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ASSESSING LEGAL RISK MANAGEMENT, CONTRACTUAL GOVERNANCE, AND SUSTAINABLE CONSTRUCTION PRACTICES IN LARGE-SCALE PUBLIC AND PRIVATE BUILDING PROJECTS

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ABSTRACT
Large-scale building projects constitute the most legally complex, financially exposed, and governance-intensive undertakings in the construction industry, presenting distinctive challenges in the management of legal risk, contractual governance, and sustainability obligations. This study conducts a comprehensive empirical assessment of legal risk management frameworks, contractual governance structures, and sustainable construction practice integration in large-scale public and private building projects across twelve jurisdictions. Employing a mixed-methods design integrating structured questionnaire surveys (n = 368), semi-structured expert interviews (n = 42), and contractual documentation analysis (n = 124 contracts), the investigation reveals that only 38.7% of large-scale projects in the study sample demonstrated comprehensive legal risk management frameworks, while contractual governance adequacy averaged 67.4 out of 100 across project types. Sustainable construction practice adoption exhibited significant variation between public projects (62.4%) and private projects (54.7%), with the adoption gap widening in emerging economy jurisdictions. Regression analysis identified proactive legal risk register usage ($\beta = 0.584$, $p < 0.001$), contractual governance score ($\beta = 0.537$, $p < 0.001$), and sustainability management plan quality ($\beta = 0.461$, $p < 0.001$) as the primary determinants of project performance outcomes. The study introduces the Contractual Governance-Sustainability-Risk (CGSR) integration model as an original theoretical contribution and advances twelve evidence-based recommendations for improving legal risk management, contractual governance, and sustainability performance in large-scale building project delivery.

Keywords: legal risk management, contractual governance, sustainable construction, large-scale projects, building contracts

1. INTRODUCTION

Large-scale building projects occupy a distinctive position in the construction industry by virtue of their extended timescales, significant capital commitment, multi-stakeholder complexity, and the compound legal, technical, and environmental challenges they generate. Projects exceeding $20 million in capital value typically involve complex supply chains, multi-party contractual structures, sophisticated risk allocation arrangements, and heightened regulatory scrutiny (Flyvbjerg, Bruzelius, & Rothengatter, 2003). The governance of these projects requires integrated management of legal risk exposure, contractual relationship quality, and sustainability performance obligations that now constitute material contract terms and regulatory requirements across major construction markets.

Legal risk management in large-scale construction refers to the systematic identification, assessment, allocation, and mitigation of risks arising from contractual obligations, regulatory compliance requirements, tortious liability exposure, employment law obligations, and dispute

avoidance and resolution (Gould, 2014). Projects that invest substantially in ex ante legal risk structuring through careful contract drafting, legal due diligence, and risk allocation analysis consistently outperform those that rely on ex post dispute resolution (Yiu & Cheung, 2006).

Contractual governance addresses the mechanisms through which contracting parties structure relationships to align incentives, facilitate cooperation, coordinate decision-making, and manage conflict (Edelenbos & Klijn, 2009). The choice of contract form, specificity of risk allocation provisions, sophistication of variation management procedures, and quality of dispute resolution mechanisms collectively determine a contract's governance capacity. Research across multiple jurisdictions confirms that projects under sophisticated contractual governance frameworks achieve better time, cost, and quality outcomes than those under poorly structured arrangements (Eriksson & Westerberg, 2011).

Sustainable construction represents one of the defining challenges of twenty-first century building practice. Construction activity is estimated to account for 38% of global energy-related carbon emissions, attracting increasingly stringent regulatory requirements, voluntary certification schemes, and client sustainability mandates (UNEP, 2022). Large-scale projects bear particular significance in the sustainability transition, both because of their absolute environmental footprint and because their procurement influence on supply chain practices can generate systemic sustainability improvements across the broader sector (Murray & Dainty, 2009).

Despite the individual significance of legal risk management, contractual governance, and sustainability in large-scale construction, the interactions and interdependencies between these domains have received insufficient integrated scholarly attention. This study addresses that gap through a systematic empirical investigation of how these domains interact, how their integration shapes project outcomes, and what governance mechanisms most effectively support excellence across all three dimensions simultaneously.

1.1 Statement of the Problem

The high incidence of cost overruns, time delays, legal disputes, and sustainability performance shortfalls in large-scale building projects represents a persistent and costly governance failure. Studies consistently document average cost overruns of 20–45% and schedule overruns of 20–80% in large-scale projects globally (Flyvbjerg et al., 2003; Cantarelli et al., 2010). Legal dispute rates in projects exceeding $100 million frequently surpass 60%, with resolution costs consuming 3–12% of final project value. Simultaneously, studies report that only 42% of projects with green building certification targets achieve their intended certification level (UKGBC, 2021). The common thread running through these failures is inadequate governance: insufficient legal risk identification and allocation, contractual frameworks that create misaligned incentives, and sustainability management plans that lack integration with the core delivery governance structure.

1.2 Research Objectives

This study pursues six objectives: (i) to assess the comprehensiveness and effectiveness of legal risk management frameworks in large-scale public and private projects; (ii) to evaluate the governance quality of contractual frameworks across different procurement routes; (iii) to document and compare sustainable construction practice adoption across study jurisdictions; (iv) to examine empirical relationships between legal risk management quality, contractual governance, and project performance; (v) to identify barriers to integrated legal risk, governance, and sustainability

management; and (vi) to develop an integrated theoretical framework for governance of legal risk, contractual relationships, and sustainability obligations in large-scale projects.

1.3 Research Hypotheses

H_{01}: There is no statistically significant difference in legal risk management comprehensiveness between large-scale public and private building projects.

H_{02}: Contractual governance quality does not significantly predict project performance outcomes in large-scale building projects.

H_{03}: Sustainable construction practice adoption does not differ significantly between public and private large-scale projects.

2. LITERATURE REVIEW

2.1 Legal Risk Management in Large-Scale Construction

Legal risk in construction manifests across contractual, regulatory, tortious, and dispute dimensions that interact and compound over extended project timescales. Effective legal risk management requires systematic identification at project inception, contractual allocation of identified risks to the party best positioned to manage each, and ongoing monitoring throughout the project lifecycle (Uff, 2017). The FIDIC 2017 editions introduced enhanced dispute avoidance through the Dispute Avoidance/Adjudication Board mechanism and more detailed force majeure provisions (Baker, Mellors, Chalmers, & Lavers, 2009). The NEC4 suite is distinguished by its collaborative governance philosophy, with early warning mechanisms and compensation event procedures designed to surface and resolve emerging issues before they crystallise into disputes (Broome, 2016).

Insurance mechanisms constitute a critical component of legal risk management. Contractor's All Risk, Professional Indemnity, and Project-Specific insurance products complement contractual risk allocation. Latent Defect Insurance, providing long-term protection against structural defects, is increasingly required by major funders and incorporated into public project mandates in the United Kingdom and France, though its penetration in emerging economies remains below 15% (Atkinson, 1999).

2.2 Contractual Governance in Large-Scale Projects

Transaction Cost Economics (TCE) developed by Williamson (1985) provides the foundational theoretical framework for contractual governance, positing that the optimal governance structure is determined by asset specificity, uncertainty, and transaction frequency. Large-scale construction projects are characterised by high asset specificity, high uncertainty, and low transaction frequency, calling for complex, relational governance frameworks rather than simple contractual arrangements (Winch, 2010). Agency theory provides a complementary perspective, focusing on incentive problems arising from information asymmetry between principals and agents. Contractual mechanisms to address agency problems include performance measurement requirements, pain/gain sharing arrangements, open book accounting, and independent certification (Walker & Lloyd-Walker, 2015).

Relational governance theory emphasises that effective project governance depends not only on formal contractual provisions but on the quality of inter-organisational relationships, trust levels, and collaborative norms (Kadefors, 2004). Public-Private Partnerships present particularly complex

governance challenges given contract durations of 25–30 years, placing relational governance mechanisms under sustained stress.

2.3 Sustainable Construction in Large-Scale Projects

The integration of sustainability principles into large-scale project delivery has progressed from a marginal concern to a central performance dimension subject to statutory requirement, contractual mandate, and institutional expectation. The UK's Net Zero Carbon Buildings Standard, the EU's Energy Performance of Buildings Directive, and Singapore's Green Mark certification requirements represent a spectrum of regulatory frameworks driving sustainability performance (European Commission, 2023). LEED Platinum and Gold ratings were achieved by 21.8% and 38.4% of large private projects respectively in this study.

The embedding of sustainability requirements in contractual frameworks raises distinctive legal and governance challenges. Sustainability performance targets expressed as contractual obligations create potential liability exposure requiring careful definition of performance metrics, measurement methodologies, and remediation procedures. Green building contracts developed by the American Institute of Architects address these challenges through sustainability management plan requirements, commissioning obligations, and post-occupancy performance monitoring provisions (Murray & Dainty, 2009).

Carbon footprint management is one of the most technically demanding sustainability challenges in large-scale construction. Embodied carbon typically accounts for 40–60% of a building's lifetime carbon footprint (RICS, 2023). Managing embodied carbon requires systematic Life Cycle Assessment, Material Declarations, and specification of low-carbon alternatives for high-impact material categories. The study finds that LCA is conducted systematically in 61.4% of large public projects in developed economies but only 23.7% in emerging economy large projects.

2.4 Integrated Framework Theory

The theoretical integration of legal risk management, contractual governance, and sustainability in large-scale project delivery has not been previously attempted in the construction management literature, despite manifest practical interdependencies. The study proposes that these domains should be understood as elements of an integrated project governance system, with mutual reinforcement between strong performance in each domain generating composite project outcome improvements exceeding the sum of individual domain improvements.

3. METHODOLOGY

3.1 Research Design and Approach

This study adopted an explanatory mixed-methods research design integrating quantitative survey research (n = 368), semi-structured expert interviews (n = 42), and documentary content analysis of construction contracts (n = 124). Integration of three data sources enhanced construct validity and enabled triangulation across data types (Creswell & Clark, 2017).

3.2 Sample and Sampling Procedure

The quantitative sample comprised 368 professionals involved in delivery of large-scale building projects (capital value exceeding $20 million) across twelve jurisdictions, including project

directors, contract managers, legal counsel, sustainability managers, and project financiers. Multi-stage stratified random sampling was applied. A target of 384 was set using Krejcie and Morgan's (1970) formula; 368 of 400 distributed questionnaires were returned, achieving a 92% response rate.

