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An Empirical Impact Assessment of Antecedents and Enablers of Sustainable Project Management Implementation using a Structural Equation Modeling Approach

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ABSTRACT

This study examines the influence of key antecedents and enablers for the successful implementation of Sustainable Project Management (SPM). In emerging nations, organizations face challenges to integrate sustainability practices in the project life cycle due to the lack of integration of enabling factors. SPM is basically a new concept that seeks to align project objectives with social, environmental and economic benefits. In this study, the moderating effect of sustainability performance measurement and the mediating effect of sustainable project planning and technological advancement were thoroughly examined. A survey-based methodology was adopted to collect responses from project management professionals involved in project-based organizations. A total of 162 valid responses were analyzed, which is considered adequate for Partial Least Squares Structural Equation Modeling (PLS-SEM), given its suitability for small to medium sample sizes and complex models. The proposed hypotheses were tested using PLS-SEM techniques. The results show that antecedents and enablers had a significant impact on SPM implementation. The mediating effects of sustainable project planning and Technological advancement were found to be significant. However, the moderating effect of sustainability performance measurement was insignificant. The research concluded that incorporating sustainability into project management requires a holistic framework that accounts for both antecedents and enablers as key drivers. It also provides theoretical and practical implications for project practitioners to incorporate sustainability across various project life-cycle stages to improve project outcomes, which aligns with SDG 12 (Responsible Consumption and Production).

Keywords: Sustainable Project Management, Sustainability Dimensions, Antecedents, Enablers, PLS-SEM.

1. INTRODUCTION

The concept of Project management is changing rapidly worldwide. In the past, the success of projects depended on scope, budget, and schedule. Whereas nowadays, long-term financial stability, increasing social inequality, and growing environmental concerns have totally changed this perception. Project management that considers the impacts of the environment, economy, and social equity is termed Sustainable Project Management (SPM). Despite the increasing importance of sustainability in the project management discipline, SPM has recently gained scholarly attention. SPM is an emerging school of thought in the project management literature [1]. Although the hypothetical case for SPM is robust and broadly accepted, its practical implementation remains a significant global challenge. SPM adaptation is particularly crucial, as emerging economies have fragile ecosystems, complex social dynamics, rapid industrialization, urbanization, infrastructure development, and limited resources [2]. Sustainability is still a new

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concept in Pakistan, and most studies indicate that a lack of awareness and interest, along with inadequate organizational capabilities, are major hindrances to sustainable practices. For successful SPM implementation, the antecedents and enablers are key factors. The antecedents include government regulations and laws, stakeholder's engagement, customers pressure, competitor pressure, market competitive-edge etc. whereas enablers include leadership commitment, project planning, organizational commitment, employee involvement, communication climate, team building, etc.

Pakistan is selected as the empirical context of this study due to its classification as an emerging economy characterized by rapid industrialization, urban expansion, and increasing infrastructure development. Despite these growth dynamics, the country faces significant sustainability challenges, including environmental degradation, resource constraints, and limited institutional capacity to integrate sustainability into project management practices. Furthermore, the adoption of SPM in Pakistan remains at an early stage, with limited empirical research examining the interplay of organizational and operational factors influencing its implementation. Therefore, Pakistan provides a relevant and insightful context to investigate the antecedents and enablers of SPM within emerging economies.

Some theoretical ideas that influenced project management include Institutional Theory, Resource-Based View (RBV), Complexity Theory, and Stakeholder Theory. Institutional theory emphasizes that organizational behavior is shaped not only by internal efficiency goals but also by external pressures from regulations, norms, cultural expectations, and industry standards. The theory encompasses coercive pressure (laws and regulations), normative pressure (professional norms and industry standards), or mimetic pressure (copying what successful peers do)[3]. Research shows that normative pressure and mimetic pressure have a significant impact on SPM implementation [3]. According to the Resource-Based View (RBV), a company's resources and capabilities are crucial for achieving long-term competitive advantage. SPM can help increase the likelihood of long-term project success. The unique and inimitable skills of SPM help companies to achieve better results [4]. Stakeholder theory emphasizes the importance of considering the diverse needs and interests of all project stakeholders, including customers, employees, local communities, suppliers, and government agencies. It is very important to consider stakeholder needs across all three dimensions: economic, environmental, and social [5]. Stakeholder Theory is central to operationalizing SPM because projects inherently affect multiple stakeholders, including communities, regulators, employees, customers, supply chains, and ecosystems. Complexity theory holds that traditional linear approaches are ineffective in dynamic, unpredictable environments. However, it suggests that project management strategies should be adaptive and flexible, especially in conflict-affected areas [6]. Projects, especially large-scale sustainable projects, involve multiple stakeholders, uncertain environments and dynamic challenges. Complexity Theory helps managers recognize that rigid planning may not always work, however the adaptive strategies can create significant impacts and making project outcomes unpredictable. The theoretical foundation of SPM is shown in Figure 1.

Shaukat et al. examined the relationship between SPM and Project Success (PS) highlighting that stakeholder engagement and team building did not have a significant impact on PS, suggesting other factors like effective communication and organizational culture that might induce a major improvement [7]. Rehman et al. explored the effectiveness of technology management processes in small and medium-sized businesses and the benefits for entrepreneurs [8]. Jianing et al. research highlighted that the policy and regulatory frameworks, infrastructure, human capital and socio-cultural factors are major barriers towards technological advancements. To rectify these issues, the author suggested strengthening to policy framework and increasing investment in research and development [9]. Omoloso et al. examined both internal and external drivers of social sustainability and emphasized the relevance of stakeholders and institutional theory [10]. Liaqat et al. investigated that SPM is positively associated with sustainable project success, with sustainable leadership serving as a moderating factor in this relationship. The research offers

valuable insights into the emerging trends of SPM and SPS and contributes to recent studies [4]. Hassan 2021 highlighted that innovation in sustainable development projects yields positive benefits by applying new strategies, developing new management practices, and increasing team commitment towards outcomes. The study also identifies challenges that cause hinderance towards sustainability practices such as resistance towards innovation and stakeholder requirements [11]. Summers & Smith recognized social equity and well-being as key drivers that can force changes in human well-being towards sustainability practices [12]. Al Mansoob et al. demonstrated that organizational culture has a positive effect on sustainability practices, and that there is a significant relationship between organizational culture implementation and sustainability outcomes [13]. Chow et al. examined the effect of sustainable project management on sustainable project planning and project success in manufacturing firms [14].

