



Linking Sustainable Project Management to Project Success: The Roles of Modern Construction Practices and Sustainable Leadership in Private Projects

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ABSTRACT

This study investigates the influence of Sustainable Project Management (SPM) on the success of private construction projects in Pakistan, with Modern Methods of Construction (MMC) as a mediating variable and Sustainable Leadership (SL) as a moderating factor. A quantitative research design was adopted using a structured questionnaire distributed to professionals from the private construction sector, yielding 250 valid responses. Data were analyzed through SPSS and Hayes' PROCESS macro to test direct, mediating, and moderating relationships. The results reveal that SPM has a significant positive impact on project success. Moreover, MMC partially mediates the relationship, indicating that adoption of innovative construction methods strengthens the effect of SPM. Additionally, SL was found to positively moderate both the direct and indirect paths, suggesting that strong leadership enhances the role of SPM in achieving successful project outcomes. The study contributes to project management literature by integrating sustainability and innovation perspectives while offering practical guidance for project managers and policymakers in the construction sector.



Introduction

The construction industry is a cornerstone of economic growth, contributing significantly to GDP, employment, and urbanization while shaping the built environment that affects quality of life (Doloi, 2013; Loosemore, 2015). Despite its importance, the industry is widely recognized for chronic inefficiencies, including cost overruns, delays, and high resource consumption. These issues have triggered a global demand for sustainable and innovative project management practices aligned with environmental, social, and economic objectives (Martens & Carvalho, 2016).

In Pakistan, the private construction sector drives urban expansion and employment but struggles with rework, weak leadership, and slow adoption of sustainability principles (Maqbool et al., 2023). Such challenges highlight the need for strategies that enhance project success while embedding sustainability. Sustainable Project Management (SPM), rooted in the Triple Bottom Line (TBL) and supported by the Resource-Based View (RBV), extends traditional project management by integrating environmental, social, and economic dimensions through stakeholder engagement, innovation, and knowledge management (Silvius & Schipper, 2014). However, empirical evidence of SPM's role in Pakistan remains limited.

Modern Methods of Construction (MMC) including BIM, prefabrication, and digital tools are acknowledged across the literature as catalysts for enhancing efficiency, fostering collaborative behaviours, and advancing environmental sustainability (Gao et al., 2019). Yet empirical uptake in the Pakistani context remains suboptimal, constrained by resource limitations and reluctance to embrace innovative practices (Maqbool et al., 2023). Concurrently, frameworks defined by Sustainable Leadership (SL) delineated by robust ethical principles, forward-oriented vision, and broad stakeholder engagement are imperative for institutionalising sustainability imperatives and accelerating the penetration of MMC. Previous empirical analyses substantiate the claim that leadership behaviour exerts a significant moderating effect on project outcomes (Ling et al., 2009; Müller et al., 2012).

Although Sustainable Project Management (SPM), Modern Methods of Construction (MMC), and Sustainable Leadership are each well recognized, there is limited research that examines how these factors work together. This study responds to the identified gap by evaluating the direct relationship between SPM and project success, establishing MMC as a mediating conduit, and recognising SL as a moderating variable within the Pakistani private construction sector.

Problem Statement

The private construction industry in Pakistan plays an essential role in economic progress, yet it struggles with frequent cost increases, extended timelines, and variable quality (Maqbool et al., 2023; Asghar et al., 2024; Shabbir, 2025). These persistent maladies derive in substantial part from longstanding dependence on traditional project management paradigms, minimal uptake of contemporary construction technologies, and a lack of decisive executive commitment to sustainable practices (Silvius & Schipper, 2025). The resultant inefficiencies dilute project efficacy and curtail the sector's capacity to meaningfully advance the country's sustainable development agenda.

Although Sustainable Project Management (SPM) furnishes a coherent framework for the simultaneous consideration of economic, social, and ecological objectives throughout the project lifecycle, empirical uptake in the Pakistani context remains limited. Concurrently, Modern Methods of Construction (MMC) notably Building Information Modelling (BIM), , and off-site prefabrication have delivered demonstrably higher productivity and sustainability in a range of international environments; yet they continue to be marginally applied within the country as a result of restrictive financial structures, insufficient technical expertise, and deeply entrenched cultural practices (Goodier & Gibb, 2007; Gao et al., 2019). Moreover, while extant literature identifies executive leadership as an antecedent of superior project results (Müller et al., 2012), the congruent influence of a Sustainability Leadership (SL) construct on amplifying the effectiveness of SPM and the deployment of MMC within Pakistan's private construction context remains under-investigated in the academic and professional discourses.