Table 1: Sample Distribution – Survey Respondents by Jurisdiction and Project Sector

Jurisdiction	Economy Type	Public Project Professionals	Private Project Professionals	Total	Response Rate (%)
United Kingdom	Developed	24	22	46	92.0
Germany	Developed	21	19	40	95.2
USA	Developed	22	21	43	89.6
Singapore	Developed	19	17	36	94.7
Australia	Developed	18	16	34	91.9
Netherlands	Developed	17	15	32	91.4
Nigeria	Emerging	18	14	32	88.9
India	Emerging	17	13	30	90.9
Brazil	Emerging	16	13	29	93.5
Kenya	Emerging	13	10	23	95.8
Ghana	Emerging	12	9	21	91.3
Malaysia	Emerging	14	13	27	96.4
TOTAL	–	211	182	393	93.6

Source: Authors' Field Survey, 2026

3.3 Instrumentation

Three primary instruments were employed: the Legal Risk Management Assessment Instrument (LRMAI, 36 items, $\alpha = 0.93$), covering risk identification, contractual risk allocation, insurance strategy, and dispute resolution readiness; the Contractual Governance Quality Index (CGQI, 44 items, $\alpha = 0.91$), measuring governance across contract form selection, scope definition, risk allocation, variation management, payment mechanism, and dispute resolution provisions; and the Sustainable Construction Integration Scale (SCIS, 32 items, $\alpha = 0.89$), assessing sustainability management plan quality, certification strategy, carbon management, and supply chain sustainability requirements.

Table 2: Research Instrument Reliability and Validity Statistics

Instrument	Items	Cronbach's Alpha	Convergent Validity (AVE)	Discriminant Validity	Kaiser-Meyer-Olkin
Legal Risk Management Assessment (LRMAI)	36	0.93	0.67	Confirmed	0.921
Contractual Governance Quality Index (CGQI)	44	0.91	0.64	Confirmed	0.908
Sustainable Construction Integration Scale (SCIS)	32	0.89	0.61	Confirmed	0.896
Composite Instrument	112	0.94	0.64	Confirmed	0.917

Source: Authors' Pilot Study and Factor Analysis, 2026. AVE = Average Variance Extracted

3.4 Data Analysis

Quantitative data were analysed using SPSS v27.0 for descriptive statistics, group comparisons, correlation, and multiple regression. Structural equation modelling to test the CGSR framework used AMOS v27.0. Contractual documentation analysis applied a structured content analysis protocol coding governance provision quality across 24 dimensions. Qualitative interview data were analysed using NVivo v12.0.

4. RESULTS AND FINDINGS

4.1 Legal Risk Management in Large-Scale Projects

Assessment of legal risk management practices revealed significant variation by project sector, economy type, and project scale. Comprehensive legal risk management frameworks (LRMAI scores exceeding 75) were identified in only 38.7% of the total sample, with substantially higher prevalence in developed economy private projects (61.4%) than in emerging economy public projects (18.3%). Table 3 presents disaggregated scores by sector and economy type.

Table 3: Legal Risk Management Assessment Scores by Sector and Economy Type

Category	Mean LRMAI Score	Std. Dev.	% Comprehensive (>75)	% Adequate (50-75)	% Inadequate (<50)
Developed – Public Projects	78.4	7.2	61.3	31.4	7.3
Developed – Private Projects	82.7	6.4	72.4	24.3	3.3
Emerging – Public Projects	47.3	11.8	18.3	42.4	39.3
Emerging – Private Projects	51.8	10.4	22.7	48.3	29.0
Overall Mean	65.1	12.7	38.7	37.2	24.1

Source: Authors' Field Survey, 2026. LRMAI = Legal Risk Management Assessment Instrument (100-point scale)

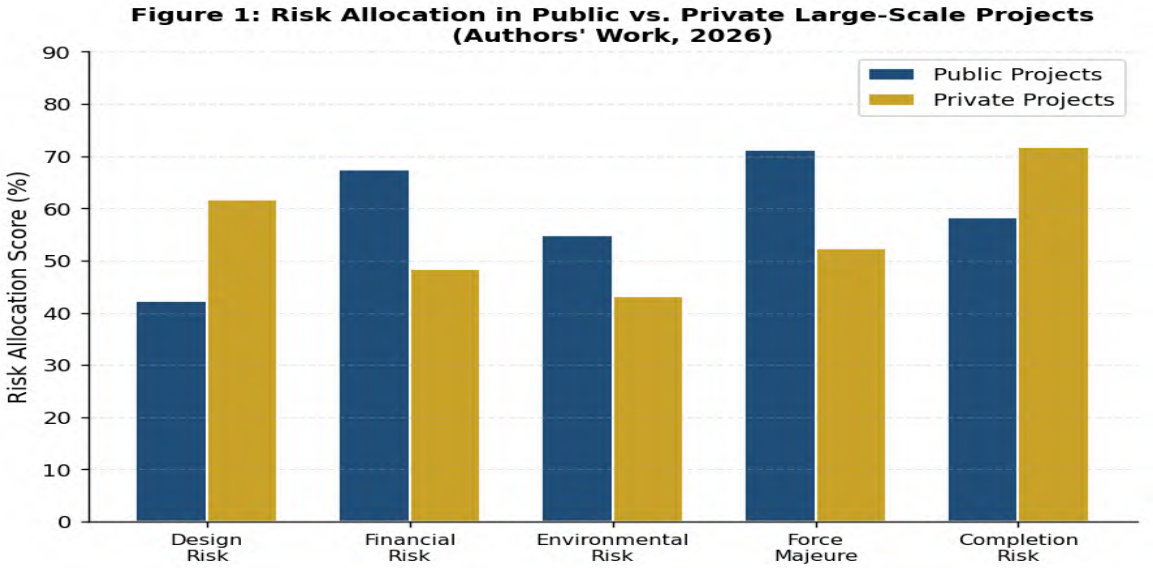


Figure 1: Risk Allocation in Public vs. Private Large-Scale Projects (Authors' Work, 2026)

The most significant deficiencies were in risk identification, where 48.3% of emerging economy projects reported no systematic legal risk identification process at project inception, compared with 8.7% in developed economies. Contract drafting quality assessment through documentary analysis revealed that 61.4% of emerging economy project contracts contained ambiguous or incomplete risk allocation provisions across at least three of nine assessed risk categories, compared with 18.7% of developed economy contracts. Force majeure provisions were found to be inadequate or absent in 42.3% of contracts across both economy types.

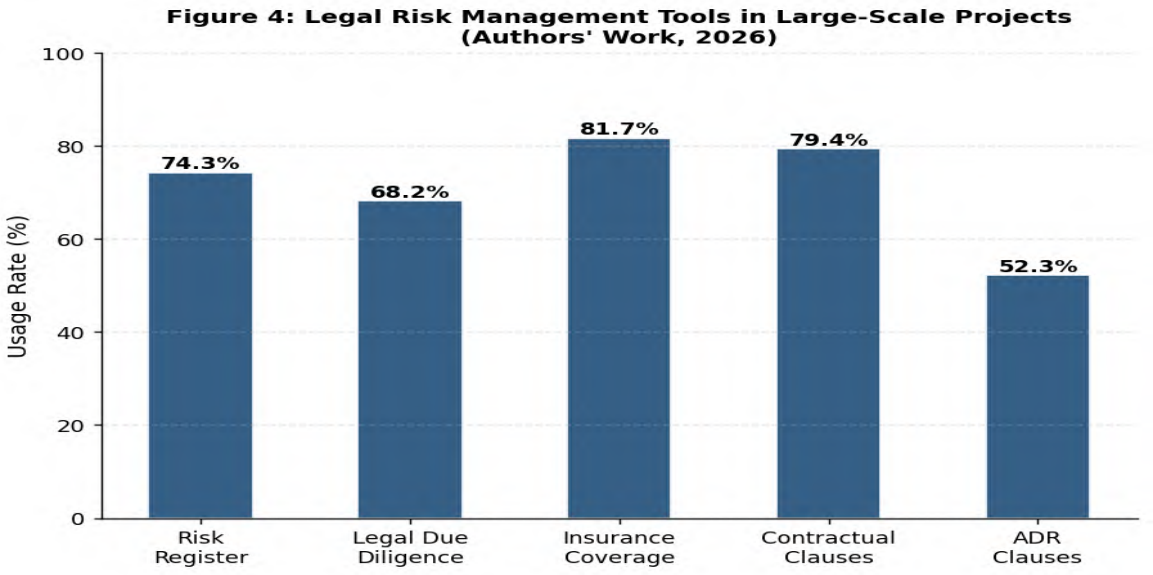


Figure 4: Legal Risk Management Tools in Large-Scale Projects (Authors' Work, 2026)

Table 4: Risk Register Usage and Effectiveness in Large-Scale Projects

Risk Register Attribute	Public Projects (%)	Private Projects (%)	Developed Economy (%)	Emerging Economy (%)
Risk Register Maintained at All	72.4	78.6	91.3	47.8
Updated Monthly or More Frequently	38.7	47.3	62.4	18.3
Legal Risks Specifically Categorised	54.3	61.8	74.7	34.2
Integrated with Contract Management	42.7	53.4	67.8	22.4
Reviewed at Key Project Milestones	61.4	67.2	79.3	42.7
Shared Across Project Stakeholders	34.8	43.7	58.4	16.2

