GPP → SRM	0.301	6.021	<0.001	0.092	Supported
H5	SE → SRM	0.334	6.684	<0.001	0.108	Supported
H6	TC → SRM	0.289	5.612	<0.001	0.085	Supported
H7	SRM → SPP	0.481	9.354	<0.001	0.224	Supported

The findings of the structural model show that the proposed theoretical pattern is correct and all the hypothesized relations are statistically significant and of the expected direction. Green Project Planning (GPP) has a positive effect on Sustainable Project Performance (SPP) with a path coefficient (b) of 0.241 and a t-value equal to 4.883 indicating that environmentally conscious planning has a direct effect on the better sustainability results. The positive impact of Stakeholder Engagement (SE) on SPP is also significant (b = 0.268, t = 5.144), which demonstrates the relevance of implementing the stakeholder opinions in the attainment of project sustainability. In the same manner, Technological Capability (TC) has a positive influence on SPP (b = 0.213, t = 4.322), which proves the fact that high-technological integration improves performance. Moreover, the three antecedents, including GPP, SE, and TC, have a significant impact on Sustainable Risk Management (SRM) with the path coefficients of 0.301, 0.334, and 0.289, respectively, indicating that all the capabilities reinforce the capabilities of the organization to identify, evaluate, and eliminate environmental and social risks. The effect of Sustainable Risk Management on SPP (b = 0.481, t = 9.354) is also positive which serves as a confirmation of its

role in mediating between the project capabilities and the real sustainability results. The f2 values show that the direct paths are relatively small to medium in effect sizes, and SRM has a relatively large effect on SPP, which highlights its importance in the improvement of sustainable project performance. In general, these results confirm the relevance of the suggested model showing that the combination of capabilities of projects and risk management contributes to high sustainability results within project-based organizations.

4.7 Mediation Results (Indirect Effects)

Table 4.7 Mediation Results

Mediation Path	Indirect β	t-value	p-value	Effect	Mediation Type
GPP → SRM → SPP	0.145	5.401	<0.001	Medium	Partial
SE → SRM → SPP	0.161	5.984	<0.001	Medium	Partial
TC → SRM → SPP	0.139	5.213	<0.001	Medium	Partial

The mediation analysis depicts that the relationship between the independent variables and Sustainable Project Performance (SPP) is mediated partially by Sustainable Risk Management (SRM). In particular, Green Project Planning (GPP) through SRM (b = 0.145, t = 5.401), Stakeholder Engagement (SE) through SRM (b = 0.161, t = 5.984), and Technological Capability (TC) through SRM (b = 0.139, t = 5.213) are all statistically significant with p = 0.001, which means that SRM has a significant role to play in realizing the sustainability outcomes of the project capabilities The effect sizes are medium and it indicates that although GPP, SE and TC have direct effects on SPP, a significant proportion of their effect is mediated by SRM. This biased mediation highlights the significant role of risk management in project-based organizations as it allows identifying, evaluating and preventing environmental and social risks in advance and, therefore, improving the efficiency of planning, stakeholder involvement, and technological integration to attain higher sustainable project performance.

5.0 Discussion and Conclusion

The results of this research give strong evidence that Green Project Planning, Stakeholder Engagement, and Technological Capability can have a great impact on Sustainable Project Performance in project-based organizations, and Sustainable Risk Management mediates the relations, partly. The reliability and validity tests affirm that the measurement model is not just consistent, but it is also accurate and a reliable interpretation of the structural relationship can be made. The positive and significant path coefficients mean that proactive environmental planning, involvement of the stakeholders and high level of technological integration are the main determinants of the sustainability outcomes. In particular, it was determined that Green Project Planning has a direct positive result on the Sustainable Project Performance by ensuring that the

environmental aspects are incorporated in the early project design and implementation, minimization of waste, optimizing the resources, and alignment of project operations to the ecological principles. These findings support the previous studies that emphasize the strategic value of including the notion of sustainability in the planning stage of the project (Ghazilla et al., 2015; Abbas and Awan, 2021), and the studies are extended by the authors who have shown this impact in relation to Pakistani project of urban development, specifically in Lahore.

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