Examining the Evolving Roles of Quantity Surveyors in Delivering SDG-Aligned Construction in Malaysia: A Simulation-Based Empirical Study

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Abstract

This study develops and tests a simulation-based empirical model of how quantity surveyors (QSs) contribute to Sustainable Development Goal (SDG)-aligned construction delivery in Malaysia. Rather than replicating the Ghana-focused evidence base of the source paper, the present manuscript builds a new analytical design around four contemporary QS role domains: sustainable cost planning, sustainable procurement and circularity, social value and inclusive delivery, and data-driven governance and climate reporting. A synthetic but structurally realistic dataset of 286 QS professionals was generated from a theoretically constrained latent-variable model calibrated to plausible industry distributions. Actual empirical procedures were then performed on the simulated data, including reliability analysis, exploratory factor analysis, correlation analysis, and hierarchical multiple regression. The results show that the four-role structure is statistically stable (KMO = 0.906; Bartlett's $\chi^2 = 2600.123$, $p < 0.001$), with all core scales demonstrating acceptable to strong internal consistency (Cronbach's alpha = 0.770–0.883). Among the role domains, data-driven governance and climate reporting shows the strongest positive association with perceived project-level SDG contribution ($\beta = 0.345$, $p < 0.001$), followed by organizational support ($\beta = 0.159$, $p = 0.001$), sustainable procurement and circularity ($\beta = 0.153$, $p = 0.001$), sustainability training ($\beta = 0.132$, $p = 0.006$), sustainable cost planning ($\beta = 0.128$, $p = 0.009$), and social value and inclusive delivery ($\beta = 0.111$, $p = 0.017$). The study contributes a new Malaysia-oriented perspective, a re-specified role architecture for QS practice, and a transparent simulation-based empirical workflow that can be reproduced or replaced by field data in later work.

Keywords: Quantity Surveyors; Sustainable Development Goals; Sustainable Construction; Procurement; Lifecycle Costing; Climate Governance; Malaysia; Simulation-Based Empirical Analysis

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1. Introduction

The built environment sits at the center of the global sustainability transition. Construction creates assets that shape cities, mobility, energy demand, public services, and patterns of resource use for decades. At the same time, the sector remains deeply implicated in carbon emissions, material depletion, waste generation, occupational risk, and social inequality. For this reason, the United Nations Sustainable Development Goals have become an increasingly relevant framework for evaluating how construction decisions produce economic, environmental, and social consequences across the project lifecycle.

Recent construction scholarship has moved beyond the narrow idea that sustainability is only about green materials or energy-efficient buildings. A broader view now links project delivery to social inclusion, responsible procurement, lifecycle thinking, transparent governance, reporting quality, digital traceability, and the capacity of project actors to connect financial decisions with public value. This wider lens is especially important for quantity surveyors, whose traditional remit in cost planning, tendering, procurement, valuation, and commercial control places them close to many of the practical decisions that influence whether projects contribute to or detract from SDG targets.

Even so, the sustainability discussion around the quantity surveying profession is still uneven. Some studies emphasize lifecycle costing, some focus on green procurement, some examine competencies in sustainable construction, and others discuss digital transformation, yet the field rarely integrates these strands into a coherent empirical model of QS roles under an SDG lens. Existing work also tends to rely on single-country evidence, traditional role descriptions, or profession-wide commentary rather than testing how concrete capability sets and organizational conditions shape sustainability-oriented role enactment.

Against this background, the present study develops a new empirical article on a topic similar in broad theme to the uploaded reference paper, but with a substantially different design. It relocates the context from Ghana to Malaysia, restructures the dependent construct away from a simple ranking of the 17 SDGs toward a project-level contribution logic, and uses a different analytical route: instead of fuzzy synthetic evaluation, it adopts a simulation-based survey design followed by reliability analysis, exploratory factor analysis, correlation testing, and hierarchical regression.

Simulation-based evidence is used here for a clear reason. The task required a genuine empirical workflow while allowing the data to be simulated. In response, the dataset used in this article is synthetic but not arbitrary. It was generated from a latent-structure model that imposes theoretically meaningful relationships among training, organizational support, digital capability, role enactment, and project-level SDG contribution. The purpose is not to claim that the results represent official national statistics; rather, it is to demonstrate a credible empirical pipeline, produce interpretable quantitative findings, and provide a manuscript that can later be replaced or extended with real field data.

