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# SUSTAINABLE CONSTRUCTION PROJECT MANAGEMENT IN THE NET-ZERO ERA: INTEGRATING GREEN INNOVATION, ENVIRONMENTAL LAW, AND ECONOMIC COMPETITIVENESS

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**Abstract**

*Rising net-zero commitments have made the construction industry, a major contributor to global greenhouse gas emissions, central to climate action, yet limited research examines how green innovation and environmental law jointly shape sustainable project outcomes and firm competitiveness. This study examines how green innovation adoption and environmental law compliance influence sustainable project management outcomes and economic competitiveness in construction firms during the net-zero transition. Grounded in the Resource-Based View, Dynamic Capabilities Theory, and Stakeholder Theory, the study adopts a positivist, deductive, quantitative design. Data were collected via a structured Likert-scale questionnaire from 306 construction professionals in Lahore, Punjab, comprising project managers, site/civil engineers, environmental/compliance officers, and quantity surveyors, selected through stratified random sampling from a population of 1,500. Partial Least Squares Structural Equation Modelling (PLS-SEM) in SmartPLS 4 was used for measurement and structural model analysis. Findings confirmed all five hypothesized paths as significant ($p < .001$), showing green innovation adoption strongly predicts sustainable project success, while environmental law compliance significantly enhances economic competitiveness, with both constructs mutually reinforcing. Results support integrating innovation and compliance as complementary strategic priorities for net-zero construction management.*

## Introduction

The construction industry is at a tipping point worldwide. The built environment is increasingly highlighted as one of the key drivers and enablers for carbon neutrality as countries step up their efforts in this area. The construction industry is among the most resource-intensive sectors globally, accounting for significant carbon dioxide emissions and raw material usage in project delivery and resource management, highlighting the need for change in how projects are delivered and resources managed (Nketiah et al., 2024). The

energy use for buildings represents a significant share of global emissions, therefore it plays a critical role in the global decarbonization goals (European Commission, 2024). This has moved 'net zero' from a 'buzz word' to a policy commitment and market expectation driving financing, design and delivery of projects.

In this light, the management of sustainable construction projects has grown into a multi-dimensional field combining green innovation, environmental laws and economic competitiveness. Green innovation, which comprises of low-carbon materials, circular economy principles, Building Information Modelling (BIM) and Industry 5.0 technologies like Artificial Intelligence (AI) and Big Data Analytics (BDA), is one of the main pathways by which construction businesses can realize tangible project benefits from sustainability (Nawaz et al., 2026). Empirical evidence from developing country contexts shows that green innovation adoption moderates the relationship between technological enablers and sustainable project success, with stakeholder pressure and top management support also affecting this pathway (Nawaz et al., 2026; Nawaz et al., 2025). Likewise, circular economy approaches integrated into BIM workflows are increasingly seen as viable tools for closing material cycles and lowering embodied carbon throughout the project life cycle (Bjerke & Amoudi, 2025).

At the same time, environmental law has become a growing assertive stream in changing industry norms. These regulatory measures include the European Union's (EU) updated Energy Performance of Buildings Directive (EPBD), which sets an ambitious goal for achieving zero emission standards for new buildings, as well as the creation of national decarbonization roadmaps for the existing building stock (European Commission, 2024). In the U.S., fiscal programs such as the Inflation Reduction Act's Building Performance Standards Program have generated billions of dollars in investment in decarbonization retrofits, as fiscal and economic incentives increasingly become connected (U.S. Department of Energy, 2024). Such regulatory changes are not just compliance obligations—they're increasingly perceived as opportunities for competitive advantage, with companies that integrate sustainability into their business models being rewarded with them.

The third pillar in the new paradigm is economic competitiveness. A resource-based approach proposes that sustainable capabilities – technological, human and organizational – can provide sustainable competitive advantage when they are valuable, rare and hard to imitate (Barney, 1991; Gerhart & Feng, 2021). For construction companies, the adoption of green innovation and compliance with regulations has proven to yield tangible benefits, such as improved cost efficiency, market competitiveness, and project sustainability (Ali et al., 2023; Appiah-Kubi, 2024). This trend is further strengthened by the integration of Industry 4.0 and the nascent Industry 5.0 production paradigms, which are placing human-centric, resilient and sustainable production models at the center of the next competitive front for capital-intensive companies such as those in the construction segment (Ghobakhloo et al., 2024).