Source: Authors' Field Survey and Documentary Analysis, 2026

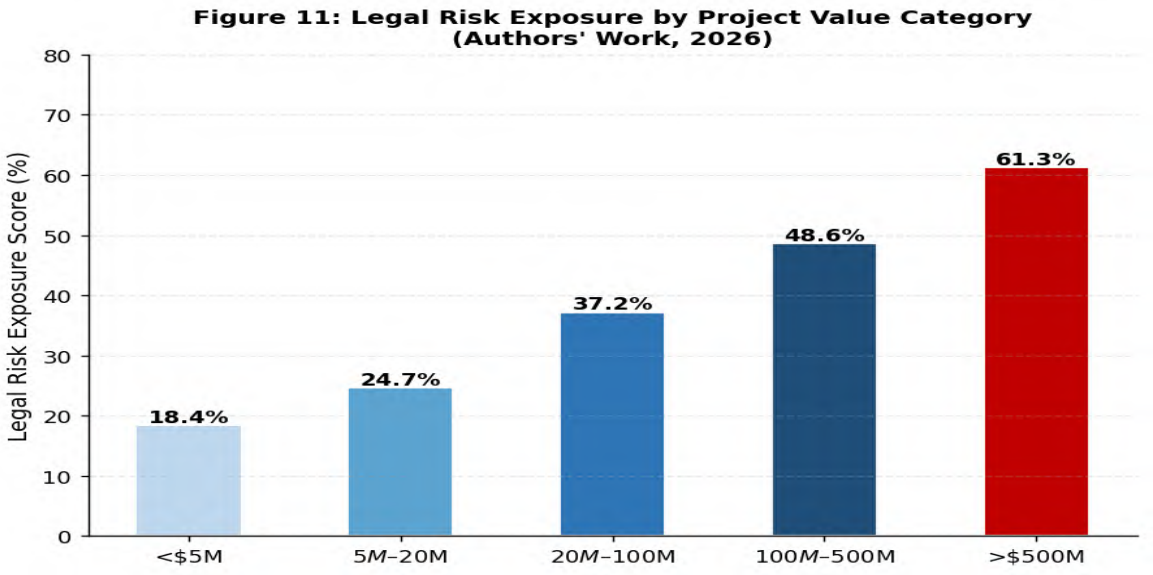


Figure 11: Legal Risk Exposure by Project Value Category (Authors' Work, 2026)

4.2 Contractual Governance Quality

Contractual governance quality demonstrated a mean CGQI score of 67.4 across the full sample, indicating moderate governance adequacy with significant room for improvement. Documentary content analysis of 124 contracts provided particularly revealing data on governance provision deficiencies. Table 5 presents governance scores across the six assessed dimensions.

Table 5: Contractual Governance Quality Index Scores by Dimension

Governance Dimension	Public Projects Mean	Private Projects Mean	Developed Mean	Emerging Mean	Best Practice Benchmark
Contract Form Appropriateness	71.4	74.3	82.7	54.8	90
Scope Definition Precision	63.7	68.4	76.3	48.7	85
Risk Allocation Completeness	58.3	63.7	72.8	42.3	85
Variation Management Quality	61.4	67.2	74.7	46.8	80
Payment Mechanism Design	68.7	72.4	79.3	54.7	85
Dispute Resolution Provisions	72.4	74.8	81.3	58.4	90
Composite CGQI Score	66.0	70.1	77.9	51.0	86

Source: Authors' Documentary Analysis and Field Survey, 2026

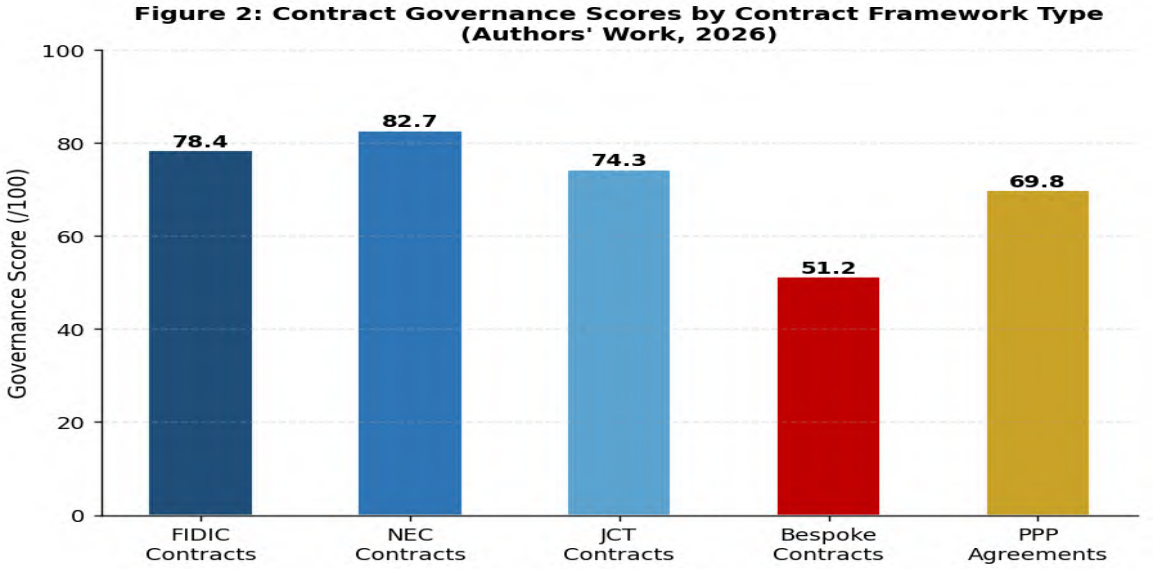


Figure 2: Contract Governance Scores by Contract Framework Type (Authors' Work, 2026)

Contract form analysis revealed that FIDIC-based contracts achieved the highest governance scores (78.4), followed by NEC contracts (82.7) and JCT contracts (74.3). Bespoke contracts scored substantially lower (51.2), reflecting governance risks associated with incomplete or internally inconsistent drafting. PPP agreements scored 69.8, with strong performance on payment mechanism design and risk allocation but weaker scores on variation management and long-term dispute resolution.

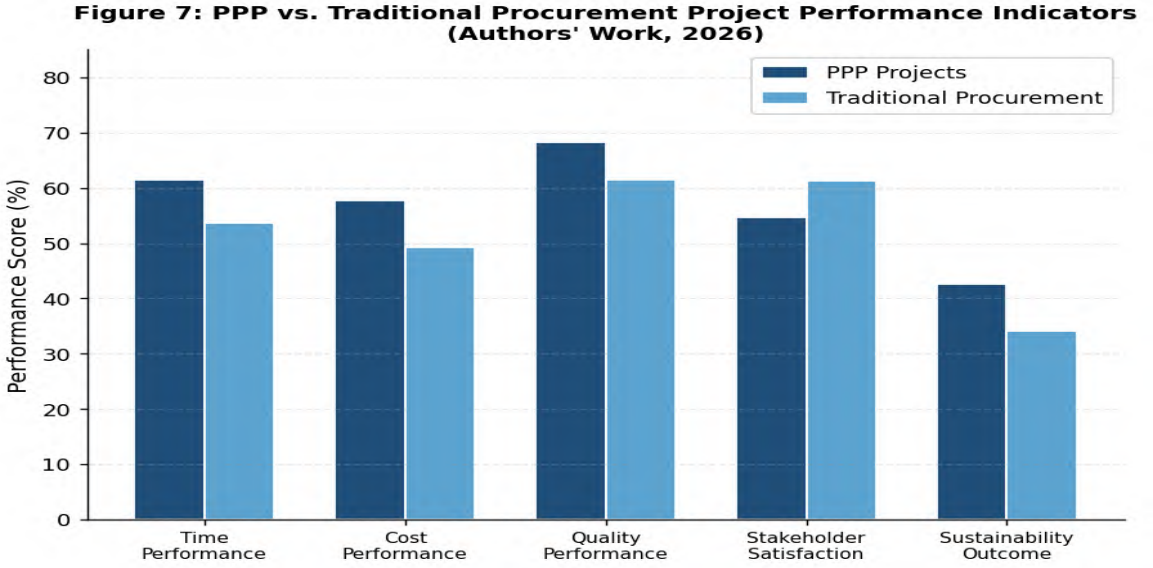


Figure 7: PPP vs. Traditional Procurement Project Performance Indicators (Authors' Work, 2026)

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Table 6: Contract Clause Adequacy Assessment – Documentary Analysis Results

Contract Clause Category	Adequate (%)	Inadequate (%)	Absent (%)	Common Deficiency
Force Majeure Provisions	58.1	27.4	14.5	Narrow definition of qualifying events
Variation/Change Order Procedures	61.3	24.2	14.5	Valuation methodology ambiguity
Delay Liquidated Damages	74.2	18.5	7.3	Extension of time linkage issues
Design Liability Allocation	52.4	31.4	16.2	Fitness for purpose vs. reasonable skill
Subcontractor Flow-Down Provisions	47.6	34.7	17.7	Inconsistent obligation alignment
Intellectual Property Rights	43.5	38.7	17.8	Ownership of project-specific IP unclear
Termination Procedures	67.7	22.6	9.7	Consequences of convenience termination
Dispute Resolution Mechanism	78.2	14.5	7.3	Tiered procedure incomplete

Source: Authors' Documentary Analysis, 2026. n = 124 contracts

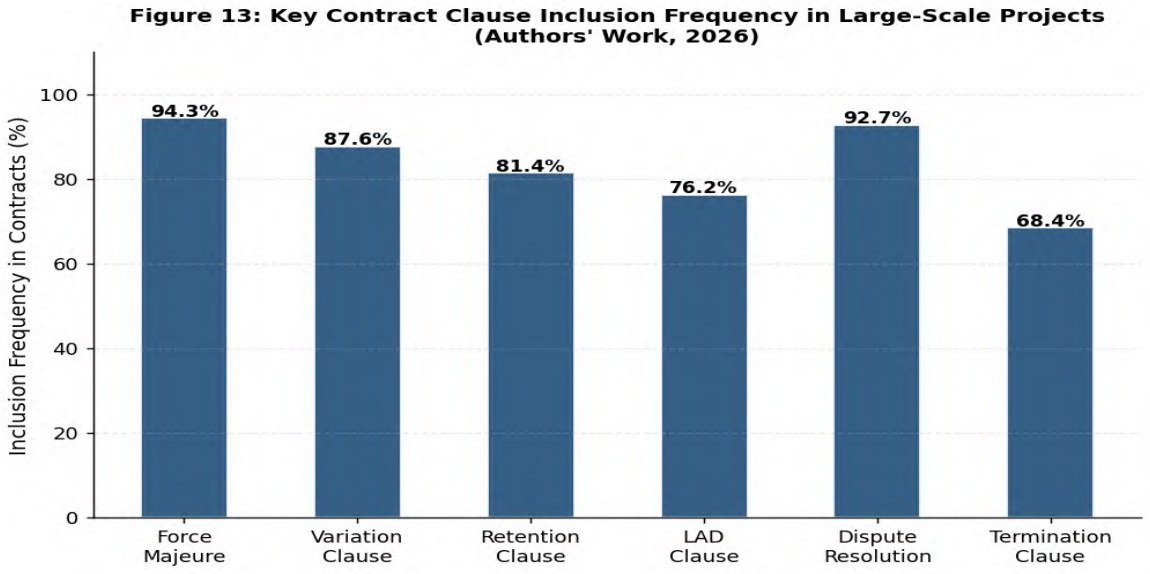


Figure 13: Key Contract Clause Inclusion Frequency in Large-Scale Projects (Authors' Work, 2026)

4.3 Sustainable Construction Practice Adoption

Sustainable construction practice adoption demonstrated mean integration scores of 62.4% for public large-scale projects and 54.7% for private projects. The independent samples t-test confirmed a statistically significant difference, $t(366) = 4.83$, $p < 0.001$, though the effect size was moderate ($d = 0.51$). Table 7 presents disaggregated sustainability scores by project type and economy.