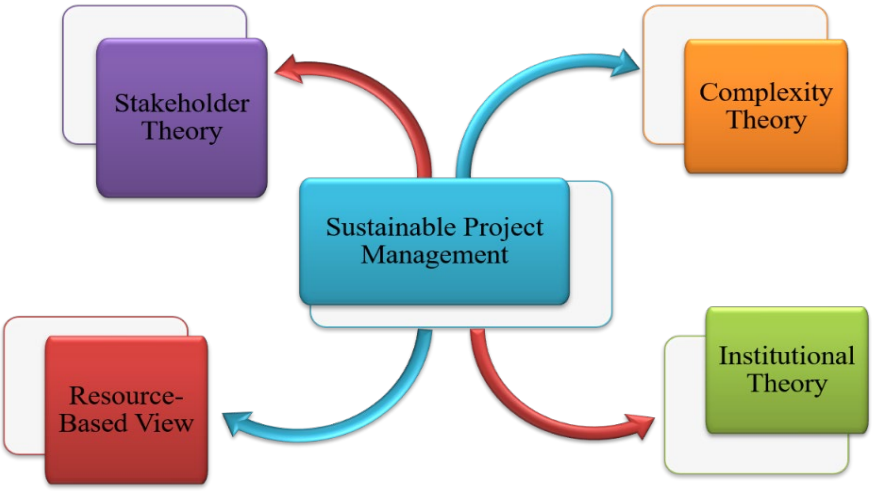

Figure 1: Theoretical Foundation of Sustainable Project Management.

1.1 Research Gap

Despite the growing global recognition and understanding of SPM, its effective implementation remains a significant challenge, particularly in emerging economies. The existing literature has addressed various aspects of sustainability, but a clear research gap persists in examining the interaction between the characteristics of specific organizations and their operational capabilities that influence SPM implementation. The existing literature reveals a lack of rigorous investigation into both the direct and indirect effects of key antecedents (social equity and well-being, organizational culture, and effective communication) and enablers (sustainable project planning, technological advancement, and performance measurement of sustainability). The mediating and moderating effects among these factors were not thoroughly examined in existing studies and it constrains the development of targeted strategies to enhance sustainability practices. The existing studies have investigated the impact of individual factors, such as institutional pressures, stakeholder involvement, or project planning, on SPM and have overlooked the complex, interrelated dynamics of antecedents and enablers.

In order to address the research gap, the integrated structural model was designed to examine the mediating and moderating roles of key factors on the SPM implementation. The study contributes by providing a holistic, empirically grounded explanation of how these factors interact and influence SPM implementation. Moreover, the research provides valuable conceptual guidance and practical insights for managers and policymakers committed to integrating sustainability into project management processes. The key factors identified from the literature for to research are shown in Figure 2.

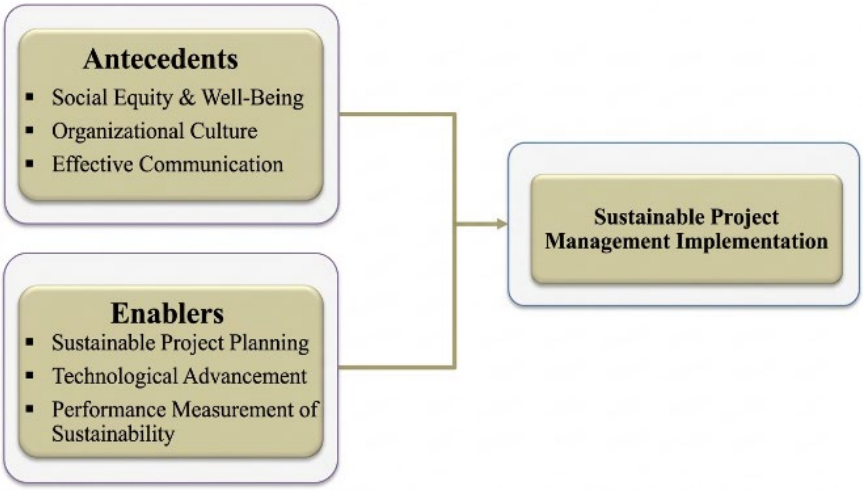

Figure 2: Conceptual framework of antecedents & enablers of SPM.

2. THEORETICAL FRAMEWORK AND HYPOTHESES DEVELOPMENT

2.1 Theoretical Framework

2.1.1 Sustainable Project Management (SPM)

SPM incorporates environmental, social, and economic aspects throughout the project lifecycle [15]. The integration of sustainability principles into traditional project management practices results to enhancing project outcomes and mitigating negative impacts. SPM provides a holistic framework of the Triple Bottom Line (TBL) that emphasizes three core dimensions: People, Planet, and Profit [16]. This approach promotes the projects to measure success not only in terms of financial gains but also by their social and environmental performance. A sustainable project seeks to minimize its carbon footprint (Planet), ensure fair labor practices (People), and maintain economic viability (Profit). The main components of SPM include Environmental Stewardship which aims to achieve sustainability through resource conservation, waste reduction, preventing pollution and biodiversity protection using sustainable materials, energy-efficient systems and effective waste management approaches [17]. Economic viability emphasizes achieving financial objectives while maintaining long-term economic stability and sustainable growth. It involves considering life-cycle costs, fostering local economies, and creating sustainable business models [18].

2.1.2 Social Equity and Well-Being (SE&WB)

Social equity and well-being are the social pillar of TBL and are considered a fundamental foundation for SPM. Social equality and prosperity significantly influence individuals and communities to in achieving sustainable outcomes [16]. SPM focuses on collective efforts of all stakeholders to generate positive outcomes while ensuring fair treatment, preventing discrimination and benefiting local communities [2]. Projects should deliver social values by addressing challenges primarily associated with large-scale projects, such as forced displacement and the lack of citizen participation in decision-making processes [19]. It aligns with the social aspect of sustainability, which aims to increase the value of human capital and achieve a positive impact on society. Modern project management must involve and consider all stakeholders beyond their economic interests and it is imperative to integrate ethical and socially responsible methodologies [5]. Project managers should comprehend and address the varied requirements of stakeholders to foster equitable relationships [5]. It entails advocating sound ethical principles and responsible conduct to addressing social concerns [20]. A significant challenge in this domain involves guaranteeing an equitable distribution of benefits between professionals and clients.

From the literature discussed earlier, it was concluded that organizations that neglect social equity eventually damage their reputations. In comparison, prioritization of SE&WB builds trust and secures a social license to operate, especially in developing economies.

2.1.3 Organizational Culture (OC)

A strong organizational culture reflects shared behaviors, underlying assumptions and deeply held beliefs that are pre-requisite for effective SPM implementation. A sustainability-oriented culture fosters a sense of community and strengthens employees' collective commitment to achieving sustainability objectives. A cohesive organizational culture represents values, norms, and behaviors across the organization that facilitate the adoption to sustainable practices and support the progressive development of project management capability [13, 21]. A positive organizational culture significantly improved employees' well-being and overall organizational performance. Research shows that a well-aligned organizational culture positively influences sustainable development. Integrating a sustainability-oriented culture within the organization results in the successful implementation of sustainable practices and the achievement to sustainable outcomes [13]. The integration of sustainability into projects is substantially influenced by management's disposition and leadership attributes. The leaders must foster a culture of sustainability to ensure that all employees develop an intrinsic understanding of environmental concerns [16]. The employee's reluctance to shift from traditional methods to sustainable practices is considered a significant barrier to the adoption of sustainable initiatives. This could be achieved by fostering an inclusive culture that encourages sustainability, promotes adaptability, and supports affordability [22].