Empirical literature in the Pakistani context has indeed examined various components of project governance, stakeholder engagement, and risk management (Maqbool et al., 2023; Saad et al., 2025), yet the simultaneous influence of sustainable project management (SPM), modern methods of construction (MMC), and sustainable leadership (SL) upon project performance remains under researched. This gap calls for both theoretical clarification of the relationships between variables and the practical development of context-specific, evidence-based recommendations aimed at achieving sustainable outcomes in the country's built environment.

Research Gap

While Sustainable Project Management (SPM) has earned widespread recognition as a conduit for simultaneously producing economic, environmental, and social value, actual adoption within Pakistan's private construction sector has lagged, manifesting in recurrent cost overruns, schedule slippages, and systemic quality shortcomings (Shabbir, 2025; Abidin & Jaapar, 2008). At the same time, globally disseminated construction techniques—specifically Building Information Modelling (BIM), modularization, and prefabrication—have been successfully imported in diverse settings to enhance productivity and concomitantly curtail ecological impact (Goodier & Gibb, 2007; Gao et al., 2019). However, domestic encounters with these innovations remain narrow, rendering the mediation of such methodologies in the SPM–performance nexus incompletely understood within the Pakistani market. Equally, the literature is scant on the contributions of Sustainable Leadership (SL), conceived as embodying ethical orientation, stakeholder inclusivity, and an intergenerational time perspective (Avery & Bergsteiner, 2011). Despite the profusion of leadership paradigms, the potential of SL to serve as a moderating influence in the SPM–outcome causal chain has yet to receive sustained empirical examination.

In summary, three interrelated knowledge deficits require immediate and sustained scholarly inquiry. First, available empirical evidence offers limited quantification of the causal contributions of Sustainable Project Management (SPM) to the successful completion of private-sector construction initiatives in Pakistan. Second, the prevailing body of literature neglects to articulate the mediatory function of Modern Methods of Construction (MMC) in amplifying the sustainability-oriented benefits of SPM on overall project performance. Third, a rigorous and data-driven exploration of Strategic Leadership (SL) as a latent moderator across both SPM and MMC dimensions remains conspicuously absent. Addressing these interstitial domains not only consolidates theoretical advance by interweaving sustainability, technological innovation, and strategic stewardship into a mutually reinforcing synthesis, but also equips practitioners with empirically-tested directives capable of enhancing performance and delivering value in the private construction sector of Pakistan.

Research Questions

This study is directed for the above gaps and is guided by the following questions:

- a) What is the impact of Sustainable Project Management (SPM) on project success in private construction projects in Pakistan?
- b) Does the adoption of Modern Methods of Construction (MMC) mediate the relationship between Sustainable Project Management and Project Success?
- c) Does Sustainable Leadership moderate the relationship between Sustainable Project Management and project success?
- d) Does Sustainable Leadership moderate the relationship between Sustainable Project Management and project success via Modern Methods of Construction?
- e) Does Sustainable Project Management impact the adoption of Modern Methods of

Construction (MMC) in Pakistan's private construction projects?

- f) To what extent do Modern Methods of Construction (MMC) contribute to improving project success in Pakistan's private construction sector?

Research Objectives

The aim of this study is to address the key objectives aligning with the research questions:

- a) To identify the impact of Sustainable Project Management (SPM) practices on project success in private construction projects in Pakistan.
- b) To assess the mediating role of Modern Methods of Construction (MMC) in strengthening the relationship between SPM and project success.
- c) To examine the moderating role of Sustainable Leadership (SL) between Sustainable Project Management and project success.
- d) To examine the moderating role of Sustainable Leadership (SL) between Sustainable Project Management and project success via Modern Methods of Construction.
- e) To examine the direct influence of Sustainable Project Management (SPM) on the effectiveness of Modern Methods of Construction (MMC) in private construction projects in Pakistan.
- f) To assess the direct influence of Modern Methods of Construction (MMC) on Private Construction Project Success (PCPS).

Hypothesis Development

Sustainable Project Management

Over the past twenty years, sustainability has been steadily integrated into the cultural fabric of project-based sectors, with construction operations emerging as particularly illustrative. Conventional project management rested upon the iron triangle of budget, schedule, and quality; however, the paradigm has been progressively perceived as insufficient against the compound pressures of climate irregularity, finite resource availability, and heightened stakeholder expectations regarding social stewardship (Martens & Carvalho, 2016).