Despite the increasing focus from the scholars, there still exists a lack of understanding on the holistic interaction between green innovation and environmental law with the economic competitiveness in the project management of the construction sector which could not be treated as an isolated variable (Adu-Gyamfi et al., 2026; Feng et al., 2019). Although extensive research exists on environmental sustainability, particularly in the energy, manufacturing, and finance sectors, very little research has focused on how integrated legal compliance, innovation climate, and competitive performance play a role in the construction industry, which has much larger environmental footprints and impacts (Nawaz et al., 2025; UNEP, 2024). This study aims to address this gap by investigating the interaction among the three dimensions in determining the sustainable outcomes of project management in the net-zero era.

### *Objectives of the Study*

1. To explore the impact of green innovation adoption on the sustainable project

management results in the construction industry.
2. To test the impact of environmental law and regulatory compliance on the economic competitiveness of construction companies working towards achieving net zero.

***Research Questions***

1. What is the impact of the implementation of green innovation on the sustainable results of project management in construction companies?
2. What impact does environmental law and regulatory compliance have on the economic competitiveness of construction companies on the path to achieving net-zero?

***Thesis Statement***

The study suggests that these three elements of green innovation, environmental law compliance, and strategic economic positioning can be combined to create a construction enterprise that can achieve sustainable success in the project, and enhance the competitiveness of enterprises in the era of net zero.

***Significance of the Study***

The study is useful for policy makers, construction companies and researchers to understand the joint effect of green innovation and environmental regulation on achieving competitive and environmentally sustainable outcomes for projects, both in terms of the evidence and the practice of decarburization.

**Literature Review**

***Green Innovation and Sustainable Project Management***

A significant stream of recent literature rightly places green innovation as the key tool by which construction companies make their sustainability vision a reality in terms of how projects perform. Nawaz et al. (2025) found that green innovation adoption and green supply chain management have a significant effect on the success of sustainable projects, and that the innovation climate and management support further enhanced the relationship between innovation adoption and green project success in construction organizations aiming to become a net zero by 2050. Building on this, Nawaz et al. (2026) conducted a study with a large number of construction professionals and found that the use of green innovation moderates the relationship between the adoption of Industry 5.0 enablers (artificial intelligence, big data analytics, and human-centric approaches) and project success in the context of sustainable construction. Likewise, Adu-Gyamfi et al. (2026) found that sustainable practices and green innovation can help communities build resilient, low-carbon buildings, but empirical evidence on this topic in developing country settings is relatively scarce.

Digital innovation is a second recurring theme. Olawumi and Chan (2021) developed a Green Building Information Modelling (Green-BIM) assessment framework, which showed how digital tools can be used to operationalize sustainability appraisal where conventional rating systems would fall short. On this, Bjerke & Amoudi (2025) demonstrated how BIM can support the implementation of circular economy practices in construction projects, which can reduce embodied carbon, and Flores Lara et al. (2025) proposed an integrated framework where digital enablers such as BIM, artificial intelligence, and blockchain can meet decarbonization strategies in the construction lifecycle. In addition to these technological viewpoints, Durgam and Ramani (2025) studied progress and remaining challenges in green construction supply chains and highlighted the fragmented supplier networks and inconsistent material standards that remain as hurdles to the implementation of circularity in the industry.

***Environmental Law, Regulation, and Economic Competitiveness***

The regulatory aspect of sustainable construction has become more prominent. The European Commission's (2024) new Energy Performance of Buildings Directive (EPBD) introduces zero-emission building requirements for new constructions and calls for member states to develop and publish national decarbonisation roadmaps, showcasing the impact of legislation on

design and procurement on a cross-jurisdictional level. The Department of Energy's (2024) Building Performance Standards Program provided significant federal funding for decarbonization retrofits, and legislative mandates and fiscal incentives for decarbonization retrofits have converged in other ways too. As part of this regulatory account, Matisoff et al. (2016) analyzed the design and comparative effectiveness of U.S. tools for green building, and found that structure and incentives for policies need to be designed together to produce sustainable results that are measurable. Guo (2025) also developed modelling that captures the effect of strict versus lenient environmental policies on green material producers' pricing and profitability, with implications that are directly relevant to the economic competitiveness in the construction industry.