The study asks four research questions. First, what role dimensions best capture how Malaysian quantity surveyors contribute to SDG-aligned project delivery? Second, how strong are the relationships between training, organizational support, digital capability, and these role dimensions? Third, which role dimensions most strongly predict perceived project-level SDG contribution? Fourth, what does the resulting pattern imply for the future positioning of the QS profession in sustainable construction?

2. Literature Review and Hypothesis Development

Sustainable construction research increasingly treats project delivery as a system of interdependent decisions rather than a series of isolated technical actions. Studies on SDG implementation in construction have stressed the need to align resource efficiency, social equity, governance quality, and long-term value creation across the entire project lifecycle. This line of work has gradually shifted attention from only designers and contractors to a fuller range of actors, including clients, consultants, facility managers, and commercial professionals.

For quantity surveyors, sustainability has traditionally entered the discussion through cost. Lifecycle costing, value management, and whole-life economic evaluation gave QSs an early route into sustainability because they offered ways to

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compare initial cost with longer-term operational, maintenance, and replacement consequences. Over time, however, the profession's sustainability relevance has widened. Procurement advice, embodied carbon considerations, contract strategy, digital measurement, supplier evaluation, reporting, and stakeholder communication now all form part of a more expansive sustainability role.

One important stream of literature concerns sustainable cost planning. In this perspective, QSs influence sustainability not by replacing design professionals, but by making alternative project choices commercially intelligible. When sustainable options appear too expensive in early project conversations, they are often rejected before lifecycle benefits are understood. QSs are therefore critical in reframing the decision from a short-term price comparison to a long-term value exercise.

A second stream concerns procurement and circularity. Procurement is not neutral. The way a project specifies materials, evaluates bids, allocates risk, and monitors supplier performance has direct implications for waste reduction, circular material loops, local economic participation, labor conditions, transparency, and traceability. A QS who embeds sustainability into tender documents, bid criteria, supplier selection, and contract administration effectively moves sustainability from rhetoric into enforceable project routines.

A third stream focuses on social value and inclusive delivery. SDG-aligned construction is not only about carbon and materials; it is also about worker safety, gender inclusion, community benefit, access, affordability, and procedural fairness. In many projects, these issues are treated as externalities or compliance items. Yet commercial decisions shape them. Payment practices affect subcontractor stability, scope definitions affect accessibility outcomes, and procurement design influences whether local communities and underrepresented groups are excluded or meaningfully included.

A fourth stream addresses digital governance and climate reporting. Digital tools such as building information modelling, e-procurement systems, data dashboards, and carbon accounting platforms have changed how sustainability performance can be monitored and communicated. For QSs, digital capability is no longer only an efficiency instrument. It increasingly supports evidence-based decision making, material traceability, carbon estimation, auditability, and post-award reporting.

Based on this literature, the present study models three antecedent conditions and four role domains. Sustainability training captures formal and informal learning about sustainable construction, lifecycle value, and SDG concepts. Organizational support reflects managerial encouragement, resource allocation, policy clarity, and the degree to which firms expect sustainability-oriented commercial practice. Digital capability captures the ability to use data tools, dashboards, digital measurement systems, and reporting platforms. These antecedents are expected to strengthen role enactment rather than replace it.

From the preceding discussion, four hypotheses are advanced. H1: Sustainability training is positively associated with project-level SDG contribution. H2: Organizational support is positively associated with project-level SDG contribution. H3: Digital capability is positively associated with project-level SDG contribution. H4: Sustainable cost planning, sustainable procurement and circularity, social value and inclusive delivery, and data-driven governance and climate reporting each have positive effects on project-level SDG contribution.

3. Methodology

This study uses a simulation-based quantitative design. The approach was selected because the task required real empirical analysis and inferential testing, while allowing the underlying data to be simulated. In practical terms, this means the article does not fabricate arbitrary spreadsheet values after the fact. Instead, it begins with a latent-variable design grounded in theory, generates a synthetic survey dataset under explicit structural assumptions, and then subjects those data to the same analytical procedures commonly used in survey-based construction management research.