Sustainable Project Management (SPM) augments the core project lifecycle by deliberately embedding environmental, social, and economic principles within project goals, methodologies, and decision-making hierarchies. Informed by the Triple Bottom Line (TBL) framework, SPM aspires to uphold requisite technical and financial deliverables while simultaneously cultivating net-positive environmental and social consequences. Operationalising this ambition, environmental subprogrammes encompass energy efficiency interventions, circular economy-inspired waste diminution, and strategically calibrated carbon footprint abatement; the social sphere is addressed through equitable labour regimes, proactive stakeholder and community consultation, and the elevation of health and safety metrics; and economic viability is reinforced through life-cycle cost minimisation, maximisation of stakeholder worth, and reinforcement of long-term project resilience (Silvius & Schipper, 2014; Almahmoud & Doloi, 2015).

The Resource-Based View (RBV) complements Sustainable Project Management (SPM) by positioning sustainability-focused knowledge, stakeholder engagement, and innovation as strategic capabilities that confer competitive advantage (Barney, 1991; Maqbool et al., 2023). Within construction undertakings, SPM emerges as a distinctive organizational competence that realizes not only explicit technical targets but also transitory and durable benefits.

SPM, therefore, articulates a systematic framework that targets these endemic difficulties. By institutionalizing sustainability norms throughout all project phases, private firms in Pakistan may harmonize technical efficacy, economic return, and enduring ecological viability.

Modern Methods of Construction

Traditional paradigms in the construction sector continue to exhibit persistent inefficiencies, characterized by labor-intensive execution, fragmented scheduling, considerable cost overruns, recurrent delays, extensive rework, and wasteful resource consumption (Goodier, Gibb, 2007). Such deficiencies have catalyzed an international reorientation toward Modern Methods of Construction (MMC), an assemblage of progressive methodologies aimed at advancing efficiency, product quality, and environmental sustainability in the delivery of built assets (Gao et al., 2019).

MMC does not represent a monolithic solution; instead, it integrates a heterogeneous array of techniques, including Building Information Modeling (BIM), prefabrication, modular construction, off-site fabrication, lean process principles, and digital instruments for real-time tracking and stakeholder collaboration. Synthesizing these approaches facilitates optimized utilization of materials, minimizes waste at every production stage, heightens safety thresholds, and fosters superior quality attainment, all while compressing construction duration. BIM, for example, enhances project visualization and enables earlier clash detection and stakeholder coordination, thereby curtailing the incidence of expensive rework (Arif et al., 2017). Likewise, prefabrication and modular methodologies leverage controlled factory environments to elevate productivity and quality, mitigate disruptions at the construction site, and compress project delivery intervals (Pan et al., 2012).

Evaluated through a sustainability lens, modern methods of construction (MMC) exhibit a robust correspondence with the principles of the Triple Bottom Line, advancing simultaneously the environmental, economic, and social dimensions of project viability. On the environmental front, MMC techniques diminish both material wastage and embodied energy consumption, a conclusion attested by findings in the domain of off-site manufacturing (Blismas & Wakefield, 2009).

Empirical analysis identifies persistent impediments, namely elevated capital requirements, skill deficits among the labour cadre, sociocultural inertia, and a pervasive underappreciation of prospective long-term economic and environmental returns (Maqbool et al., 2023; Shabbir, 2025). Such constraining forces have circumscribed the private construction sector's capacity to exploit MMC's envisaged integrative gains fully.

Empirical evidence increasingly indicates that the concurrent implementation of Modern Methods of Construction (MMC) and established sustainability frameworks yields superior performance enhancements relative to the exclusive application of traditional construction approaches (Pan et al., 2012; Blismas & Wakefield, 2009). Within the Pakistani construction landscape, characterized by persistent inefficiencies, elevated rates of rework, and governance deficiencies that systematically compromise project outcomes, the adoption of MMC emerges as a decisive lever for translating aspirational sustainability principles into demonstrable and enduring project success.

Sustainable Leadership

Sustainable Leadership (SL) has become indispensable for the deep integration of sustainability within project-based organizations. Departing from conventional leadership models that prioritize immediate efficiency or profit margins, SL centres on the creation of enduring value, ethical accountability, inclusive engagement of stakeholders, and the mutually reinforcing pursuit of economic vitality, social equity, and environmental stewardship (Avery & Bergsteiner, 2011; D'Amato & Henderson, 2009). Within the context of construction projects, SL is the critical vector that translates sustainability principles into routine autopilot practices, cultivates a collaborative organisational culture, and stimulates the kind of iterative, project-wide innovation that fortifies overall performance (Fernando, 2021). While Sustainable Project Management (SPM) articulates the strategic roadmap for sustainability, the achievement of that roadmap is frequently underpinned by the manifest commitment of the leadership. SL that is firmly rooted in sustainable values instills a consistent sense of purpose, cultivates a climate where innovation flourishes, and ensures that project decisions are informed by a pluralism of stakeholder insights (Maqbool et al., 2023).