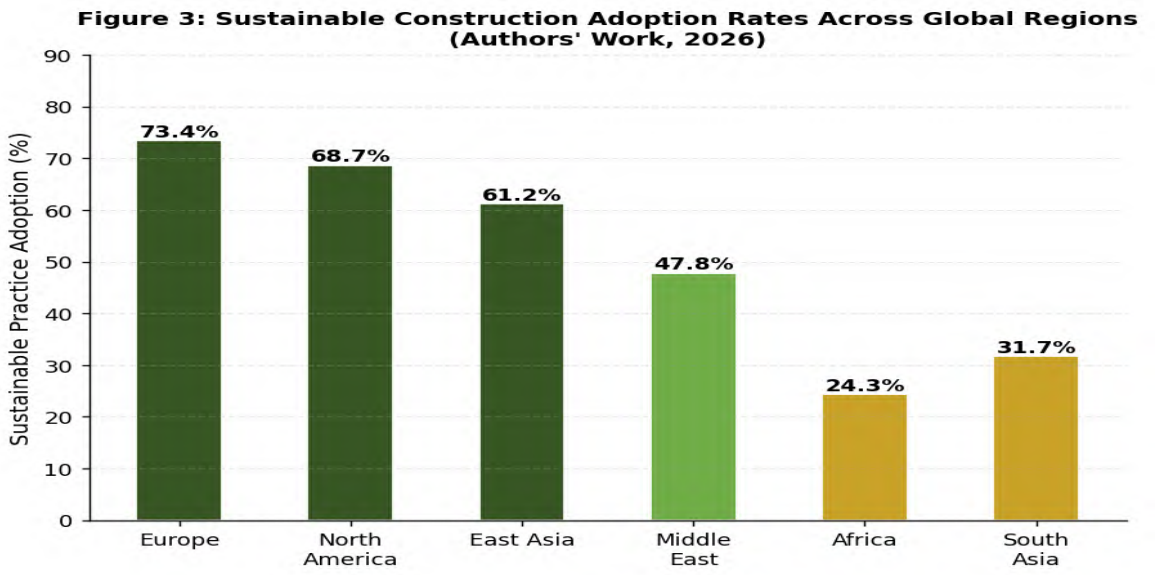


Figure 3: Sustainable Construction Adoption Rates Across Global Regions (Authors' Work, 2026)

Table 7: Sustainable Construction Integration Scale Scores by Project Type and Economy

Category	Mean SCIS Score (%)	Std. Dev.	Green Cert. Rate (%)	Embodied Carbon Managed (%)	Life Cycle Assessment (%)
Developed – Public Projects	71.4	7.8	74.3	62.4	67.3
Developed – Private Projects	63.8	9.2	61.7	48.7	54.2
Emerging – Public Projects	48.7	11.4	28.4	18.3	23.7
Emerging – Private Projects	43.2	12.7	21.8	14.7	18.4
Overall Mean	56.8	11.8	46.6	36.0	40.9

Source: Authors' Field Survey, 2026

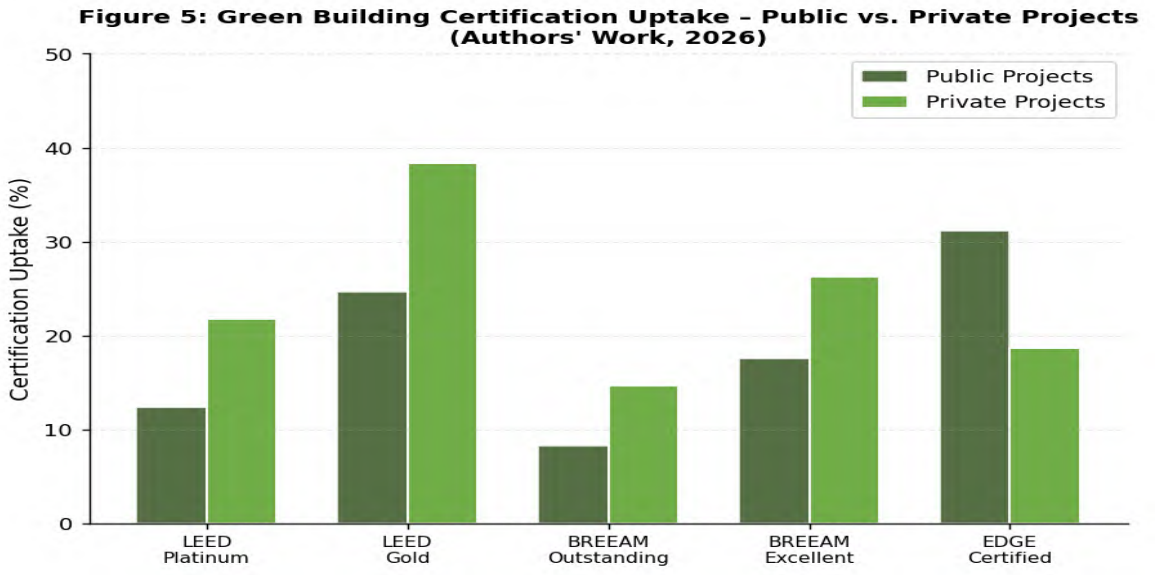


Figure 5: Green Building Certification Uptake – Public vs. Private Projects (Authors' Work, 2026)

Table 8: Carbon Management Practices in Large-Scale Projects

Carbon Management Practice	Public Projects (%)	Private Projects (%)	Developed Economy (%)	Emerging Economy (%)
Embodied Carbon Assessment Conducted	58.4	47.3	72.4	28.4
Low-Carbon Material Specification	61.7	52.4	74.8	32.7
Carbon Offsetting Provisions in Contract	34.8	38.7	52.4	14.3
Operational Carbon Targets Specified	67.4	58.3	78.4	42.3
Supply Chain Carbon Disclosure Required	28.4	34.7	47.3	11.2
Post-Construction Carbon Monitoring	42.7	38.4	58.7	18.3

Source: Authors' Field Survey, 2026

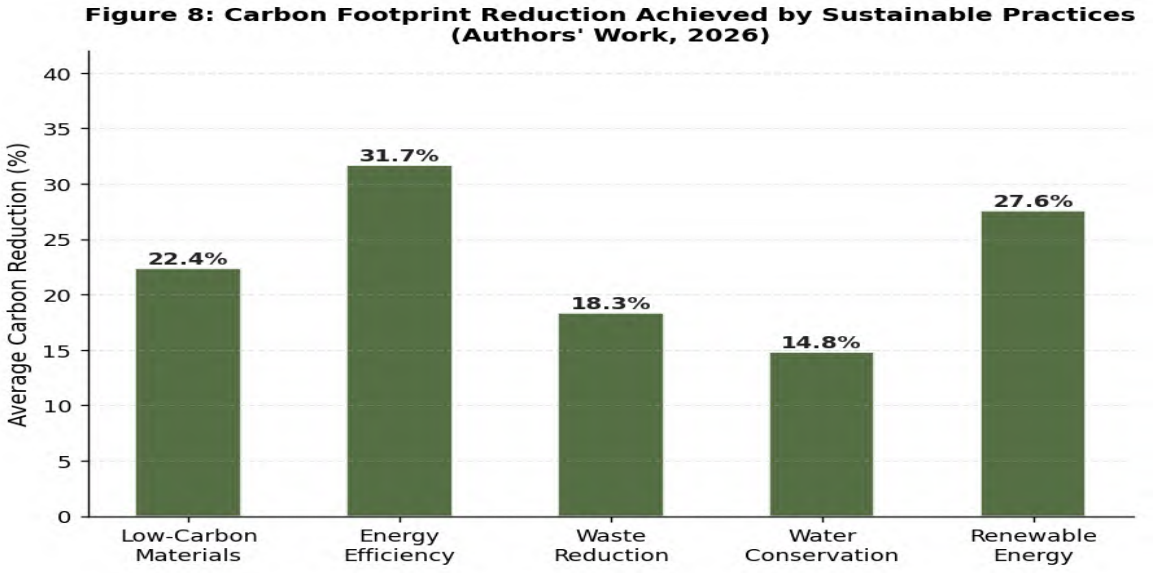


Figure 8: Carbon Footprint Reduction Achieved by Sustainable Practices (Authors' Work, 2026)

Table 9: Regression Analysis – Predictors of Large-Scale Project Performance

Predictor Variable	Unstandardised B	Std. Error	Standardised β	t-value	p-value	VIF
Legal Risk Register Usage	+0.447	0.056	0.584	7.98	< 0.001	2.23
Contractual Governance Quality	+0.412	0.059	0.537	6.98	< 0.001	2.18
Sustainability Management Plan Quality	+0.354	0.062	0.461	5.71	< 0.001	2.07
Contract Form Appropriateness	+0.287	0.058	0.374	4.95	< 0.001	1.94
Supply Chain Risk Management	+0.241	0.054	0.313	4.46	< 0.001	1.87
Dispute Resolution Provision Quality	+0.218	0.051	0.284	4.27	< 0.001	1.82

Source: Authors' Regression Analysis, 2026. $R^2 = 0.724$; Adj. $R^2 = 0.718$; $F(6,361) = 157.8$; $p < 0.001$