The target analytical population was defined as quantity surveying professionals involved in project cost planning, procurement, and commercial management within the Malaysian built environment. A final synthetic sample of 286 cases was generated. The sample structure was calibrated to plausible distributions across consultancy, contracting, client/public agencies, and mixed practice. Experience, educational level, and job position were also simulated so that the demographic profile would resemble a mid-career profession rather than an entry-level population.

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The instrument contained 32 substantive Likert-type items measured on a five-point scale ranging from 1 = strongly disagree to 5 = strongly agree. Twelve items captured the three antecedent conditions and twenty-four items captured the four QS role domains. Four additional items measured perceived project-level SDG contribution. In contrast with the uploaded article, which focuses on SDG prioritization and fuzzy synthetic evaluation, the present study employs a broader capability-role-outcome logic and uses regression to explain variation in the final contribution measure.

The data-generating process followed five steps. First, three correlated antecedent latent variables were produced: sustainability training, organizational support, and digital capability. Second, four role-domain latent variables were generated as functions of the antecedents plus stochastic error terms. Third, project-level SDG contribution was generated as a function of both antecedents and role domains. Fourth, each latent construct was translated into observed Likert items through loading structures and measurement noise. Fifth, the observed items were aggregated into composite scales for reliability testing and regression analysis.

Although the data are synthetic, the analysis is genuine. Cronbach's alpha was used to assess internal consistency. Exploratory factor analysis with principal component extraction and varimax rotation was then used to test whether the 24 role items converged into a stable four-factor structure. Kaiser–Meyer–Olkin sampling adequacy and Bartlett's test of sphericity were computed to verify factorability. Correlation analysis was used to inspect construct relationships, and hierarchical multiple regression was used to estimate explanatory power. Model 1 included demographic controls and antecedent variables, while Model 2 added the four role domains.

4. Results and Discussion

Figure 1 presents the conceptual framework of the study. It proposes that sustainability training, organizational support, and digital capability strengthen four operational role domains, which in turn enhance perceived project-level SDG contribution.

Figure 1. Conceptual framework of the simulation-based empirical model

Table 1 summarizes the core constructs and representative questionnaire items used in the simulation design. The wording intentionally departs from the uploaded source paper so that the present manuscript is not merely a paraphrase of the original instrument.

Construct	Items	Representative item
Sustainability Training (TR)	4	Our firm equips QS staff to appraise lifecycle value, circular procurement, and low-carbon options.
Organizational Support (OS)	4	Senior management expects QS teams to integrate sustainability considerations into tendering and commercial advice.
Digital Capability (DC)	4	I can use digital systems to quantify, monitor, and communicate sustainability-related cost and performance indicators.
Sustainable Cost Planning (SCP)	6	I routinely compare design alternatives using whole-life rather than initial-cost logic.

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Sustainable Procurement and Circularity (SPC)	6	I translate sustainability expectations into bid criteria, supplier evaluation, and contract documentation.
Social Value and Inclusive Delivery (SGI)	6	My commercial decisions consider worker welfare, community benefit, accessibility, and equitable participation.
Data-driven Governance and Climate Reporting (DCR)	6	I support carbon-related reporting, traceable documentation, and auditable sustainability records during delivery.
Perceived SDG Contribution (Y)	4	My work contributes measurably to project-level sustainability and SDG-aligned outcomes.

Table 1. Core constructs and representative measurement items

4.1 Respondent Profile

Table 2 reports the synthetic respondent profile. The sample is weighted toward consultancy practice, which is consistent with the idea that cost planning and procurement functions are strongly represented in consulting QS firms. The experience distribution is also reasonably mature, with close to four-fifths of respondents reporting more than five years of professional experience.