2.1.4 Effective Communication (EC)

SPM implementation requires effective communication that fosters mutual understanding among employees and stakeholders while supporting sustainable development practices. Stakeholder management plans and comprehensive communication are clearly relayed to all stakeholders to understand the objectives and the implementation of sustainability initiatives. The organizations that manage the diverse needs and expectations of multiple stakeholders require effective management [23]. The employees adopt sustainable practices and consistently share information related to sustainability objectives, practices, and outcomes [5]. Stakeholders sharing innovative ideas and exchanging knowledge led to better collaboration and greater transparency. Management information systems are instrumental in acquiring and distributing information that supports corporate strategies and environmental sustainability objectives. In contrast, ineffective communication often becomes a significant barrier to achieving project success [24].

2.1.5 Sustainable Project Planning (SPP)

Sustainable Project Planning (SPP) plays a vital role in SPM because it ensures that project requirements are followed throughout project execution to achieve sustainable environmental outcomes. The approach maintains sustainability throughout all project stages, from project initiation to execution, and goes beyond conventional project management methods [14]. Implementing sustainability principles into the initial project development and planning process enables organizations to evaluate all potential effects throughout the project life cycle, including environmental, social, and economic impacts [25]. To achieve balanced outcomes, environmental, social, and economic factors should be evaluated throughout the entire development process, ensuring present requirements while protecting the interests of future generations. SPP emphasizes the importance of aligning operational processes, risk management, and control processes [14]. Effective planning and proactive risk management help in minimizing sustainability-related project risks [26]. Therefore, the inclusion of stakeholders' perspectives is essential and must be considered during risk identification and assessment processes.

2.1.6 Technological Advancement (TA)

SPM uses advanced technological tools that enable project managers to achieve sustainable project success. Digitalization has transformed project management by enabling better communication channels, more efficient resource allocation, and accelerating project progress to achieve outcomes within the defined timeframe. Digital tools enable organizations to adopt sustainability principles throughout their operations by following circular-economy standards. Modern tools and technologies support sustainability practices, boost efficiency and overall impact, and make it easier to monitor and report on project progress [27]. In project management, computer-based systems facilitate an in-depth understanding of sustainability-related challenges and assist in identifying the most optimized solutions. The integrated frameworks with feedback mechanisms enable project teams to assess the long-term sustainability of decisions and actions while ensuring continuous improvement throughout the project life cycle.

2.1.7 Performance Measurement of Sustainability (PMS)

The evaluation process requires a sustainability performance assessment of project managers to determine the effectiveness of the methodologies they adopt. The evaluation includes examining the economic, social and environmental performance. The proposed model establishes evaluation criteria that use a fuzzy-based method to assess the project's sustainability maturity in light of existing uncertainties. This approach uses fundamental knowledge areas of the Project Management Body of Knowledge (PMBOK) because it includes integration, scope, schedule, cost, quality, personnel, communication, risk and procurement [28]. Researchers have classified Corporate Sustainability Performance (CSP) assessment methods into four categories: standalone indicators, indicator frameworks, the Sustainability Balanced Scorecard (SBSC), and Sustainability Performance Measurement Systems (SPMS). SPMS represent the optimal solution for assessing complex comprehensive indicators, yet their implementation remains challenging [29].

2.2 Hypotheses Development

The hypothesized relationships among antecedents and enablers of SPM implementation are shown in Table 1. Figure 3(a) shows the hypothesized direct relationships among the constructs, while Figure 3(b) presents the mediating & moderating relationships in the SPM framework. Based on existing studies, the theoretical justifications for the proposed hypothesized relationships are presented in Table 2.

Table 1: Summary of hypothesized relationships among research constructs.

Factors	Abb	Relationships	Hypothesis
Social Equity & Well-Being	SE&WB	SE&WB -> SPM	H1: Direct Effect
		SE&WB -> SPP ->SPM	H2: Indirect Effect
Organizational Culture	OC	OC -> SPM	H3: Direct Effect
		OC -> TA ->SPM	H4: Indirect Effect
Effective Communication	EC	EC -> SPM	H5: Direct Effect
		EC -> PMS ->SPM	H6: Indirect Effect
Sustainable Project Planning	SPP	SPP -> SPM	H7: Direct Effect
Technological Advancement	TA	TA -> SPM	H8: Direct Effect
Performance Measurement of Sustainability	PMS	PMS -> SPM	H9: Direct Effect
Sustainable Project Management	SPM	-	-