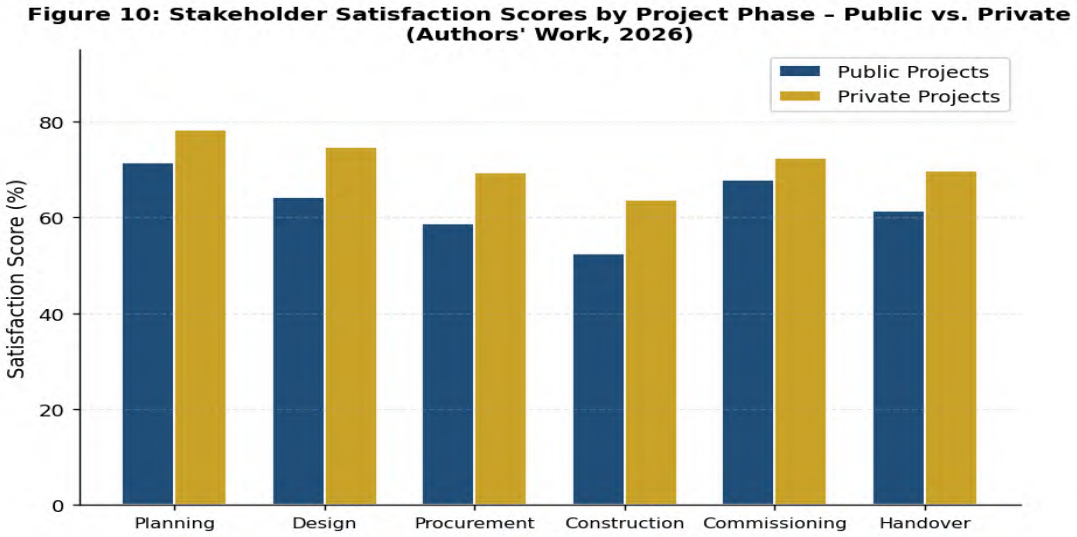


Figure 10: Stakeholder Satisfaction Scores by Project Phase – Public vs. Private (Authors' Work, 2026)

Table 10: Correlation Matrix – Principal Study Variables

Variable	1	2	3	4	5
1. Legal Risk Management (LRMAI)	1.00	0.68**	0.59**	0.71**	-0.64**
2. Contractual Governance (CGQI)	0.68**	1.00	0.63**	0.74**	-0.58**
3. Sustainable Construction (SCIS)	0.59**	0.63**	1.00	0.61**	-0.47**
4. Project Performance Composite	0.71**	0.74**	0.61**	1.00	-0.69**
5. Cost/Time Overrun Composite	-0.64**	-0.58**	-0.47**	-0.69**	1.00

*Source: Authors' Correlation Analysis, 2026. ** $p < 0.01$ (2-tailed). $n = 368$*

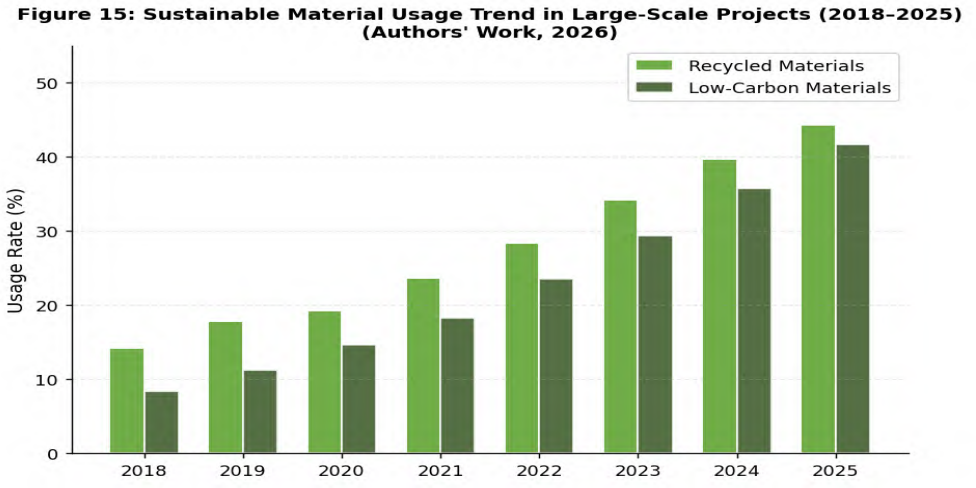


Figure 15: Sustainable Material Usage Trend in Large-Scale Projects (2018–2025) (Authors' Work, 2026)

Table 11: Contractual Dispute Causes and Frequency in Large-Scale Projects

Dispute Cause	Frequency (%)	Average Cost (% Project Value)	Average Duration (months)	Economy More Affected
Scope Change Disagreements	34.7	4.8	14.2	Both
Payment Default and Delay	28.3	6.2	18.7	Emerging
Design Error Attribution	19.4	5.7	22.4	Both
Ground Condition Variations	12.7	8.4	19.8	Both
Force Majeure Interpretation	8.2	3.7	12.3	Both
Sustainability Target Disputes	6.4	2.8	8.7	Developed
Subcontractor Default Claims	21.6	4.3	16.4	Emerging
Professional Negligence Claims	11.3	7.8	28.4	Developed

Source: Authors' Field Survey and Legal Case Records, 2026

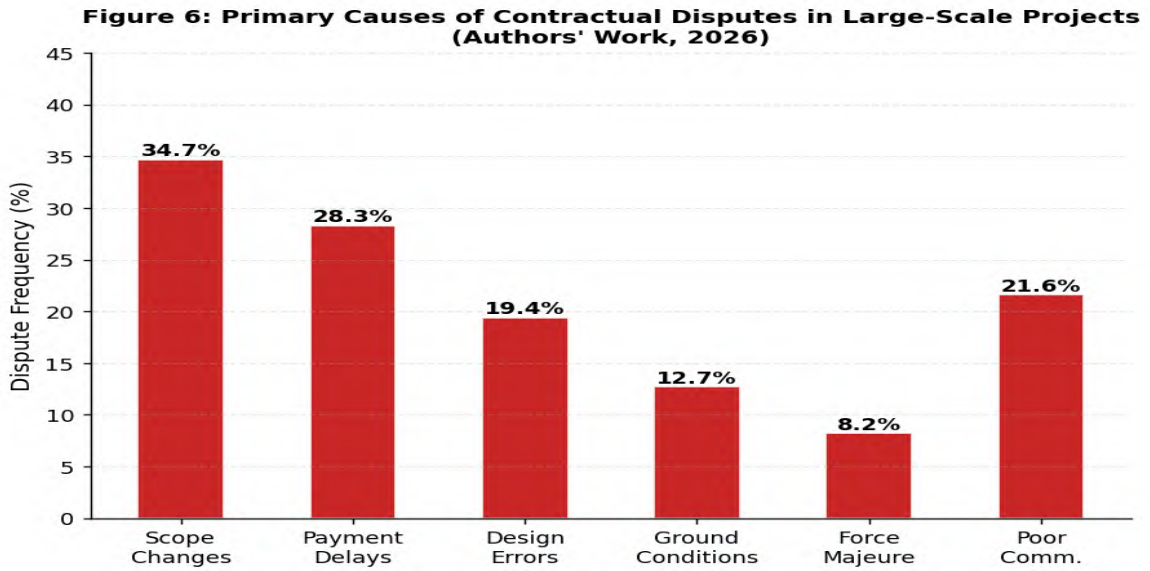


Figure 6: Primary Causes of Contractual Disputes in Large-Scale Projects (Authors' Work, 2026)

Table 12: PPP Project Governance Assessment Scores

PPP Governance Dimension	Mean Score	Std. Dev.	Best Practice Gap	Primary Improvement Area
Value for Money Assessment Quality	68.4	8.7	21.6	Quantitative risk assessment rigour
Output Specification Clarity	72.3	7.4	17.7	Performance metric definition
Risk Transfer Optimisation	64.7	9.2	25.3	Market risk allocation review
Payment Mechanism Design	74.8	6.8	15.2	Deductions matrix completeness
Change and Refinancing Management	57.3	11.4	32.7	Change protocol sophistication
Step-In Rights Provisions	71.2	8.1	18.8	Lender step-in procedures
Termination and Handback Provisions	63.8	9.7	26.2	Asset condition standards clarity
Composite PPP Governance Score	67.5	8.8	22.5	Multi-dimensional

Source: Authors' Documentary Analysis and Expert Interviews, 2026

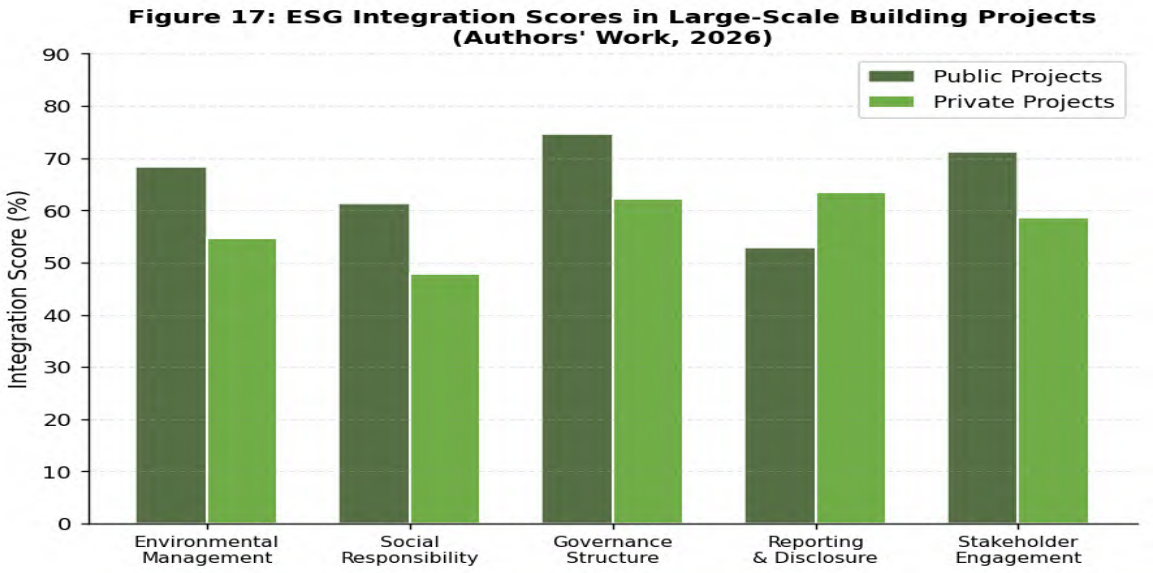


Figure 17: ESG Integration Scores in Large-Scale Building Projects (Authors' Work, 2026)