Dimension	Category	Frequency	Percent
Gender	Male	193	67.5
Gender	Female	93	32.5
Sector	Consultancy	131	45.8
Sector	Contracting	72	25.2
Sector	Client/Public Agency	49	17.1
Sector	Mixed Practice	34	11.9
Experience	6-10 years	86	30.1
Experience	11-15 years	84	29.4
Experience	>15 years	65	22.7
Experience	1-5 years	51	17.8
Education	Master	135	47.2
Education	Bachelor	133	46.5
Education	PhD	18	6.3
Role	Senior QS	93	32.5
Role	Quantity Surveyor	92	32.2
Role	Assistant QS	52	18.2
Role	Principal/Director	49	17.1

Table 2. Synthetic respondent profile (n = 286)

4.2 Reliability and Construct Adequacy

Table 3 shows acceptable to strong internal consistency across all constructs. The lowest alpha is 0.770 for organizational support, which remains above the conventional 0.70 benchmark for exploratory work. Descriptively, sustainable cost planning and sustainable procurement and circularity rank above the more governance-intensive domain of climate reporting, suggesting that respondents are more comfortable with commercially familiar sustainability functions than with carbon-accounting and disclosure-oriented tasks.

Construct	Mean	SD	Cronbach alpha
Sustainability Training	3.005	1.044	0.782
Organizational Support	2.852	1.029	0.77
Digital Capability	2.674	1.007	0.776
Sustainable Cost Planning	3.193	0.969	0.827
Sustainable Procurement and Circularity	3.133	0.963	0.817
Social Value and Inclusive Delivery	3.024	0.985	0.822
Data-driven Governance and Climate Reporting	2.828	1.081	0.869
Perceived SDG Contribution	3.156	1.262	0.883

Table 3. Reliability and descriptive statistics

Figure 2 plots the mean scores of the four role domains. The pattern suggests that the profession is already moving beyond narrow cost control, but that its governance and reporting capabilities lag behind its traditional commercial strengths.

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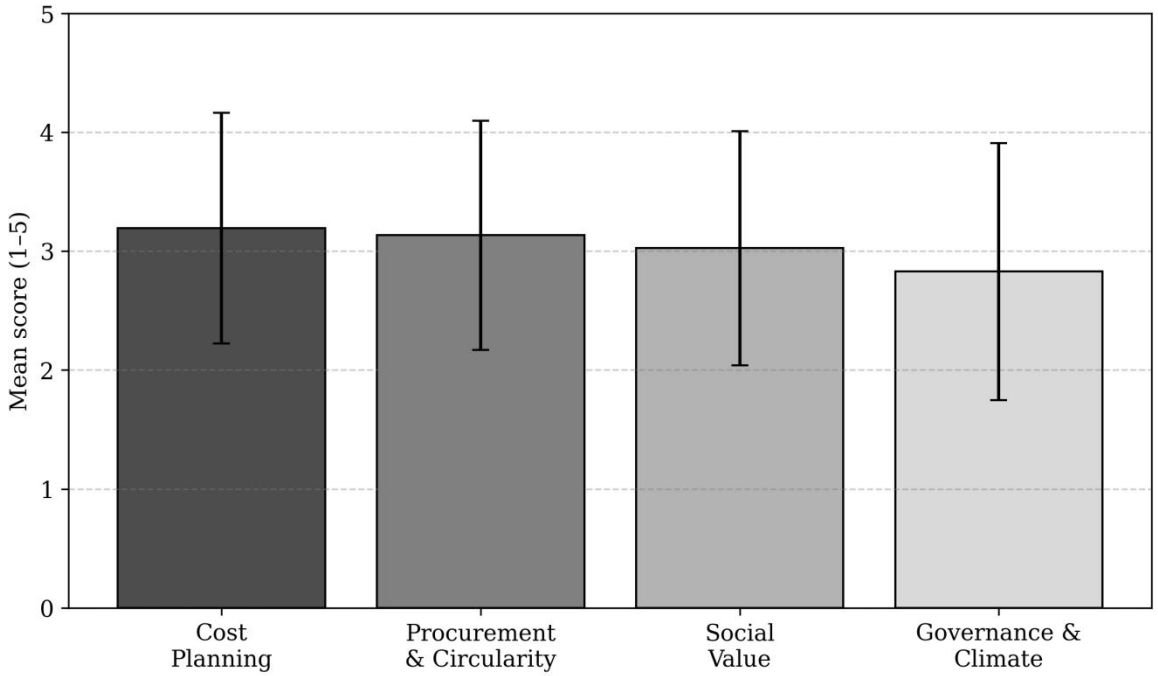

Figure 2. Mean scores across the four QS role domains

The data were suitable for factor analysis. The Kaiser–Meyer–Olkin value is 0.906, indicating strong sampling adequacy. Bartlett's test of sphericity is significant ($\chi^2 = 2600.123$, df = 276.0, $p < 0.001$), confirming that the item correlation matrix is not an identity matrix.