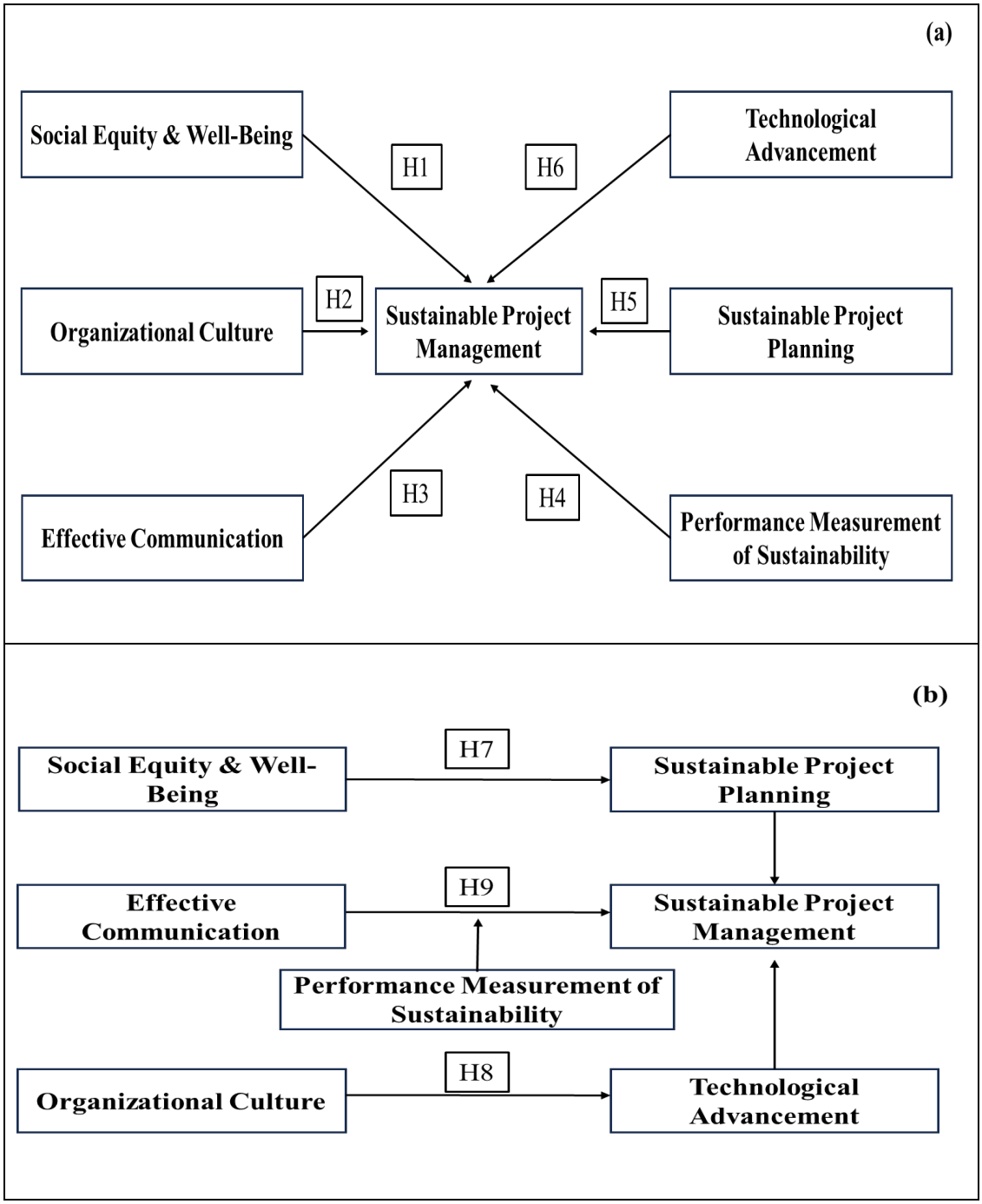

Figure 3: (a) Direct hypothesized relationships among the constructs, (b) Mediating & Moderating relationships in the SPM framework.

Two research questions (RQ1 & RQ2) were derived based on the above discussion to be answered in this study. RQ1: Examine the direct effect of key antecedents (SE&WB, OC, EC) and key enablers (SPP, TA, PMS) on SPM implementation. RQ2: Examine the indirect (mediating and moderating) effect of key antecedents and enablers on SPM implementation.

Table 2: Summary of Hypotheses with Corresponding Theoretical Justifications.

Hypothesis	Justification
H1: SE&WB -> SPM	Social equity and well-being are expected to enhance SPM implementation by promoting stakeholder inclusiveness, social responsibility, and long-term project sustainability.
H2: SE&WB -> SPP -> SPM (Mediation)	Social equity and well-being are likely to improve sustainable project planning, which in turn facilitates the effective implementation of SPM practices.
H3: OC -> SPM	Organizational culture is hypothesized to influence SPM positively as sustainability-oriented values and norms foster commitment toward sustainable practices.
H4: OC -> TA -> SPM (Mediation)	A supportive organizational culture encourages technological advancement, which enhances the efficiency and effectiveness of SPM implementation.
H5: EC -> SPM	Effective communication is expected to improve SPM by aligning stakeholder expectations and facilitating the integration of sustainability objectives.
H6: EC -> PMS -> SPM (Moderation)	Effective communication can enhance the use of sustainability performance metrics, thereby influencing the effectiveness of SPM implementation.

3. METHODOLOGY

The systematic approach is adopted to analyze the direct and combined effects of antecedents and enablers on SPM implementation are analyzed using the systematic approach shown in Figure 4. A quantitative cross-sectional survey is conducted to test the research hypothesis for empirical validation. The project management professionals were targeted from multiple project-based organizations like R&D, IT, construction, and telecommunication. The primary research instrument in this study is a self-reported questionnaire. The survey used Google Forms for data collection, and the survey links were shared through professional networks, including alumni groups, WhatsApp, email, and other platforms. Purposive sampling is employed to target project management professionals. The selection criteria included individuals currently working in project-based organizations, having at least one year of professional experience in project management or related roles, and direct involvement in project planning, execution, or monitoring activities. This approach ensured that respondents possessed adequate knowledge and practical exposure to sustainability practices within project environments, thereby minimizing potential selection bias and enhancing the reliability of the collected data.

The data were collected from professionals using a five-point Likert-scale questionnaire. The measurement items for each construct were adapted from established studies to ensure content validity and reliability. Specifically, items for Sustainable Project Management (SPM) and Sustainable Project Planning (SPP) were adapted from Chow et al. [14], while Social Equity and Well-Being (SE&WB) items were derived from Ullah et al. [2] and Summers and Smith [9]. Organizational Culture (OC) items were adapted from Al Mansoob et al. [10], and Effective Communication (EC) items were based on Shah et al. [21] and Misopoulos et al. [20]. Technological Advancement (TA) items were adapted from Rusch et al. [23], whereas Performance Measurement of Sustainability (PMS) items were derived from Siew et al. [24] and Damtoft et al. [25]. All items were measured using a five-point Likert scale ranging from “strongly disagree” to “strongly agree.”

The ‘SPM construct’ is dependent variable and consists of 10 items. However, all other are independent variables and each consists of 5 items. All items for each construct were selected based on relevant literature related to sustainability aspects in project management. The sample

size of 162 respondents was obtained from different organizations. Sekaran and Bougie [30] found that sample sizes of 30 to 500 are generally sufficient for most behavioral studies. The Partial Least Squares Structural Equation Modeling (PLS-SEM) technique was applied using SmartPLS-4 software for data analysis. To ensure the validity of the survey questionnaire, a pilot test was conducted with a sample size of n=20 to assess the validity of the collected responses.

The quantitative data analysis employed Structural Equation Modeling to determine the reliability and validity, the coefficient of determination (R^2), and the statistical significance of hypothesized paths. The analysis was conducted in two stages. In the first stage, the reliability and validity of the measurement model were tested. The criteria for validating the measurement model were to evaluate the model's reliability and validity. Measurement model testing includes item reliability (factor loadings), internal consistency reliability (Cronbach's alpha and composite reliability), convergent validity (Average Variance Extracted), and discriminant validity (Fornell-Larcker, HTMT, and Cross Loadings). In second stage, after reliability and validity checks of the measurement model, the structural model was used to assess the research hypotheses. In a structural model, R^2 measures the proportion of variance in an endogenous (dependent) variable explained by exogenous (independent) variables. The evaluation of the structural model involves examining the coefficient of determination (R^2) and the statistical significance of hypothesized paths. Falk and Miller recommended that R^2 values should be equal to or greater than 0.10 for the variance explained of a particular endogenous construct to be deemed adequate [31].