SL furthermore emerges as an enhancer of the mediating role performed by Modern Methods of Construction (MMC) within the sustainability-performance nexus. While MMC possesses embedded capacities—namely BIM, modularization, and prefabrication—to translate sustainability objectives into quantifiable indicators, its assimilation within developing settings such as Pakistan remains hampered by critical impediments, including elevated initial expenditures, entrenched cultural inertia, and insufficient skill development (Shabbir, 2025). Sustainable leadership possesses the capacity to mitigate such impediments by cultivating a generative learning climate, intentionally directing resources toward incremental and disruptive innovation, and executing purposeful management of organisational transitions (Hargreaves & Fink, 2006). By pursuing these mediating strategies in synchrony, the probability that MMC materializes sustainability-performance management (SPM) principles into discernible enhancements in cost efficiency, product quality, and stakeholder satisfaction is thereby augmented.

Project Success

Historically, the success of construction projects has been quantified against the so-called “iron triangle,” encapsulating duration, budget, and quality. Though these norms offer a rudimentary framework, prevailing discourse critiques their limitations, particularly when the projects a predominant share of which feature extended lifecycles produce lasting environmental and societal effects (Ika, 2009).

Recent quantitative and qualitative analyses reveal a statistically robust association between the principles of Sustainable Project Management (SPM) and the extended conception of project success, mediating superior resource efficiency, diminished lifecycle expenditure, and heightened stakeholder participation (Pandithawatta et al., 2024; Silvius & Schipper, 2025). Nevertheless, evidence from Pakistan's privatised construction ecosystem discloses a predilection for conventional techniques in which the intrinsic, delayed dividends of sustainability are frequently neglected. The consequence is persistent resource depletion, elevated running costs, and an exacerbation of deleterious repercussions upon host communities (Maqbool et al., 2023). Such conditions mandate a formal reappraisal of the decisive project metrics, inclusion of sustainability-adjusted parameters namely, calibrated energy performance, formal environmental conformity, integrated community advancement, and legacy value anchoring—becoming non-negotiable to the project's mathematical and moral objectives (Abidin & Jaapar, 2008; Fardaus, 2025).

Existing literature further substantiates the assertion that the integration of Modern Methods of Construction (MMC) and Sustainable Leadership (SL) amplifies the strategic priority of sustainability. Strategic Project Management (SPM) serves as the comprehensive architecture guiding sustainability objectives, whereas MMC injects a repertoire of technological instruments namely, Building Information Modelling (BIM), modularization, and prefabrication capable of translating conceptual efficiency into quantifiable resource savings and design innovation (Gao et al., 2019). Concurrently, SL articulates a normative vision and delegated governance architecture that effectively transposes sustainability precepts into the generative culture of the project (Maqbool et al., 2023).

Research Framework

This research outlines an integrative conceptual framework, synthesising the Triple Bottom Line (TBL) and Resource-Based View (RBV) perspectives, that explicitly connects Sustainable Project Management (SPM) to Project Success (PS) within the private construction sector of Pakistan. Within the framework, SPM is designated as the antecedent construct, systematically incorporating economic viability, environmental stewardship, and social responsibility, whilst PS is positioned as the focal outcome, conceptualised as a multidimensional phenomenon that transcends the traditional criteria of cost, time, and quality to encompass stakeholder satisfaction, realised business value, and enduring sustainability (Martens & Carvalho, 2016a; Love et al., 2019).

Modern Methods of Construction (MMC) is conceptualised as a mediating mechanism, operationalising the sustainability imperative into concrete project outputs through the deployment of Building Information Modelling (BIM), modularisation, and advanced prefabrication techniques (Gao et al., 2019). Sustainable Leadership (SL) is introduced as a moderating force, augmenting both the direct and the mediated paths by cultivating an organisational ethic centred on ethical stewardship, stakeholder inclusiveness, and a time-horizon that extends beyond the project life-cycle (Avery & Bergsteiner, 2011). Through this triadic configuration, SPM furnishes the strategic scaffolding, MMC supplies the requisite technological artefacts, and SL imparts an ethical and behavioural anchor, thereby contributing both theoretical enrichment and actionable policy orientation to the procurement of improved performance in Pakistan's construction industry.