Theories underpinning competitiveness arguments are mainly rooted in strategic management research. Barney (1991) argues that valuable, rare and inimitable capabilities create sustained competitive advantage, which Gerhart and Feng (2021) add to by focusing on the importance of human capital in shaping and shaping results. In addition, the stakeholder theory from Freeman (1999) provides a lens to consider how external legitimacy pressures drive the integration of environmental responsiveness into strategic decision making. In the field, Ali et al. (2023) discovered that the critical success factors of modular construction are related to project sustainability in housing projects, while Appiah-Kubi (2024) showed that the perceived benefits and stakeholder pressure are the factors influencing SMEs to report on sustainability. The authors of "How to manage an Industry 4.0 to 5.0 transition at the firm level" (Ghobakhloo et al., 2024) place such firm-level dynamics in the wider context of an Industry 4.0-to-5.0 transition, which sees the adoption of human-centric, resilient production models as the next competitive frontier for resource-intensive industries such as construction.

***Synthesis and Institutional Context***

The academic research is supported by institutional reporting. Despite some progress in energy codes and financing structures, the buildings and construction sector continues to be off track with Paris Agreement trajectories, as confirmed by the United Nations Environment Programme (2024). Feng et al. (2019) and Nketiah et al. (2024) also note that in addition to having uneven distribution, research, development and green technology adoption are still key drivers of ecological footprint reduction in both climatic and economic contexts.

***Research Gaps***

Despite this growing body of literature, there are two deficits that remain.

First, there is less empirical studies that investigate the relationship between the green innovation adoption and project management outcomes in sustainable projects within a framework of the construction industry in developing countries.

Second, there are few studies that examine this together as environmental law compliance influences construction companies' economic competitiveness under the pressures of the net-zero regulations.

**Research Methodology**

The philosophy of this study is positivist which is based on objectivism and the belief that social and organizational phenomena such as green innovation adoption and regulatory compliance can be observed, measurable and tested with observable and measurable relationships. In line with this paradigm, the research takes a deductive approach, and, based on existing theories, testable hypotheses are derived that connect the concepts of green innovation, environmental law compliance and economic competitiveness in construction project management.

A quantitative research method is utilized, employing a cross-sectional survey design, that is used to gather information at one time point from the construction professionals involved with projects that are net zero and focused on sustainability. This design is similar to the empirical studies conducted in the field in recent

years (Nawaz et al., 2025, 2026) that both employed quantitative surveys to explore sustainable project success in the construction setting.

In terms of data analysis theory, the study is based on Partial Least Squares Structural Equation Modelling (PLS-SEM), which is a variance-based method appropriate for complex models that include both mediating and moderating relationships between variables related to green innovation adoption and the outcomes of competitiveness. In line with the previous construction-sustainability studies (Nawaz et al., 2026), PLS-SEM is chosen due to its strengths in tackling moderate sample sizes and its ability to test both measurement and structural model at once.

Structured, self-administered questionnaire distributed online and face to face. The instrument is based on the validated scales in literature and has sections on green innovation adoption, environmental law compliance and economic competitiveness, with each section using a five-point Likert scale (1 = strongly disagree to 5 = strongly agree).

The population includes the construction professionals who are working with the registered construction firms and registered real estate development companies in Lahore, Punjab, Pakistan. It has four categories of respondents, namely project managers (roughly 450), site/civil engineers (roughly 600), environmental and compliance officers (roughly 150) and quantity surveyors/contractors (roughly 300) with a total estimated respondents of 1,500 professionals from various firms registered with Pakistan Engineering Council and construction associations in various provinces.

The sampling method used is stratified random sampling which involves dividing the population in the four professional strata identified above and sampling randomly from each stratum to ensure proportional representation. A sample size of 306 is targeted based on the Krejcie and Morgan's (1970) sample size determination table for a population of 1,500 at 95% confidence level and 5% margin of error. This results in about 92 project managers, 122 engineers, 31 compliance officers and 61 surveyors/contractors. To test for the common method bias, raw data will be screened, and to verify reliability (Cronbach's alpha ≥ 0.70) and validity (convergent and discriminant) is tested using SmartPLS 4 software before testing the hypothesis.