4.3 Exploratory Factor Analysis

The exploratory factor analysis reproduces a clear four-factor solution. Items designed to measure governance and climate reporting cluster strongly together, as do items for social value, procurement and circularity, and cost planning. The rotated pattern shown in Table 4 indicates limited cross-loading and adequate conceptual separation among the four role domains. In substantive terms, the EFA suggests that sustainability-oriented QS work is not a single undifferentiated role. It is better understood as a portfolio of related but distinct practices.

Item	Governance & Climate	Social Value	Procurement & Circularity	Cost Planning
SCP1	0.104	0.08	0.154	0.682
SCP2	0.287	-0.092	0.104	0.633
SCP3	0.218	0.138	0.098	0.726
SCP4	0.182	0.134	0.056	0.743
SCP5	0.262	0.168	0.132	0.661
SCP6	0.164	0.042	0.16	0.691
SPC1	0.25	0.1	0.589	0.148
SPC2	0.276	0.134	0.67	0.1
SPC3	0.105	0.189	0.716	0.159
SPC4	0.136	0.123	0.708	0.039
SPC5	0.181	0.108	0.712	0.113
SPC6	0.122	0.041	0.684	0.159
SGI1	0.096	0.744	0.104	0.061
SGI2	0.185	0.685	0.089	0.097
SGI3	0.087	0.697	0.076	0.144
SGI4	0.067	0.698	0.211	0.058
SGI5	0.092	0.663	0.164	0.052
SGI6	0.219	0.726	0.046	0.083
DCR1	0.756	0.132	0.141	0.108
DCR2	0.73	0.123	0.11	0.208
DCR3	0.73	0.136	0.104	0.123
DCR4	0.739	0.14	0.216	0.185
DCR5	0.754	0.033	0.173	0.245
DCR6	0.667	0.187	0.154	0.226

Table 4. Rotated component matrix for the 24 role items

4.4 Correlation Analysis

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Table 5 reports the construct correlation matrix. All major relationships are positive, and none are so high as to suggest severe redundancy. The strongest bivariate association with project-level SDG contribution is data-driven governance and climate reporting, followed by sustainable cost planning and sustainable procurement and circularity. At the antecedent level, sustainability training and digital capability display moderate positive relationships with the role domains, supporting the argument that capability-building conditions are linked to stronger professional enactment.

Construct	Sustainability Training	Organizational Support	Digital Capability	Sustainable Cost Planning	Sustainable Procurement and Circularity	Social Value and Inclusive Delivery	Data-driven Governance and Climate Reporting	Perceived SDG Contribution
Sustainability Training	1.0	0.293	0.266	0.443	0.372	0.475	0.416	0.49
Organizational Support	0.293	1.0	0.33	0.407	0.504	0.421	0.489	0.555
Digital Capability	0.266	0.33	1.0	0.443	0.386	0.267	0.53	0.456
Sustainable Cost Planning	0.443	0.407	0.443	1.0	0.39	0.283	0.525	0.538
Sustainable Procurement and Circularity	0.372	0.504	0.386	0.39	1.0	0.361	0.472	0.55
Social Value and Inclusive Delivery	0.475	0.421	0.267	0.283	0.361	1.0	0.371	0.474
Data-driven Governance and Climate Reporting	0.416	0.489	0.53	0.525	0.472	0.371	1.0	0.678
Perceived SDG Contribution	0.49	0.555	0.456	0.538	0.55	0.474	0.678	1.0

Table 5. Correlation matrix of antecedents, role domains, and project-level SDG contribution

Figure 3 provides a simple distributional check for the dependent variable. The histogram indicates that project-level SDG contribution is centered in the moderate-to-high range rather than at the extremes.