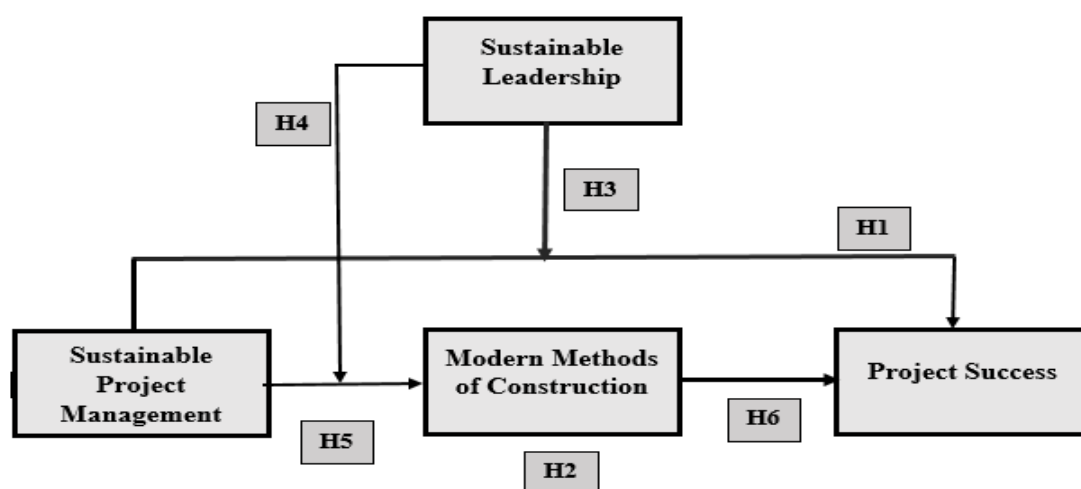


Figure 1: Conceptual Framework Model

Research Hypothesis

H1: Sustainable Project Management (SPM) has a significant positive impact on Private Construction Project Success

H2: Modern Methods of Construction (MMC) mediate the relationship between SPM and Private Construction Project Success.

H3: Sustainable Leadership (SL) moderates the relationship between SPM and Project Success, such that the effect is stronger under high levels of SL

H4: Sustainable Leadership (SL) moderates the indirect relationship between Sustainable Project Management (SPM) and Sustainable Project Success (SPS) through Modern Methods of Construction (MMC), such that the effect is stronger under high levels of SL

H5: Sustainable project management has a significant positive impact on the adoption of modern method of construction.

H6: Modern method of construction has a significant positive impact on private construction project success.

Methodology

The inquiry is positioned within a positivist framework highlighting assessment and empirical hypothesis validation predicated upon numerical data (Polit & Beck, 2010; Saunders et al., 2019). Such alignment is warranted by the imperative to measure interactions among Sustainable Project Management (SPM), Modern Methods of Construction (MMC), Sustainable Leadership (SL), and Project Success (PCPS), where objectivity is paramount. A quantitative, cross-sectional research design, governed by a deductive logic, was executed; hypotheses abstracted from theoretical discourses were subjected to empirical verification (Creswell & Creswell, 2018). The design offers a single time-based measure of sustainability efforts in Pakistan's private construction sector and fits within the current limits of time and resources. The sampling frame consisted of professionals occupying critical roles in private construction enterprises, namely project managers, engineers, architects, BIM practitioners, and construction supervisors. A purposive sampling strategy, augmented by a snowball approach, selectively recruited practitioners versed in sustainability. A total of 300 questionnaires were disseminated; 250 were retained as analytically valid, thus generating an effective response rate of 83%. A concurrent power assessment, executed using G*Power software, substantiated sufficiency; the derived cohort exceeded the requisite minimum of 212, enabling the detection of medium-size effects at 0.80 statistical power and a 0.05 alpha level.

Data were gathered via an electronically administered self-completed questionnaire delivered with Google Forms. The instrument encompassed two sections: (i) demographics (including participant role, professional tenure, and previous exposure to sustainability) and (ii) items operationalizing theoretical constructs, each rated on a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree). Indicators were drawn and modified from recognized inventories: SPM, SL, and PS (Liaquat et al., 2024); and MMC BIM (Hatem et al., 2018). A preliminary administration to 10 practitioners confirmed item clarity and logical sequence, resulting in only negligible refinements.