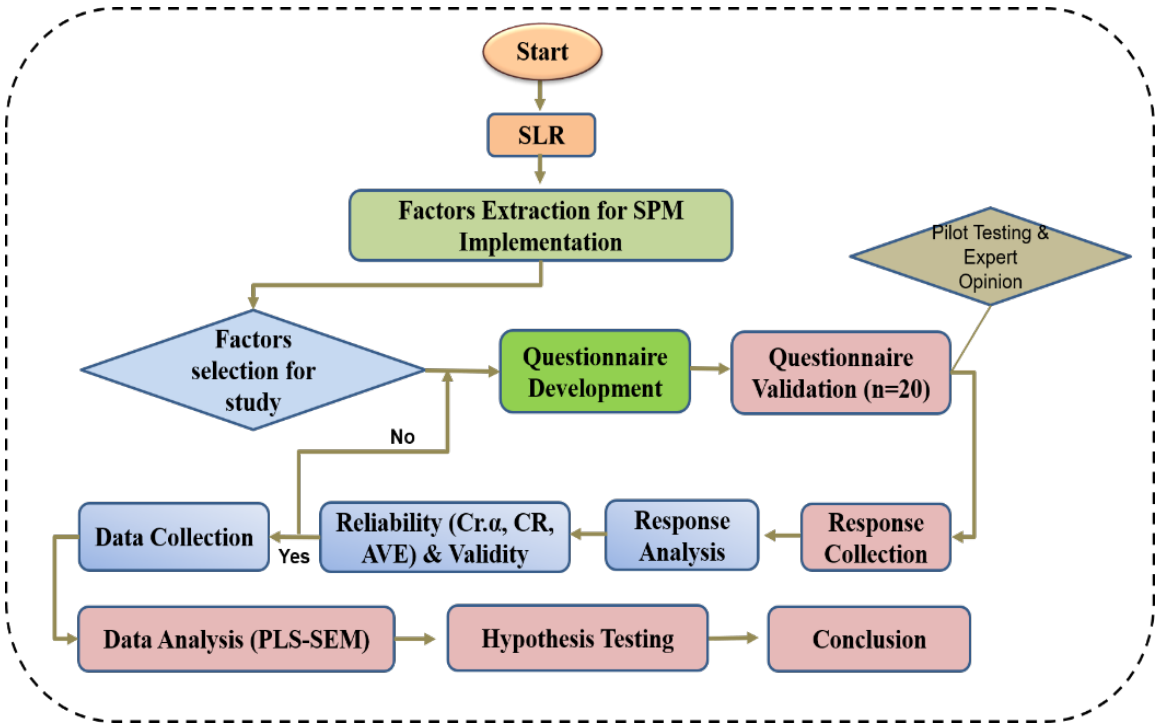

Figure 4: Research methodology and analysis process.

4. RESULTS AND DISCUSSION

4.1 Measurement Model Analysis

The measurement model was evaluated by assessing the reliability and validity of each construct. Figure 5 presents a research framework for measurement model analysis.

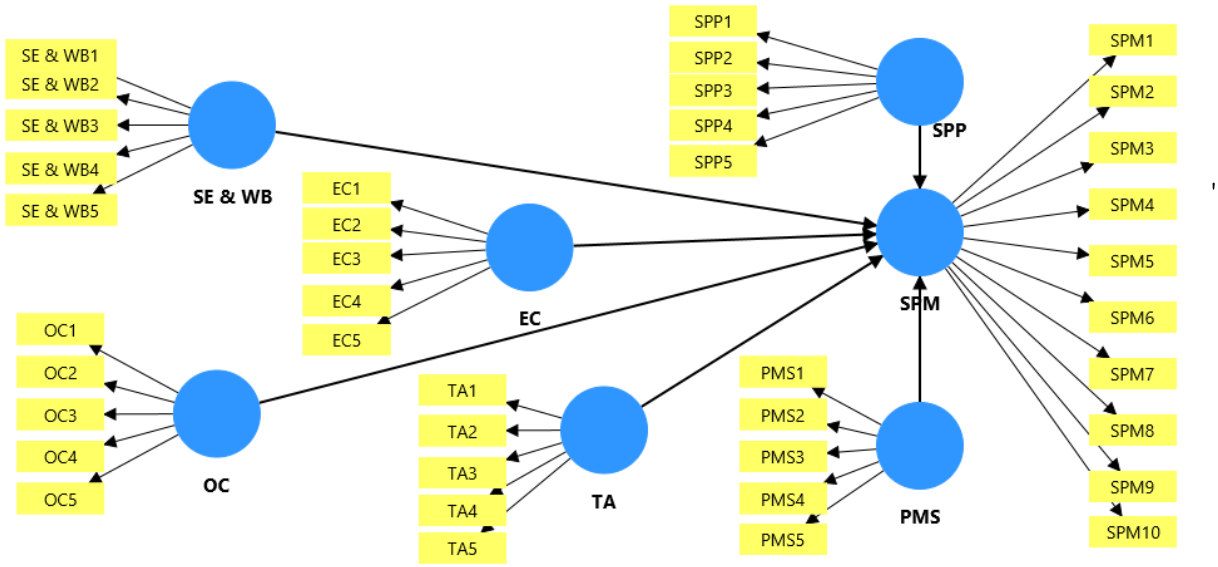

Figure 5: Measurement model for construct reliability and validity.

In the measurement model analysis, some items were removed that had low factor loadings (<0.700) and caused Average Variance Extracted (AVE) to be below 0.500 [32]. Measurement model assessment includes outer loadings, Composite Reliability (CR), and AVE; the square roots of the AVE values indicate that composite reliability and Cronbach's alpha values for all constructs are above 0.70 and below 0.9, meeting the recommended criteria [33]. In establishing the measurement model, two items of SPM, i.e., SPM3 and SPM8, were removed due to low factor loadings. Some items of SPM, i.e., SPM4, SPM5, and SPM6, were removed, causing the AVE to fall below 0.500. Furthermore, to establish discriminant validity, two items of OC i.e., OC2 and OC4, one items of EC i.e EC5, one items of SE&WB i.e. SE&WB5, one items of TA i.e. TA3, two items of PMS i.e. PMS1, PMS5 and two items of SPP i.e. SPP1 and SPP5 were removed. The graphical representation of refined measurement model after item purification is shown in Figure 6. The results of reliability and validity analysis along with items loadings are presented in Table 3.