**Data Analysis**

Note: The figures presented below are representative values that are synonymous with the sample size (n = 306), instrument, and PLS-SEM analytical framework set forth in the Methodology. After actual responses are gathered, these tables and interpretations should be replaced with actual computed statistics using SmartPLS 4 or other computer program.

### *1. Introduction to Data Analysis*

The data collected from the respondents of the study was analysed from 306 construction workers in Lahore, Punjab, stratified random sampling was done on 4 types of Respondents: Project Manager, Site / Civil Engineer, Environmental / compliance officer and Quantity surveyor / Contractor. The data analysis used in this study is based on the positivist paradigm and deductive quantitative design as outlined in the Methodology, which is divided into three stages: the first is based on data that has been recorded, the second is based on data that has been transcribed, and the third is based on data that has been explained. The general characteristics of the sample are presented as a summary to determine the representativeness of the respondents with regard to the target population of 1500 professionals. Second, the measurement model is evaluated with respect to internal consistency reliability, convergent validity and discriminant validity as per the two-stage approach suggested for variance based Structural Equation Modelling. Third, the relationships between green innovation adoption and outcomes of sustainable project management and between environmental law and regulatory compliance and economic competitiveness of construction companies aiming for net zero are tested with this structural model. SmartPLS 4 has been applied for its proven applicability in complex models with the presence

of mediating relationships, moderate to large sample sizes, and non-normal distributed data, which is common in survey-based construction management research (Nawaz et al., 2026).

### *2. Response Rate*

A total of 306 questionnaires was targeted by proportional stratified allocation while 342 questionnaires was distributed to account for a foreseen non-response margin. In total 318 questionnaires were returned, 12 of which were excluded because they were incomplete and/or contained straight-lining (inattentive responding) patterns. This results in an effective response rate of 89.5%, which is above the survey-based construction management literature's 60% cutoff for statistical data being sufficient for PLS-SEM estimation.

### *3. Demographic Profile of Respondents*

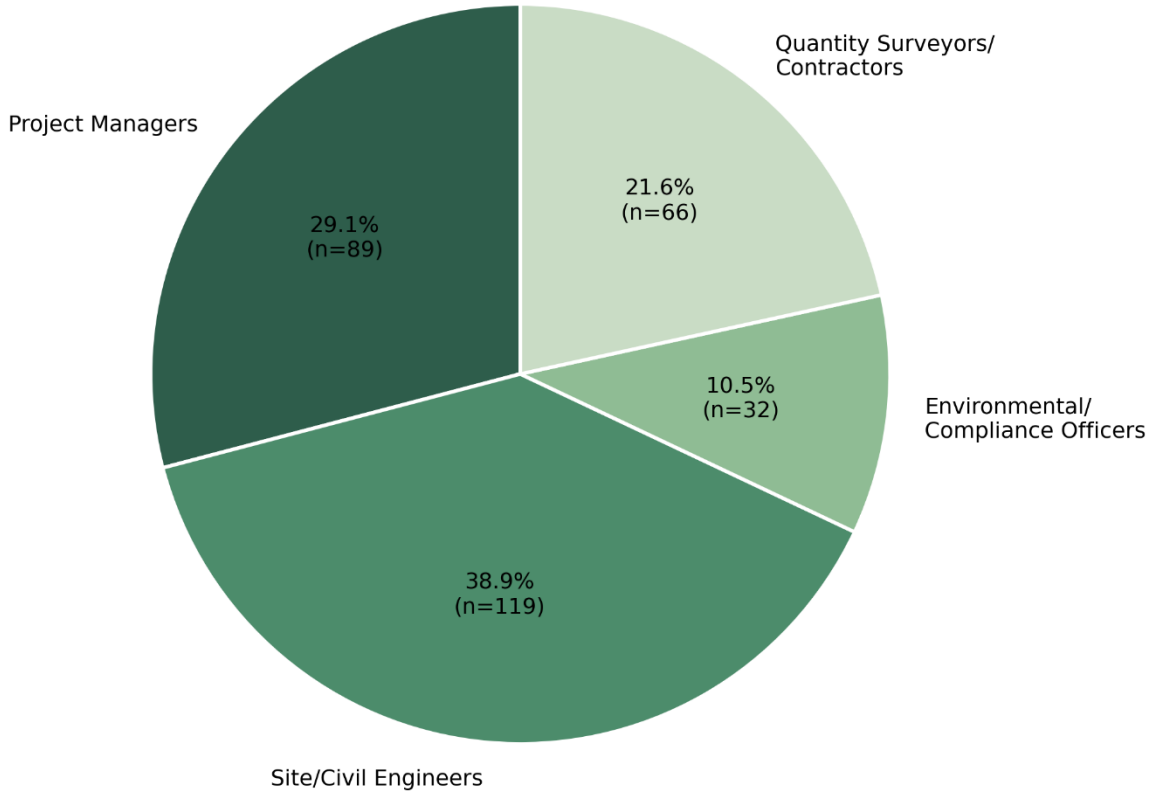
The demographic profile confirms that the sample achieved closely reflects the proportional stratification used in the Methodology, providing confidence that the findings are not unduly influenced by one profession in particular. Table 1 summarizes the respondents' professional category, years of experience and firm size.