Statistical Package for the Social Sciences SPSS (v28) alongside the PROCESS Macro (Hayes, 2022). Scale reliability was estimated through Cronbach's alpha, with all dimensions surpassing the acceptable benchmark of 0.70. Construct validity was further established by exploratory factor

analysis and inter-variable correlations. Theoretical hypotheses were operationalized using regression: Model 4 specified an indirect effect through MMC, whereas Model 8 tested the interaction effect of SL. A bias-corrected bootstrap with 5,000 replications supplied confidence intervals for both indirect and moderating effects, thus enhancing the robustness of parameter estimation.

Table 1: Measurement of Variables

Variables	References	No. Of Items
Sustainable Project Management	(Liaqat et al., 2024)	9 Items
Modern Method of Construction –BIM	(Hatem et al., 2018)	5 Items
Sustainable Leadership	(Liaqat et al., 2024)	6 Items
Project Success	(Liaqat et al., 2024)	10 Items

Analysis

This chapter details the statistical validation carried out to assess the hypotheses of the current study. The primary aim was to quantify the influence of Sustainable Project Management (SPM) on Private Construction Project Success (PCPS), situating Modern Methods of Construction (MMC) as an intervening variable and Sustainable Leadership (SL) as a moderating variable within the context of Pakistan’s private construction industry.

Data acquisition involved a methodically structured questionnaire, and subsequent analysis employed SPSS version 28 coupled with the PROCESS Macro (Hayes, 2022). The procedure adhered to a pre-defined analytical pathway comprising, in sequence, demographic characterization, computation of descriptive statistics, assessment of instrument reliability, and correlation scrutiny, after which sequential regression analyses were performed to evaluate mediation (Model 4), moderation (Model 1), and moderated mediation (Model 8).

By enacting this layered analytical strategy, the study establishes a solid methodological base that accommodates both direct and contingent influence assessment. The subsequent sections of the chapter initially summarize demographic characteristics of survey respondents, present descriptive and reliability analyses alongside correlation findings, and culminate in the reporting of inferential analyses, including the evaluation of hypotheses.

Normality & Descriptive Statistics

Table 2: Results of Descriptive Statistics

		IV	Mediator	Moderator	DV
N	Valid	250	250	250	250
	Missing	0	0	0	0
Std. Error of Mean		.05900	.06464	.06344	.06060
Std. Deviation		.93287	1.02212	1.00305	.95819
Skewness		-1.063	-1.295	-1.067	-1.344
Kurtosis		.142	.811	.151	.836

Normality of the data was evaluated using skewness and kurtosis statistics calculated for the study’s core constructs: Sustainable Project Management (SPM), Modern Methods of Construction (MMC), Sustainable Leadership (SL), and Project Success (PS). Observed skewness ranged from –

1.04 to -1.34 , evidencing modest left-tailed asymmetry. Corresponding kurtosis statistics, between 0.09 and 0.83, indicated near-mesokurtic dispositions. Given that both skewness and kurtosis statistics resided well inside conventional cutoffs (-2 to 2 for skewness and -7 to 7 for kurtosis), the dataset satisfied the normality requirement. Consequently, the suitability of the data for the parametric procedures of regression, mediation, and moderation was confirmed, obviating the need for any variables to undergo transformation procedures (Chen et al., 2021; Moore et al., 2021).

Descriptive statistics corroborated that participants, on the whole, displayed concordance with the theoretical constructs examined. The sustainability practice metric (SPM) yielded a mean of 3.82 ($SD = 0.93$), signifying generally favourable views regarding the integration of sustainability practices within project delivery. The metric for modern methods of construction (MMC) produced a mean of 3.63 ($SD = 0.96$), evidencing nascent yet advancing acknowledgement. The sustainability leadership (SL) indicator recorded a mean of 3.66 ($SD = 1.02$), illustrating moderate endorsement of leadership that prioritises sustainability, albeit with observable heterogeneity across constituent organisations. Finally, the performance sustainability (PS) mean reached 3.81 ($SD = 0.95$), affirming consensus.

Correlation Analysis

Table 3: Results of Correlation

	IV (SPM)	Mediator (MMC)	Moderator (SL)	DV (PS)
Sustainable Project Management	1	.847**	.902**	.903**
Modern Method of Construction	0.847**	1	0.867**	0.843**
Sustainable Leadership	0.902**	0.867**	1	0.917**
Project Success	0.903**	0.843**	0.917**	1

The Pearson correlation analysis yielded statistically significant and positive relationships among all constructs ($p < 0.01$), thereby confirming the hypothesized theoretical framework. Sustainable Project Management (SPM) exhibited pronounced positive relations with Modern Methods of Construction (MMC) ($r = 0.847$), Sustainable Leadership (SL) ($r = 0.902$), and Project Success (PS) ($r = 0.903$), evidencing a strong nexus between sustainability-focused practices and the pillars of innovation, leadership, and performance attainment. In parallel, MMC registered positive correlations with SL ($r = 0.867$) and PS ($r = 0.843$), whereas SL-MPS yielded the highest correlation ($r = 0.917$). The findings show that sustainability, leadership, and innovation together improve project outcomes.