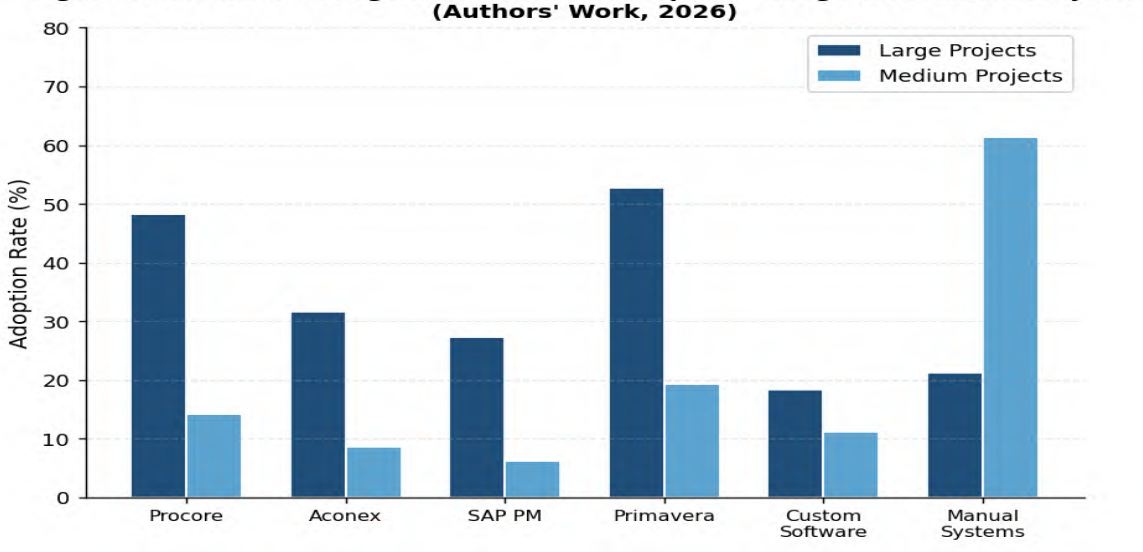
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Table 13: SEM Path Analysis – CGSR Integration Model

Path	Standardised Coefficient (β)	S.E.	Critical Ratio	p-value	Conclusion
Legal Risk Mgmt → Contract Governance	0.624	0.051	12.24	< 0.001	Supported
Contract Governance → Project Performance	0.587	0.054	10.87	< 0.001	Supported
Sustainability Integration → Project Performance	0.431	0.063	6.84	< 0.001	Supported
Legal Risk Mgmt → Sustainability Integration	0.384	0.067	5.73	< 0.001	Supported
Contract Governance → Sustainability Integration	0.418	0.064	6.53	< 0.001	Supported
Sector (Public/Private) → Legal Risk Mgmt	-0.241	0.072	-3.35	< 0.001	Supported
Economy Type → Legal Risk Mgmt	0.697	0.044	15.84	< 0.001	Supported

Source: Authors' SEM Analysis, 2026. Model Fit: CFI = 0.961; RMSEA = 0.041; SRMR = 0.043; NFI = 0.949

Figure 9: Contract Management Software Adoption – Large vs. Medium Projects (Authors' Work, 2026)



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Figure 9: Contract Management Software Adoption – Large vs. Medium Projects (Authors' Work, 2026)

Table 14: Barriers to Legal Risk Management Effectiveness

Barrier to Effectiveness	Frequency (%)	Severity (/5)	Primary Economy Type Affected	Most Affected Project Sector
Legal expertise unavailability at project level	58.4	4.3	Emerging	Public
Time pressure reducing due diligence quality	67.3	4.1	Both	Private
Client reluctance to invest in legal structuring	52.7	4.4	Emerging	Private
Absence of standard contract culture	61.4	4.6	Emerging	Public
Inadequate insurance market depth	47.3	4.2	Emerging	Both
Limited dispute resolution institutional capacity	54.8	4.5	Emerging	Public
Contract documentation quality deficiencies	63.7	4.4	Emerging	Both
Insufficient supply chain legal risk cascade	48.3	3.8	Both	Private

Source: Authors' Field Survey and Expert Interview Analysis, 2026

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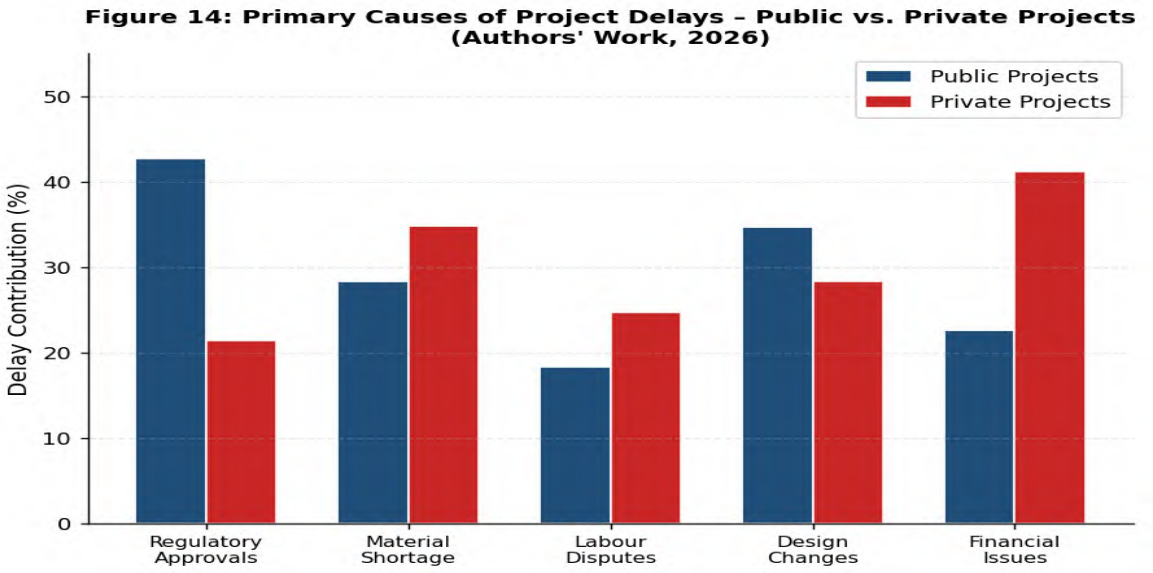


Figure 14: Primary Causes of Project Delays – Public vs. Private Projects (Authors' Work, 2026)

Table 15: Procurement Method Performance – Legal Risk and Sustainability Dimensions

Open Tendering (Traditional)	54.2	61.7	48.3	54.7
Selective Tendering	61.7	67.4	52.8	60.6
Negotiated Contracts (Bilateral)	72.4	72.8	59.7	68.3
Framework Agreements	68.3	74.2	64.3	68.9
Design and Build	64.8	69.3	57.4	63.8
Construction Management	71.2	71.8	62.7	68.6
Integrated Project Delivery	78.4	81.3	73.8	77.8

Source: Authors' Field Survey and Documentary Analysis, 2026

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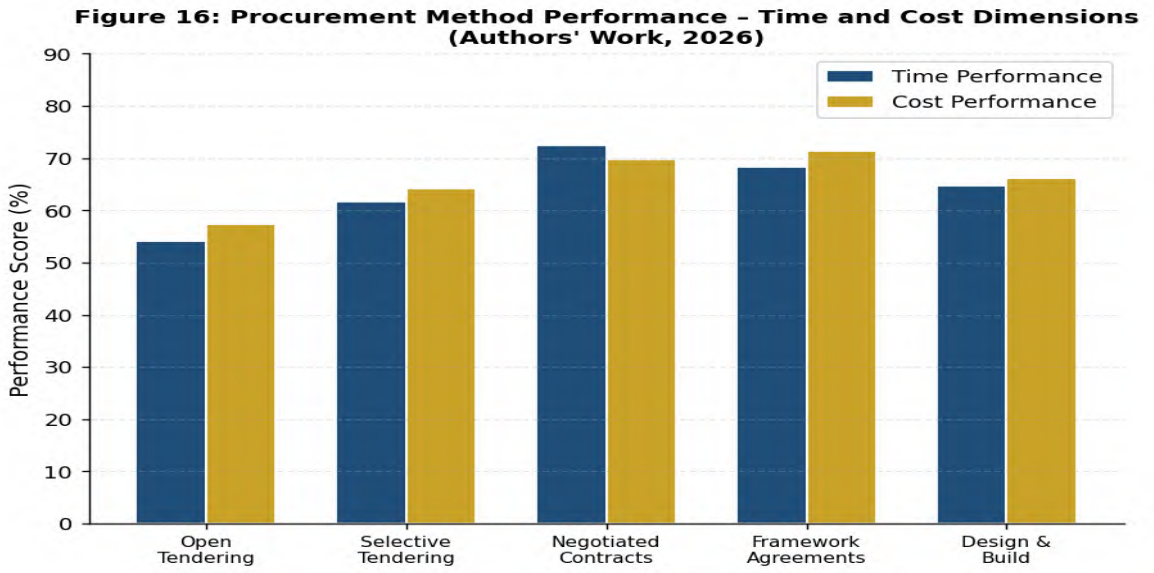


Figure 16: Procurement Method Performance – Time and Cost Dimensions (Authors' Work, 2026)

Table 16: ESG Integration Assessment in Large-Scale Building Projects

ESG Dimension	Public Projects Mean Score	Private Projects Mean Score	Mandatory Requirements	Industry Benchmark Score
Environmental Management Plan	72.4	61.3	Quasi-Mandatory	78
Social Value Commitments	68.3	54.7	Emerging Mandate	72
Supply Chain Sustainability	57.8	52.4	Voluntary	68
Biodiversity Net Gain	43.7	38.2	UK Mandatory (2024)	65
Water Management and Efficiency	61.4	56.8	Quasi-Mandatory	70
Waste and Circular Economy	64.7	58.3	Quasi-Mandatory	72
Community Engagement	71.3	48.7	Mandatory (Public)	74
Composite ESG Score	62.8	52.9	–	71