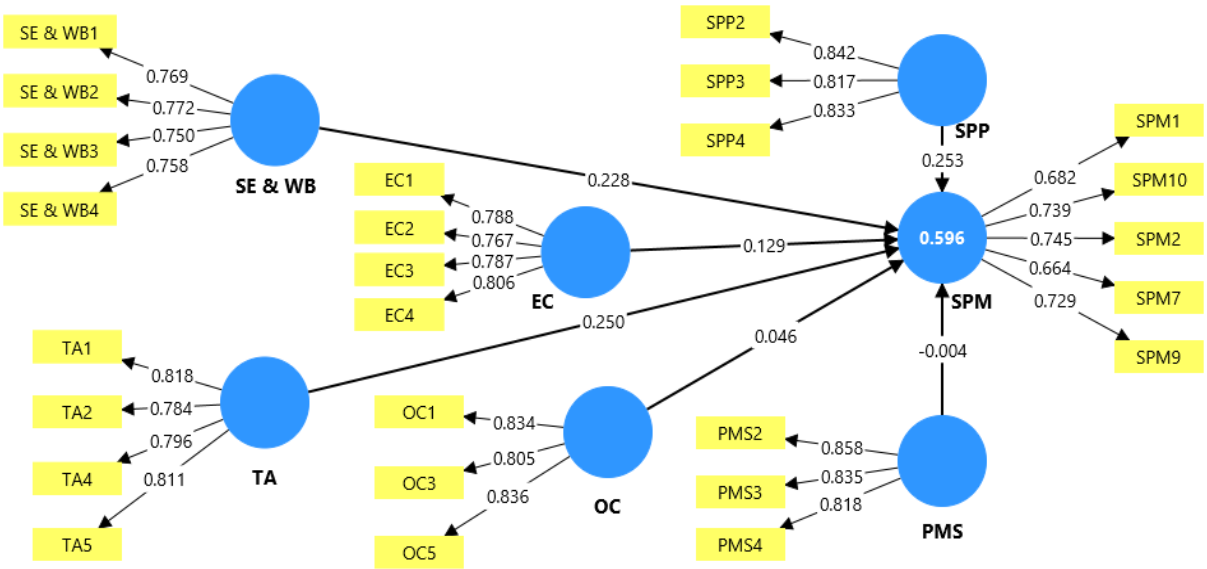

Figure 6: Graphical representation of refined measurement model.

Table 3: Factor Loading, reliability, and validity statistics.

Items	Loading	Cronbach's alpha	CR	AVE
Sustainable Project Management	-	0.757	0.837	0.507
SPM1	0.682			
SPM2	0.745			
SPM7	0.664			
SPM9	0.729			
SPM10	0.739			
Organizational Culture	-	0.767	0.865	0.681
OC1	0.834			
OC3	0.805			
OC5	0.836			
Social Equity & Well-Being	-	0.761	0.847	0.581
SE&WB1	0.769			
SE&WB2	0.772			
SE&WB3	0.75			
SE&WB4	0.758			
Effective Communication	-	0.795	0.867	0.620
EC1	0.788			
EC2	0.767			
EC3	0.787			
EC4	0.806			
Sustainable Project Planning	-	0.776	0.870	0.690
SPP2	0.842			
SPP3	0.817			
SPP4	0.833			
Technological Advancements	-	0.816	0.879	0.644
TA1	0.818			
TA2	0.784			
TA4	0.796			
TA5	0.811			
Performance Measurement of Sustainability	-	0.788	0.876	0.701
PMS2	0.858			
PMS3	0.835			
PMS4	0.818			

Although a few indicator loadings (e.g., SPM1 = 0.682 and SPM7 = 0.664) were slightly below the recommended threshold of 0.700, they were retained as their values exceeded the acceptable minimum level of 0.60 for exploratory research. Moreover, the Average Variance Extracted (AVE) for the construct remained above the 0.50 threshold, indicating adequate convergent validity. Therefore, retaining these items did not compromise the reliability and validity of the measurement model.

Discriminant validity was assessed using the Fornell-Larcker criterion and Heterotrait-Monotrait Ratio (HTMT) methods. The results revealed that the square roots of each construct's AVEs were higher than their correlations with other constructs, and all HTMT values were below the necessary cutoff point of 0.85, which confirms discriminant validity. The measurement model was assessed through reliability and validity tests, and the results confirm that the research model provides a good overall fit to perform structural model analysis in hypothesis testing.

4.2 Structural Model Analysis

The structural model assessment includes determining the coefficient of determination (R^2) and testing the statistical significance of proposed hypothesized relationships. Falk and Miller (1992)

established the requirement that R^2 values must be equal to 0.10 or greater to consider the explained variance of an endogenous construct as sufficient [31]. Hypotheses were tested using bootstrapping procedure. The graphical representation of structural model assessment using SEM analysis is shown in Figure 7. The results of structural model assessment after bootstrapping are shown in Table 4.

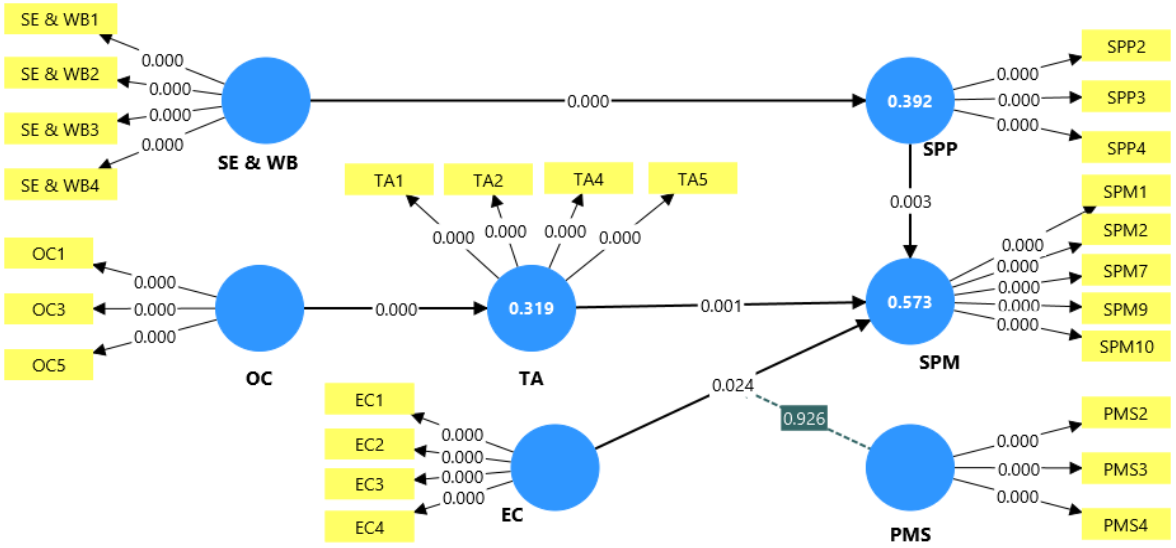

Figure 7: Structural Model representing validated paths in the SEM analysis.

Table 4: Structural model analysis results.

Total Direct Effect				
Relationships	**Path Coefficient**	**Standard Deviation**	**T-statistics**	**P values**
SE & WB -> SPM	0.194	0.069	2.822	0.005
SE & WB -> SPP	0.626	0.055	11.313	0.000
SPP -> SPM	0.31	0.102	3.022	0.003
OC -> SPM	0.185	0.059	3.15	0.002
OC -> TA	0.564	0.069	8.204	0.000
TA -> SPM	0.328	0.095	3.45	0.001
EC -> SPM	0.197	0.087	2.265	0.024
PMS -> SPM	0.025	0.086	**0.297**	**0.767**
Indirect Effect				
Relationships	**Path Coefficient**	**Standard Deviation**	**T-statistics**	**P values**
SE & WB -> SPP ->SPM	0.194	0.069	2.822	0.005
PMS x EC ->SPM	-0.004	0.045	**0.093**	**0.926**
OC -> TA ->SPM	0.185	0.059	3.15	0.002

The results show that most relationships are statistically significant, as their t-values exceed 1.96 and their p-values are below 0.05 [34]. Significant effects include SE&WB -> SPM (t = 2.822, p = 0.005), OC-> SPM (t = 3.150, p = 0.002), TA -> SPM (t = 3.450, p = 0.001), SPP -> SPM (t = 3.022, p = 0.003), EC -> SPM (t = 2.265, p = 0.024) and the mediation paths SE&WB -> SPP -> SPM (t = 2.822, p = 0.005) and OC -> TA -> SPM (t = 3.150, p = 0.002). In contrast, PMS -> SPM (t = 0.297, p = 0.767) and the moderating effect PMS × EC -> SPM (t = 0.093, p = 0.926) were found to be statistically insignificant.