Measure of reliability statistics (Cronbach's alpha)

A comprehensive reliability analysis was executed to evaluate the internal consistency across the specified constructs: Sustainable Project Management (SPM), Modern Methods of Construction (MMC), Sustainable Leadership (SL), and Private Construction Project Success (PS). The aggregated Cronbach's alpha coefficient attained a value of 0.966, thereby signifying a level of reliability that exceeds the benchmark of 0.70, as recommended by Hair Jr. et al. (2021). The detailed findings presented in Table 8 reveal that SPM, containing nine items, obtained an alpha of 0.954; MMC, with five items, recorded an alpha of 0.966; SL, featuring six items, was measured at 0.949; and PS, the construct with the largest item set of ten, reached a coefficient of 0.952. Each construct adhered to the established cut-off without necessitating the removal of any constituent item. Collectively, these indicators fortify the assertion that the measurement instrument possesses

a high level of reliability, thus rendering it amenable to the forthcoming analyses of regression, mediation, and moderation.

Table 4: Cronbach's Alpha Values

	Cronbach's Alpha if Item Deleted	No of items
SPM (IV) AVG	.954	9
MMC (Med) AVG	.966	5
SL (Mod) AVG	.949	6
PS (DV) AVG	.952	10

Regression Analysis

Table 5: Regression Results- Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.903 ^a	.815	.814	.4132	.815	1090.742	1	248	.000

Table 6: Regression Results ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	186.262	1	186.262	1090.742	.000 ^b
	Residual	42.350	248	.171		
	Total	228.613	249			

Table 7: Regression Result Coefficient

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	.403	.113		3.567	.000	.180	.625
	SPM (IV) AVG	.924	.028	.903	33.026	.000	.869	.979

The influence of Sustainable Project Management (SPM) on Project Success (PS) was quantified using a simple linear regression analysis. As presented in Table 5-7, the regression revealed a statistically meaningful relationship, exhibiting a correlation coefficient of 0.903 and an R² value of 0.815, indicating that SPM accounts for 81.5% of the variance observed in PS. The global test for the model was significant, $F(1, 248) = 1090.742$, $p < .001$, thus confirming the reliability of the regression.

The parameter estimates substantiated the predictive power of SPM on PS. The regression coefficient ($B = 0.924$) suggests that every unit enhancement in the adoption of sustainable project practices corresponds to a 0.924 unit elevation in the project success score. The standardized coefficient ($\beta = 0.903$), the t-statistic ($t = 33.026$), and the p-value ($p < .001$) collectively affirm that the effect is both practically and statistically significant. Additionally, the 95% confidence interval for the unstandardized coefficient, spanning [0.869, 0.979], affirms a narrow range for the

expected value. Accordingly, the evidence corroborates the hypothesis that SPM is a decisive determinant of PS, underscoring its strategic importance in the governance of construction initiatives.

Mediation & Moderation Analysis

Table 8: Process Macro Results for Mediation & Moderation

<u>Hypothesis</u>	<u>Relationship</u>	<u>Results</u>						
H1	SPM → PS (Sustainable Project Management → Project Success)	Model						
			coeff	se	t	p	LLCI	ULCI
		SPMIV	.7955	.0946	8.4084	.0000	.6091	.9818
H2	SPM → MMC → PS (Mediation via modern method of construction)	Indirect effect(s) of X on Y:						
			Effect	BootSE	BootLLCI	BootULCI		
		MMCMed	.2357	.0531	.1375	.3465		
H3	(Moderation over direct path) SPM → PS	Model						
			coeff	se	t	p	LLCI	ULCI
		Int_1	.1208	.0229	5.2698	.0000	.1660	.0757
H4	(Moderated Mediation) SPM → MMC → PS	Index of moderated mediation:						
			Index	BootSE	BootLLCI	BootULCI		
		SLMOD	.0026	.0046	.0149	.0040		
H5	SPM → MMC (Sustainable project management → Modern method of construction)	Model						
			coeff	se	t	p	LLCI	ULCI
		SPMIV	.9205	.0370	24.8988	.0000	.8477	.9933
H6	MMC → PS (Modern method of construction → Project Success)	Model						
			coeff	se	t	p	LLCI	ULCI
		MMCMed	.2560	.0456	5.6188	.0000	.1663	.3458