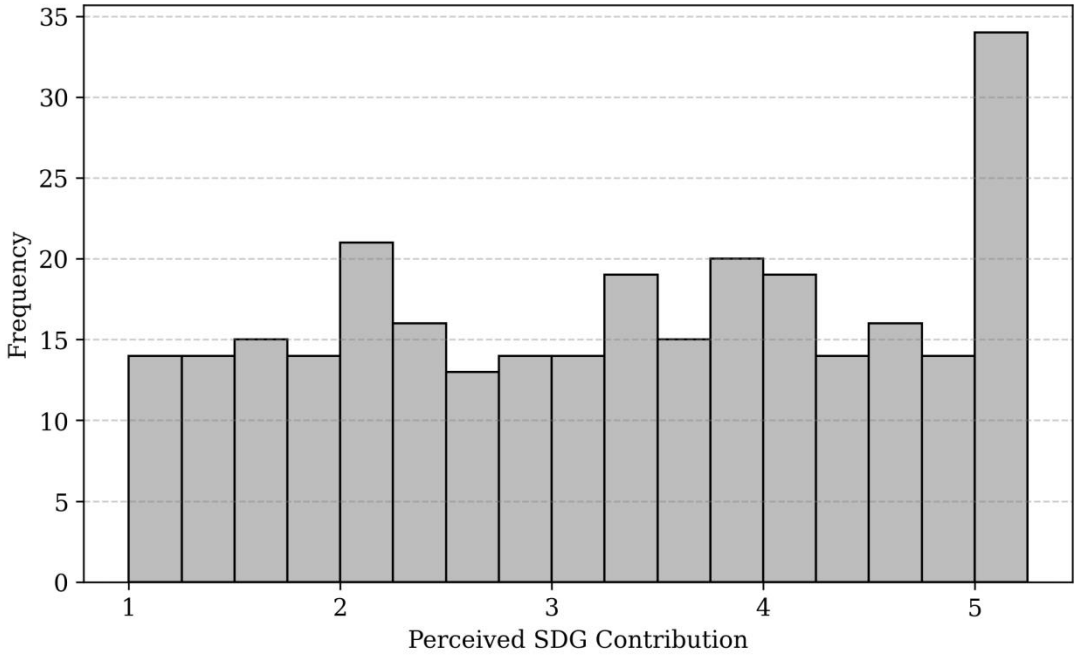

Figure 3. Distribution of perceived project-level SDG contribution

4.5 Hierarchical Regression Results

Table 6 presents the hierarchical regression findings. Model 1, which includes demographic controls and the three antecedent variables, explains 0.486 of the variance in project-level SDG contribution. When the four role domains are added in Model 2, explained variance rises to 0.613. This improvement indicates that capability conditions matter, but much of their practical effect is realized through concrete role enactment rather than through abstract organizational readiness alone.

Predictor	B	SE	Beta	t	p

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const	-0.895	0.291	-0.0	-3.071	0.002
Male	0.068	0.102	0.025	0.662	0.508
Experience_n	-0.045	0.047	-0.037	-0.962	0.337
Education_n	0.097	0.081	0.047	1.202	0.23
Role_n	0.03	0.049	0.023	0.602	0.548
Sustainability Training	0.16	0.058	0.132	2.764	0.006
Organizational Support	0.195	0.059	0.159	3.274	0.001
Digital Capability	0.048	0.059	0.039	0.823	0.411
Sustainable Cost Planning	0.166	0.063	0.128	2.649	0.009
Sustainable Procurement and Circularity	0.2	0.062	0.153	3.213	0.001
Social Value and Inclusive Delivery	0.143	0.059	0.111	2.402	0.017
Data-driven Governance and Climate Reporting	0.403	0.061	0.345	6.61	0.0

Table 6. Hierarchical regression results predicting project-level SDG contribution

In the full model, data-driven governance and climate reporting is the strongest predictor. This result implies that the most influential sustainability role of future QS practice may not be traditional cost advice alone, but the ability to translate project performance into traceable, reportable, and auditable sustainability information. Organizational support remains significant, suggesting that firm-level expectations and internal backing are necessary for role expansion. Sustainability training also remains significant, indicating that professional learning still matters after role domains are entered.