4.3 Discussion

The study results demonstrated that both antecedents and enablers had a major effect on SPM adaptation throughout organizations in Pakistan. Social Equity and Well-being (SE&WB), Organizational Culture (OC), and Effective Communication (EC) have a significant impact on SPM implementation. The fundamental principles of Stakeholder Theory [35] and the Resource-Based View [36] support the results, as both theories demonstrate that organizational values and inclusive practices, together with strong internal communication, function as strategic assets to achieve sustainability goals. The results show a significant effect of SE&WB, which correlates with the findings of Ullah et al. [2] and Misopoulos et al.[5]. The studies demonstrate that fair treatment, social justice and community involvement activities create a foundation that establishes project legitimacy and ensures long-term success. The results established a strong connection between OC and SPM, as reported by Al Mansoob et al. [13], and demonstrate that sustainability-focused cultures lead to improved employee commitment and organizational adaptability. The research of Shah et al. [24] shows that effective communication strengthens the coordination among various stakeholders and brings them together to achieve sustainable development goals.

Among the enablers, SPP and TA indicate a significant impact on SPM implementation. The results align with the findings of Chow et al. [14] and Rusch et al. [27], showing that project planning needs to apply sustainability principles while using digital technologies to achieve better operational efficiency and environmental performance. On the other hand, Performance Measurement of Sustainability (PMS) shows no measurable effect because organizations fail to properly implement sustainability metrics for project decision-making. In contrast, the insignificant effect of Performance Measurement of Sustainability (PMS) suggests that sustainability metrics are not yet effectively embedded in project-level decision-making within the studied context. One possible explanation is the lack of standardized and widely accepted sustainability measurement frameworks in emerging economies such as Pakistan, which limits their practical applicability. Additionally, organizations may adopt sustainability metrics primarily for compliance or reporting purposes rather than for strategic integration into project management processes. This “check-box” approach reduces the influence of PMS on actual project execution and outcomes. Furthermore, limited technical expertise, inadequate training, and the absence of robust monitoring systems may hinder the effective utilization of sustainability performance indicators. These findings indicate that while PMS is conceptually important, its practical implementation remains underdeveloped, thereby diminishing its impact on SPM.

The results of the study align with those of Damtoft et al. [29], who demonstrated that the practical implementation of sustainability metrics is a significant challenge. The mediation analysis shows that SPP serves as a mediator between SE&WB and SPM while TA serve as a mediator linking OC to SPM. The research demonstrates that organizations need efficient technological solutions to achieve sustainability targets through their social and cultural activities (Soomro et al., [37] and Rehman et al., [8]). The study highlights that PMS has an insignificant moderating effect on the relationship between EC and SPM, because the performance metrics used by organizations currently focus on compliance requirements rather than strategic alignment.

5. CONCLUSION

The research concluded that successful implementation of SPM depends on the combined effects of key antecedents like SE&WB, OC and EC, along with crucial enablers such as SPP, TA, and PMS. The SEM results show that both antecedents and enablers boost the effectiveness of SPM implementation because SPP and TA act as strong mediators, transforming social and cultural factors into measurable sustainability outcomes. The study found that moderating role of PMS had no significant impact because sustainability metrics remain unlinked within project decision-

making processes in developing countries. The internal organizational elements of culture, communication climate and social equity have a stronger effect on achieving sustainability than external regulatory or institutional guidelines. The research shows that organizations should incorporate sustainable practices as fundamental values rather than treating them as mere compliance standards. The research presents an empirical model that verifies the discrepancy between theoretical sustainability frameworks and their actual implementation to provide valuable insights for both project managers and policymakers. Future research should also explore the impact of emerging technologies like AI and digital project tools on sustainability outcomes. Expanding data collection across more sectors and regions using probability sampling would enhance the validity and generalizability of results.

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REFERENCES

[1] Silvius, G. Sustainability as a new school of thought in project management. Journal of Cleaner Production, vol 166 (2017) pp.1479-1493. https://doi.org/10.1016/j.jclepro.2017.08.121

[2] Ullah, M., et al. A structural model for the antecedents of sustainable project management in Pakistan. Sustainability, vol 12, issue 19 (2020) pp.8013. https://doi.org/10.3390/su12198013

[3] Renukappa, S., Suresh, S., Sarrakh, R. External drivers for embedding sustainability practices within the Qatar oil and gas industry: An institutional theory perspective. (2020).

[4] Liaqat, M. M. Z., et al. Moderating role of sustainable leadership on the relationship between sustainable project management and success: An empirical test in public sector development program. Sage Open, vol 14, issue 2 (2024) pp.21582440241253571. https://doi.org/10.1177/21582440241253571

[5] Misopoulos, F., Michaelides, R., Salehuddin, M. A., Manthou, V., Michaelides, Z. Addressing organisational pressures as drivers towards sustainability in manufacturing projects and project management methodologies. Sustainability, vol 10, issue 6 (2018) pp.2098. https://doi.org/10.3390/su10062098

[6] Alsohybe, N., Mohmed, R. H. M. Leveraging contemporary project management techniques and technology for sustainable telecommunications advancement in Yemen. مجلة جامعة صنعاء للعلوم التطبيقية والتكنولوجيا, vol 2, issue 5 (2024) pp.453-466. https://doi.org/10.59628/jast.v2i5.1214

[7] Shaukat, M. B., Latif, K. F., Sajjad, A., Eweje, G. Revisiting the relationship between sustainable project management and project success: The moderating role of stakeholder engagement and team building. Sustainable Development, vol 30, issue 1 (2022) pp.58-75. https://doi.org/10.1002/sd.2228

[8] Rehman, K., Lim, K. B., Yeo, S. F., Saif, N., Ameeq, M. The nexus of entrepreneurial leadership and entrepreneurial success with a mediation of technology management processes: From the perspective of the small-and medium-sized enterprises of Khyber Pakhtunkhwa, Pakistan. Sustainability, vol 17, issue 3 (2025) pp.882. https://doi.org/10.3390/su17030882

[9] Jianing, P., Bai, K., Solangi, Y. A., Magazzino, C., Ayaz, K. Examining the role of digitalization and technological innovation in promoting sustainable natural resource exploitation. Resources Policy, vol 92, issue C (2024). https://doi.org/10.1016/j.resourpol.2024.105036