The results of hypothesis testing, presented in Table X, confirm that all six hypotheses (H1–H6) are supported with statistically significant outcomes. Sustainable Project Management (SPM) shows a strong direct effect on Project Success (PS) (H1), with $b = 0.7955$, $t = 8.4084$, $p < .001$, indicating that sustainability-driven practices in project management substantially enhance project performance. In addition, the mediation analysis validates H2, showing that Modern Methods of Construction (MMC) partially mediate the SPM–PS relationship (indirect effect = 0.2357, BootCI [0.1375, 0.3465]). This highlights that a significant portion of SPM’s influence on project success operates through the adoption of modern construction approaches such as prefabrication, modularization, and automation.

Furthermore, moderation results lend support to H3 and H4, where Sustainable Leadership (SL) strengthens both the direct and indirect pathways between SPM and PS. The interaction term (SPM × SL) is positive and significant ($b = 0.1208$, $p < .001$), suggesting that leadership with a sustainability orientation amplifies the benefits of SPM for project success. Similarly, the moderated mediation effect (index = 0.0026, BootCI > 0) confirms that SL enhances the indirect pathway, making the adoption of MMC more effective in translating sustainability practices into

project outcomes. Finally, the simple mediation paths (H5 and H6) further establish that SPM significantly predicts MMC ($b = 0.9205$, $p < .001$) and that MMC itself contributes meaningfully to PS ($b = 0.2560$, $p < .001$). Collectively, these findings validate the conceptual model and reinforce the importance of sustainability-oriented management, leadership, and construction methods in achieving private construction project success.

Discussion

The findings of this study confirm that Sustainable Project Management (SPM) has a significant and positive impact on Project Success (PS) in the private construction sector of Pakistan. Beyond the direct association, Modern Methods of Construction (MMC) emerged as an important mediator, suggesting that sustainability oriented management practices provide the organizational foundation for adopting innovative construction techniques such as prefabrication, modularization, and BIM-enabled workflows. This aligns with international literature affirming that MMC enhances cost efficiency, quality, and timeliness, thereby supporting sustainable outcomes. In addition, Sustainable Leadership (SL) demonstrated a reinforcing role, moderating both the direct and indirect relationships, and highlighting the importance of values-driven leadership in shaping organizational culture, innovation, and performance.

The theoretical framing under the Resource-Based View (RBV) is strengthened, as the study demonstrates that internal strategic resources sustainability-oriented project practices, innovative construction methods, and leadership constitute capabilities that foster superior performance. Practically, these findings emphasize the urgent need for private construction firms in Pakistan to integrate sustainability into governance, empower leadership for systemic change, and embrace MMC for operational efficiency. Collectively, the results provide a comprehensive framework in which SPM acts as the strategic driver, MMC as the operational enabler, and SL as the contextual catalyst to achieve long-term project success.

Limitations

Despite its contributions, the study has certain limitations. First, its cross-sectional design restricts the ability to capture dynamic changes across different phases of a project; longitudinal studies are recommended for future research. Second, the study adopted a quantitative mono-method approach, raising the risk of common method bias and limiting deeper contextual insights. Third, the purposive sample was drawn only from private construction projects in Pakistan, constraining the generalizability of findings to other regions, industries, or public sector projects. Finally, while SPM, MMC, and SL were the focal variables, other potentially influential factors such as stakeholder engagement, organizational culture, or technological innovation were not included and could be explored in future studies.

Recommendations

The results suggest several actionable recommendations for practice and policy. For industry stakeholders, SPM should be embedded into project governance frameworks, with sustainability principles integrated across planning, procurement, and delivery phases. Construction firms should prioritize the adoption of MMC by investing in infrastructure, digital tools, and workforce training, while fostering interdepartmental collaboration and performance metrics that go beyond cost and time to include sustainability and stakeholder value. Furthermore, leadership training focused on

sustainability, ethical governance, and systems thinking should be institutionalized to strengthen the moderating role of SL.

At the policy level, regulatory bodies such as PEC, PCATP, and PMI Pakistan should incorporate SPM and SL into certification standards and continuing professional development. Government agencies may accelerate MMC adoption through tax incentives, streamlined approvals, and workforce development programs. Additionally, institutionalizing sustainability indicators and ESG criteria into national construction oversight frameworks will align the industry with global sustainable development goals. Collectively, these recommendations provide a roadmap for advancing sustainable construction practices in Pakistan while strengthening competitiveness, resilience, and long-term value creation.

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