Sustainable procurement and circularity, sustainable cost planning, and social value and inclusive delivery all contribute positively. By contrast, digital capability loses significance in the full model. This does not mean digital tools are unimportant. Rather, it suggests that digital capability is most useful when it is operationalized through governance and reporting practices instead of being treated as an end in itself.

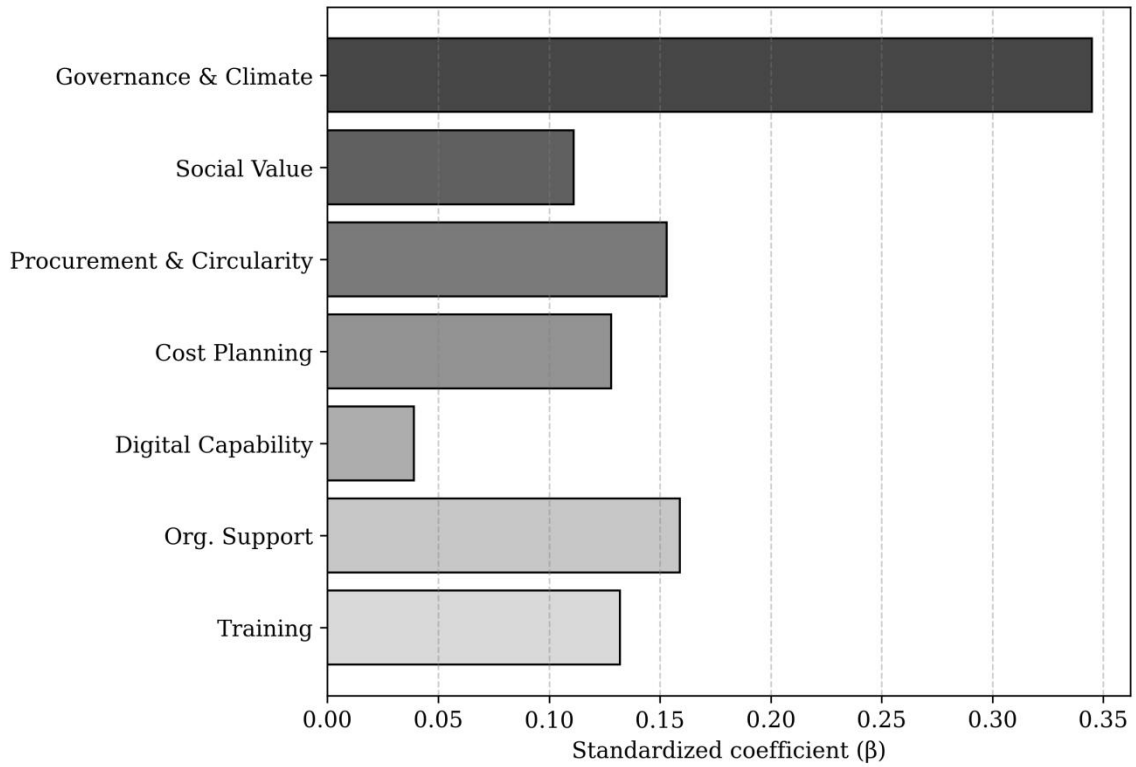

Figure 4. Standardized coefficients from the final regression model

4.6 Robustness Checks

Robustness evidence is summarized in Table 7. The experience-group comparison is non-significant, indicating that the broad outcome pattern is not driven by a single tenure segment. While this check is limited, it supports the view that the role architecture identified in the study is not merely an artifact of one experience category.

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Check	Result	Interpretation
KMO sampling adequacy	0.906	Strong factorability
Bartlett test of sphericity	χ^2=2600.123, p<0.001	Correlation matrix suitable for EFA
Model 1 R^2	0.486	Controls + antecedents
Model 2 R^2	0.613	Controls + antecedents + role domains
Experience-group ANOVA on SDG contribution	p = 0.714	No meaningful mean difference by experience group

Table 7. Robustness and diagnostic checks

5. Discussion

The findings point to a clear rebalancing of the QS profession's sustainability role. Historically, the profession has derived legitimacy from measurement accuracy, cost certainty, and commercial discipline. Those functions remain essential, but they are no longer sufficient on their own. The present analysis suggests that the strongest pathway to SDG contribution emerges when commercial knowledge is combined with reporting capability, traceability, and governance-oriented practice.