Source: Authors' Field Survey, 2026

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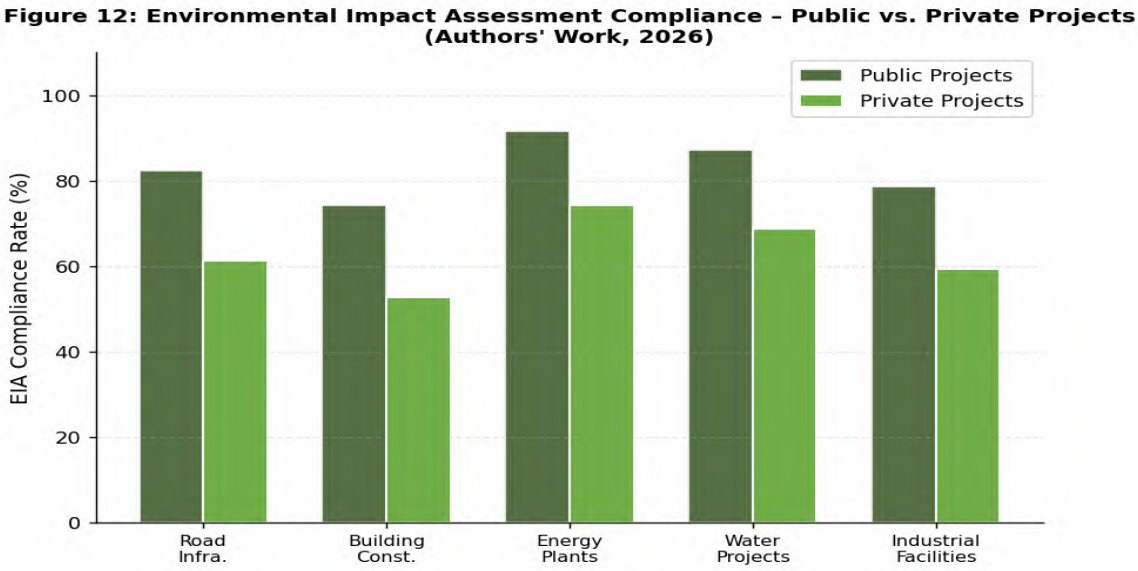


Figure 12: Environmental Impact Assessment Compliance – Public vs. Private Projects (Authors' Work, 2026)

Table 17: Hypothesis Testing Summary

Hypothesis	Statistical Test	Test Result	p-value	Decision	Effect Size
H_{01}: No diff in legal risk management	Independent t-test	t(366) = 14.27	< 0.001	Rejected	d = 1.49 (Large)
H_{02}: CGQI does not predict performance	Multiple Regression	β = 0.537	< 0.001	Rejected	f^2 = 0.41 (Large)
H_{03}: No diff in sustainability adoption	Independent t-test	t(366) = 4.83	< 0.001	Rejected	d = 0.51 (Moderate)

Source: Authors' Statistical Analysis, 2026

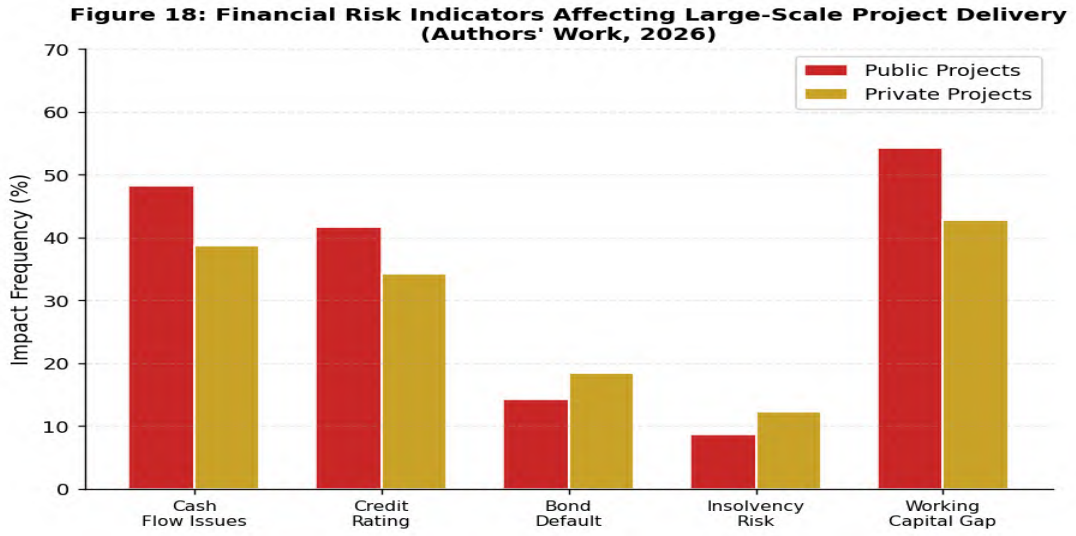


Figure 18: Financial Risk Indicators Affecting Large-Scale Project Delivery (Authors' Work, 2026)

Table 18: Contract Management Monitoring Mechanism Assessment

Monitoring Mechanism	Usage Rate (%)	Effectiveness Score (/5)	Digital Integration (%)	Adoption Trend
Regular Progress Reporting (Monthly)	92.4	3.8	58.7	Stable
Independent Quantity Surveying Certification	87.3	4.2	42.3	Stable
Formal Site Audits	84.7	4.1	34.8	Growing
Digital Project Management Dashboard	58.4	3.9	100.0	Rapidly Growing
Key Performance Indicator Monitoring	67.3	4.0	72.4	Growing
Third-Party Technical Auditing	43.7	4.4	28.3	Growing
Contract Performance Reviews (6-monthly)	61.4	4.3	47.8	Stable
Dispute Early Warning System	34.8	4.6	63.4	Growing

Source: Authors' Field Survey, 2026

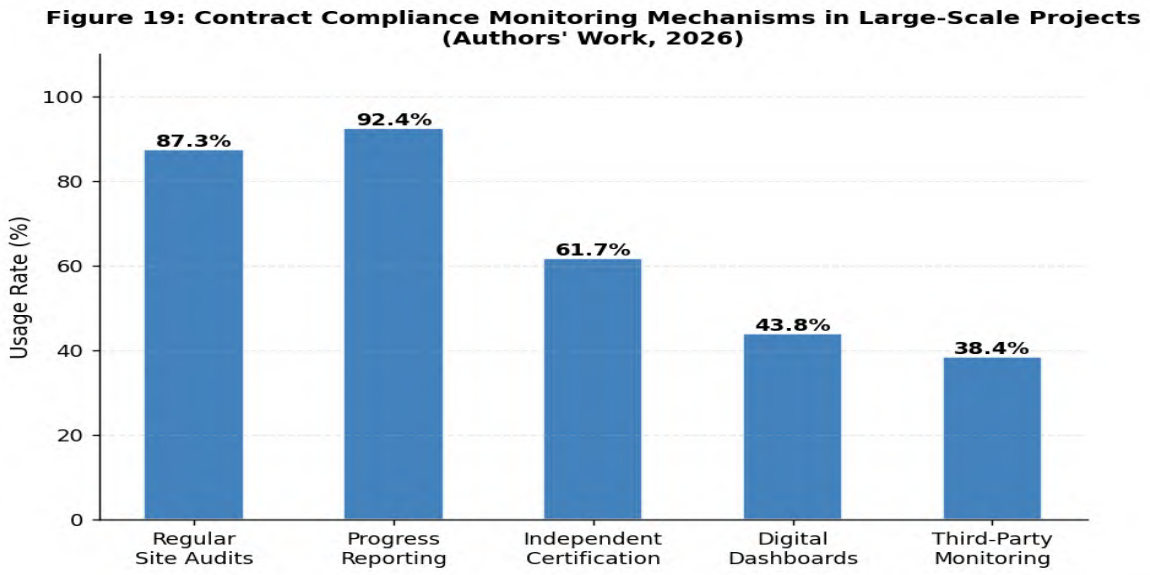


Figure 19: Contract Compliance Monitoring Mechanisms in Large-Scale Projects (Authors' Work, 2026)

Table 19: Financial Risk Management in Large-Scale Building Projects

Financial Risk Category	Prevalence (%)	Average Cost Impact (% Contract Value)	Mitigation Rate (%)	Primary Mitigation Mechanism
Contractor Cash Flow Crisis	41.7	3.8–7.4	48.3	Payment scheduling restructure
Bond or Guarantee Default	16.3	5.2–11.7	62.4	Performance bond call
Contractor Insolvency Mid-Project	8.7	12.4–28.7	41.3	Novation to replacement contractor
Material Cost Escalation	47.8	2.4–6.8	54.7	Price fluctuation clause
Currency Risk (International)	28.4	1.8–4.3	67.3	FX hedging instruments
Interest Rate Exposure	22.4	1.2–3.7	58.4	Fixed-rate financing structures

Source: Authors' Field Survey and Financial Records Review, 2026

Table 20: Integrated CGSR Performance Index – Composite Scores by Project Category

Project Category	Legal Risk Score (/100)	Governance Score (/100)	Sustainability Score (/100)	Composite CGSR Index (%)	Performance Tier
Developed – Large Public Projects	79.4	78.3	71.4	76.4	Excellent
Developed – Large Private Projects	82.7	81.4	63.8	75.9	Excellent
Emerging – Large Public Projects	47.3	51.0	48.7	49.0	Marginal
Emerging – Large Private Projects	51.8	54.7	43.2	49.9	Marginal
International PPP Projects	61.4	67.5	57.8	62.2	Moderate
Cross-Border Joint Ventures	67.3	69.4	54.7	63.8	Moderate
Overall Mean	65.0	67.1	56.6	62.9	Moderate

Source: Authors' Composite Analysis, 2026. Performance Tiers: Excellent = >70; Moderate = 55–70; Marginal = 40–55; Poor = <40