[10] Omoloso, O., Mortimer, K., Wise, W. R. The influence of sustainability drivers on the implementation of social sustainability practices in the leather industry. Cleaner Production Letters, vol 6 (2024) pp.100051. https://doi.org/10.1016/j.clpl.2023.100051
[11] Hassan, A. The antecedents and challenges of innovation in sustainable development projects: Systematic review. Environmental Management and Sustainable Development, vol 10, issue 1 (2021) pp.76-91. https://doi.org/10.5296/emsd.v10i1.18329
[12] Summers, J. K., Smith, L. M. The role of social and intergenerational equity in making changes in human well-being sustainable. Ambio, vol 43, issue 6 (2014) pp.718-728. https://doi.org/10.1007/s13280-013-0483-6
[13] Al Mansoob, M. N., Al Qubati, A., Ekowati, D. The role of organizational culture in promoting sustainability practices in educational organizations. RSF Conference Series: Business, Management and Social Sciences, vol 3, issue 3 (2023) pp.46. https://doi.org/10.31098/bmss.v3i3.690
[14] Chow, T. C., Zailani, S., Rahman, M. K., Qiannan, Z., Bhuiyan, M. A., Patwary, A. K. Impact of sustainable project management on project plan and project success of the manufacturing firm: Structural model assessment. PLOS One, vol 16, issue 11 (2021) pp.e0259819. https://doi.org/10.1371/journal.pone.0259819
[15] Train, K. Sustainable project management. (2025). https://www.knowledgetrain.co.uk/project-management/sustainable-project-management?srsltid=AfmBOoqEIeIta9fjCAVMxBdc5C3cOwshZ65I2-nN8UoghQgacZpF0kVk
[16] Orieno, O. H., Ndubuisi, N. L., Eyo-Udo, N. L., Ilojianya, V. I., Biu, P. W. Sustainability in project management: A comprehensive review. World Journal of Advanced Research and Reviews, vol 21, issue 1 (2024) pp.656-677. https://doi.org/10.30574/wjarr.2024.21.1.0060
[17] Hussain, B., Naqvi, S. A. A., Balsalobre-Lorente, D. Green building technology and sustainable construction: The case of Pakistan. Journal of Urban Technology, vol 32, issue 1 (2025) pp.77-101. https://doi.org/10.1080/10630732.2024.2405946
[18] Israr, S. M., Islam, A. Good governance and sustainability: A case study from Pakistan. The International Journal of Health Planning and Management, vol 21, issue 4 (2006) pp.313-325. https://doi.org/10.1002/hpm.852
[19] Ferahtia, A. Surface water quality assessment in semi-arid region (El Hodna watershed, Algeria) based on Water Quality Index (WQI). (2021). https://doi.org/10.24193/subbchem.2021.1.10
[20] Moczydłowska, J., Sadkowska, J., Żelazko, B., Ciocoiu, C. N., Stawicka, E. Understanding risk culture in the context of a sustainable project: A preliminary study. Sustainability, vol 15, issue 6 (2023) pp.5302. https://doi.org/10.3390/su15065302
[21] Khadri, I. J. The challenge of implementing corporate sustainability: The case of Swedish energy industry. (2018).
[22] Ohiomah, I., Aigbavboa, C., Thwala, W. An assessment on the drivers and obstacles of sustainable project management in South Africa: A case study of Johannesburg. IOP Conference Series: Materials Science and Engineering, vol 640, issue 1 (2019) pp.012022. https://doi.org/10.1088/1757-899X/640/1/012022
[23] Afif, K., Rebolledo, C., Roy, J. Drivers, barriers and performance outcomes of sustainable packaging: A systematic literature review. British Food Journal, vol 124, issue 3 (2022) pp.915-935. https://doi.org/10.1108/BFJ-02-2021-0150
[24] Shah, F. H., Bhatti, O. S., Ahmed, S. Project management practices in construction projects and their roles in achieving sustainability-A comprehensive review. Engineering Proceedings, vol 44, issue 1 (2023) pp.2. https://doi.org/10.3390/engproc2023044002
[25] Wu, S.-W., Yan, Y., Pan, J., Wu, K.-S. Antecedents and consequences of sustainable project management: Evidence from the construction industry in China. Buildings, vol 13, issue 9 (2023) pp.2216. https://doi.org/10.3390/buildings13092216
[26] Silvius, A., Schipper, R. P. Sustainability in project management: A literature review and impact analysis. Social Business, vol 4, issue 1 (2014) pp.63-96. https://doi.org/10.1362/204440814X13948909253866

[27] Rusch, M., Schöggl, J. P., Baumgartner, R. J. Application of digital technologies for sustainable product management in a circular economy: A review. Business Strategy and the Environment, vol 32, issue 3 (2023) pp.1159-1174. https://doi.org/10.1002/bse.3099
[28] Siew, R. Y., Balatbat, M. C., Carmichael, D. G. Measuring project sustainability maturity level-a fuzzy-based approach. International Journal of Sustainable Development, vol 19, issue 1 (2016) pp.76-100. https://doi.org/10.1504/IJSD.2016.073680
[29] Damtoft, N. F., van Liempd, D., Lueg, R. Sustainability performance measurement-a framework for context-specific applications. Journal of Global Responsibility, vol 16, issue 1 (2025) pp.162-201. https://doi.org/10.1108/JGR-05-2023-0082
[30] Sekaran, U., Bougie, R. Research methods for business: A skill building approach. John Wiley & Sons (2016).
[31] Falk, R. F., Miller, N. B. A primer for soft modeling. University of Akron Press (1992).
[32] Gefen, D., Straub, D. A practical guide to factorial validity using PLS-Graph: Tutorial and annotated example. Communications of the Association for Information Systems, vol 16, issue 1 (2005) pp.5. https://doi.org/10.17705/1CAIS.01605
[33] Sarstedt, M., Ringle, C. M., Cheah, J.-H., Ting, H., Moisescu, O. I., Radomir, L. Structural model robustness checks in PLS-SEM. Tourism Economics, vol 26, issue 4 (2020) pp.531-554. https://doi.org/10.1177/1354816618823921
[34] Hair, J. F. A primer on partial least squares structural equation modeling (PLS-SEM). Sage (2014). https://doi.org/10.1108/EBR-10-2013-0128
[35] Freeman, R. E. Strategic management: A stakeholder approach. Cambridge University Press (2010). https://doi.org/10.1017/CBO9781139192675
[36] Barney, J. Firm resources and sustained competitive advantage. Journal of Management, vol 17, issue 1 (1991) pp.99-120. https://doi.org/10.1177/014920639101700108
[37] Soomro, R. B., et al. The adoption of digital technologies by small and medium-sized enterprises for sustainability and value creation in Pakistan: The application of a two-staged hybrid SEM-ANN approach. Sustainability, vol 16, issue 17 (2024) pp.7351. https://doi.org/10.3390/su16177351

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