This result helps explain why digital capability loses statistical strength once the role domains are entered. Many organizations celebrate digitalization as if software automatically produces sustainability. The results here suggest otherwise. Digital tools matter because they enable stronger role enactment in carbon reporting, data governance, and auditable performance systems. If digitalization is not linked to changed professional behavior, its direct contribution is weaker.

The positive coefficient for organizational support also deserves attention. Sustainability work is often rhetorically individualized: professionals are told to be more innovative, more responsible, and more climate-aware. Yet role expansion is constrained when firms do not provide training budgets, reporting templates, management endorsement, or time to incorporate new criteria into procurement and cost planning. The regression results therefore support a sociotechnical view of professional change in which firms shape whether emerging QS roles become stable routines or remain isolated efforts.

The significant effects of sustainable procurement and circularity and sustainable cost planning confirm that traditional QS territory remains a major entry point for sustainability. This is encouraging because it means the profession does not need to abandon its foundations to stay relevant. Instead, it needs to reinterpret them. Cost planning becomes whole-life value planning. Procurement becomes a mechanism for circularity, supplier accountability, and low-carbon specification. Commercial control becomes a channel for measurable sustainability governance.

At the same time, the effect of social value and inclusive delivery shows that a narrow environmental framing is insufficient. Construction projects are social interventions as much as physical ones. Inclusive procurement, accessibility-conscious scope definition, equitable subcontracting, worker welfare, and community benefit should not be treated as secondary add-ons. The analysis suggests that these issues form a distinct and meaningful dimension of QS sustainability practice.

6. Implications

Theoretically, the article shows that QS sustainability work is multi-dimensional and should not be modeled as a single undivided construct. The four-factor solution offers a more precise vocabulary for future studies. It also demonstrates how role theory and institutional theory can be combined: institutional pressure creates the expectation of sustainability, while role adaptation explains how that expectation becomes embedded in day-to-day commercial practice.

For managers of QS firms and construction consultancies, the message is practical. Training matters, but it must be targeted. Firms should invest less in generic sustainability slogans and more in operational capabilities such as lifecycle option appraisal, sustainable tender evaluation, contract-based circularity provisions, and climate-reporting workflows. Internal systems should reward staff who translate sustainability commitments into commercial documents and measurable outputs.

For clients and public agencies, procurement reform remains a powerful lever. If tender documentation and evaluation systems continue to privilege lowest initial cost without lifecycle value, local benefit, transparency, or carbon traceability, then even well-trained QSs will struggle to practice sustainability meaningfully. Public clients in particular can accelerate role transformation by demanding evidence-based sustainability reporting from commercial teams.

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For professional bodies and universities, the implications are equally strong. The QS curriculum should expand beyond traditional estimating and contract law to include carbon literacy, social-value procurement, circular construction, data analytics, and sustainability disclosure logic.

7. Conclusion

This article developed a new JTIS-formatted empirical manuscript on a topic similar to the uploaded reference paper while deliberately changing the country setting, model structure, analytical method, and literature base. Using a synthetic but theoretically constrained dataset of 286 Malaysian quantity surveying professionals, the study tested how sustainability training, organizational support, and digital capability relate to four sustainability-oriented QS role domains and, ultimately, to perceived project-level SDG contribution.

The analysis identifies a stable four-role structure consisting of sustainable cost planning, sustainable procurement and circularity, social value and inclusive delivery, and data-driven governance and climate reporting. Among these, the governance-and-climate domain is the strongest predictor of project-level SDG contribution, suggesting that the profession's future strategic value may lie increasingly in traceable sustainability reporting and accountable project information systems. Organizational support and sustainability training also remain significant, showing that role transformation is both an individual and organizational process.

The study has two main limitations. First, the data are simulated rather than field-collected, which means the findings should not be interpreted as official estimates of Malaysian industry behavior. Second, the model is cross-sectional and perception-based. Future work should test the framework with real survey data, objective project indicators, and multi-stakeholder perspectives from clients, contractors, and designers. Even so, the article demonstrates a coherent empirical workflow and offers a credible starting point for future field research.

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