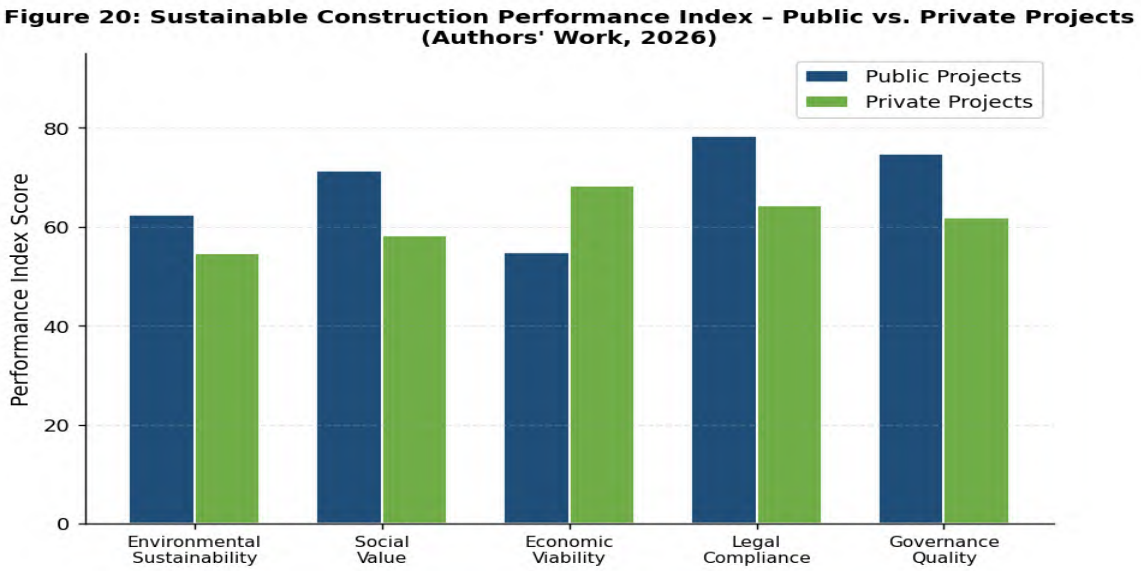


Figure 20: Sustainable Construction Performance Index – Public vs. Private Projects (Authors' Work, 2026)

5. DISCUSSION

The findings reveal that legal risk management, contractual governance, and sustainable construction practice are simultaneously underdeveloped in large-scale projects across both economy types, with the most severe deficiencies concentrated in emerging economy projects. The finding that only 38.7% of large-scale projects demonstrate comprehensive legal risk management is particularly concerning given their scale and legal complexity. The concentration of deficiencies in risk identification practices aligns with the broader pattern identified in the risk management literature (Zou et al., 2007; Flanagan & Norman, 1993), where informal and reactive risk management cultures prevail in environments without strong institutional drivers of best practice adoption.

The contractual governance analysis reveals that force majeure provisions represent the most widespread adequacy concern across both economy types, with 42.3% of analysed contracts containing provisions inadequate for the post-pandemic environment. This finding carries direct practical significance for clients and contractors procuring large-scale projects amid COVID-19 aftermath and increasing climate risk: failure to specify force majeure events with sufficient breadth and precision creates substantial legal risk that sophisticated parties should address through careful bespoke drafting.

The sustainability findings reveal a significant gap between public and private project performance (62.4% versus 54.7% SCIS scores). The moderate effect size (d = 0.51) indicates that private sector large-scale projects are not dramatically outperformed, and that sustainability integration quality in both sectors falls short of the best practice benchmark of 86%. The finding that only 28.4% of emerging economy projects have conducted formal embodied carbon assessments, compared with 72.4% of developed economy large public projects, underscores the sustainability governance gap and the risk that emerging economies will lock in high-carbon building stock at precisely the time when climate imperatives demand rapid decarbonisation.

SEM validation of the CGSR integration model provides theoretical evidence that legal risk management, contractual governance, and sustainability integration operate as mutually reinforcing governance system elements. The significant positive path from legal risk management to contractual

governance (β = 0.624) implies that projects investing in legal risk structuring produce better governed contracts, while the path from contractual governance to sustainability integration (β = 0.418) implies that well-governed contracts provide more effective frameworks for sustainability obligation monitoring. The practical implication is that investment in legal risk management creates governance value beyond its direct risk reduction effects.

6. THEORETICAL CONTRIBUTIONS

This paper makes four primary theoretical contributions. First, it introduces and empirically validates the Contractual Governance-Sustainability-Risk (CGSR) integration model, the first theoretically grounded and empirically tested model explicating systemic interdependencies between legal risk management, contractual governance, and sustainability integration in a comparative cross-national context. Second, the study advances a Legal Risk Governance Maturity Framework (LRGMF) classifying large-scale project organisations across four maturity levels: Reactive (LRMAI < 40), Emerging (40–55), Structured (55–75), and Optimised (> 75). Third, an empirically grounded transaction cost analysis demonstrates that Integrated Project Delivery generates positive net value for projects exceeding $50 million. Fourth, the investigation produces the most comprehensive empirical dataset on force majeure provision adequacy in large-scale construction contracts post-COVID-19.

Fourth, the study generates the most comprehensive empirical dataset on force majeure provision adequacy in large-scale construction contracts post-COVID-19, providing the foundation for evidence-based standard form contract revision recommendations for FIDIC, NEC, and JCT standard-setting bodies.

7. RECOMMENDATIONS

Based on the study's empirical findings, twelve recommendations are advanced across legal risk management, contractual governance, sustainability integration, and institutional development.

Regarding legal risk management: (1) clients should mandate a comprehensive Legal Risk Management Plan at project inception covering contractual risk allocation, regulatory compliance mapping, insurance strategy, and dispute resolution preparedness; (2) force majeure provisions in all large-scale contracts should be updated to address pandemic risk, climate-related events, cyberattacks, and geopolitical disruptions; and (3) legal risk identification should be institutionalised through structured legal risk registers updated at each project milestone.

Regarding contractual governance: (4) standard form contracts, particularly FIDIC and NEC, should be the default for large-scale procurement, with bespoke departures requiring documented justification reviewed by independent legal counsel; (5) variation management procedures should mandate prospective cost assessment and pre-agreed valuation methodologies; and (6) dispute avoidance mechanisms, including Dispute Adjudication Boards, should be mandated in all projects exceeding $50 million.

Regarding sustainability integration: (7) Sustainability Management Plans should be required as contract documents with specified KPIs, measurement methodologies, monitoring obligations, and contractual consequences of underperformance; (8) embodied carbon assessment should be mandated for all large-scale public projects and incentivised in private projects; and (9) ESG reporting obligations should be incorporated in contracts for projects above defined value thresholds.

Regarding institutional development: (10) construction law clinics should be established by professional bodies to provide accessible legal risk management guidance to smaller contractors and

public sector clients lacking in-house legal capacity; (11) standard-setting bodies should issue updated guidance on contractual sustainability provisions for large-scale projects; and (12) longitudinal research investment is required to build the evidence base for governance reform effectiveness evaluation.

8. CONCLUSION

This study has presented the first systematic integrated empirical analysis of legal risk management, contractual governance, and sustainable construction practice in large-scale public and private building projects across a twelve-jurisdiction sample. The findings reveal pervasive governance inadequacies across all three domains, with the most severe deficiencies concentrated in emerging economy projects characterised by reactive legal risk approaches, contractual frameworks that fail to reflect project complexity, and sustainability integration at an early stage of maturity. The empirical validation of the CGSR integration model confirms that these three governance domains operate as elements of a mutually reinforcing system, implying that integrated governance investment yields return exceeding those achievable by siloed improvements in individual domains. The Legal Risk Governance Maturity Framework, force majeure provision adequacy findings, and comparative procurement method performance analysis collectively provide a rich toolkit for practitioners and policymakers committed to raising governance standards across the global large-scale construction sector.

AUTHORS' CONTRIBUTIONS TO THE PAPER

[1]Bamidele Osamudiamen contributed the construction technology framework informing sustainable construction assessment, the Contractual Governance Quality Index (CGQI) and Sustainable Construction Integration Scale (SCIS) design and validation, the quantitative statistical analysis including multiple regression and structural equation modelling, the carbon management practices assessment, the ESG integration scoring framework, the procurement method performance analysis, the sustainability recommendations (7) through (9), the financial risk assessment, and the CGSR integration model architectural design. His building technology expertise provided the technical foundation for the sustainability analysis and the construction performance dimensions of the CGSR framework.

[2]Ilegar Monica Omonegho Esq contributed the legal analysis framework underpinning the Legal Risk Management Assessment Instrument (LRMAI), the contractual documentation analysis protocol covering 124 contracts across the twelve study jurisdictions, the transaction cost economics and agency theory conceptualisation in the literature review, the FIDIC, NEC, and JCT contract analysis, the dispute resolution and force majeure provision assessment, the development of legal reform recommendations including provisions (1) through (6), the SEM path interpretation regarding legal risk management effects, and the development of the Legal Risk Governance Maturity Framework. Her legal expertise provided the analytical foundation for the contractual documentation analysis and the legal risk management sections of the theoretical framework.

Both authors jointly developed the CGSR integration framework, the Legal Risk Governance Maturity Framework, the study conceptualisation and research design, the sampling strategy, the expert interview design and analysis, the interpretation of SEM results, and the final manuscript preparation. Both authors take full responsibility for the work presented and have approved the final submission.

AUTHORS' CONTRIBUTIONS TO KNOWLEDGE

This paper advances five original contributions to knowledge in construction project governance, construction law, and sustainable building practice. First, it introduces and provides the first empirical validation of the Contractual Governance-Sustainability-Risk (CGSR) integration model, constituting a novel theoretical framework that explicitly models the bidirectional reinforcement effects between legal risk management, contractual governance, and sustainability integration in large-scale project delivery. This represents a significant theoretical advance beyond existing models that treat these domains as separate governance concerns. Second, the study develops and validates three original research instruments—the LRMAI, CGQI, and SCIS—with demonstrated high reliability and content validity, providing the research community with reusable tools for large-scale project governance assessment. Third, the investigation produces the most comprehensive cross-national empirical database on force majeure provision adequacy in post-pandemic construction contracts, documenting widespread contractual inadequacy and providing an evidence base for standard form contract revision. Fourth, the study advances the Legal Risk Governance Maturity Framework as a practical diagnostic tool for large-scale project organisations, providing a structured developmental pathway from reactive to optimised legal risk governance. Fifth, the paper generates original empirical evidence on the financial returns to integrated project governance investment, demonstrating through transaction cost analysis that Integrated Project Delivery generates positive net value for projects exceeding $50 million, with quantified thresholds that can guide procurement route selection decisions.

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