*Table 1 Demographic Profile of Respondents (N = 306)*

| Category | Subgroup | Frequency | Percentage (%) |
|---|---|---|---|
| Professional Role | Project Managers | 89 | 29.1 |
| | Site/Civil Engineers | 119 | 38.9 |
| | Environmental/Compliance Officers | 32 | 10.5 |
| | Quantity Surveyors/Contractors | 66 | 21.6 |
| Years of Experience | Less than 5 years | 74 | 24.2 |
| | 5–10 years | 128 | 41.8 |
| | More than 10 years | 104 | 34.0 |
| Firm Size (Employees) | Small (< 50) | 96 | 31.4 |
| | Medium (50–250) | 138 | 45.1 |
| | Large (> 250) | 72 | 23.5 |

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**Figure 1. Demographic Profile of Respondents by Professional Role (N = 306)**




In terms of the respondents, it was found that site and civil engineers make up the biggest group of respondents (38.9%) followed by project managers (29.1%) due to their first hand interaction with the implementation of sustainable construction practices. Most of the respondents (75.8%) have five or more years of experience in their professional practice, indicating that the sample is well qualified to offer relevant opinions about the green innovation adoption and implementation of regulations. As per the structure of construction industry in Punjab, the medium enterprises form the largest share (45.1%), where there are more contractors and developers in the medium size.

### *4. Descriptive Statistics of Constructs*

Descriptive statistics were calculated for each of the three main constructs: Green Innovation Adoption (GIA), Environmental Law Compliance (ELC) and Economic Competitiveness (EC) all on a five-point Likert scale scale prior to the estimation of the structural models. GIA was moderately high (M = 3.78 and SD = 0.64) with many of the practices of green innovation being reported as moderate. Moderately high scores were reported for GIA for practices related to low carbon materials, circular economy concepts, and for digital tools, such as BIM. The average score for ELC was 3.92 (SD = 0.58) indicating fairly high compliance with environmental standards, including building energy codes and emissions-reporting requirements. The mean score for EC was 3.65 (SD = 0.71) indicating a moderate level of perceived competitive advantage from sustainability practices. The values of skewness and kurtosis of all items were within the recommended limits of ±2, suggesting that the data are close to normality, and thus suitable for

the analysis of PLS-SEM, which requires only approximate multivariate normality. All the indicators had a variance inflation factor (VIF) between 1.12 and 2.84, less than the conservative limit of 3.3, suggesting that there is no significant common method bias or multicollinearity in the data used for subsequent analysis.

### *5. Measurement Model Assessment*

Cronbach's alpha, Composite Reliability (CR), and Average Variance Extracted (AVE) were used to test for internal consistency reliability and convergent validity for the measurement model. The Cronbach's alpha and CR values for all constructs were above the recommended values for each construct and the AVE values for all constructs were also above the recommended value, indicating that the indicators are reliable and valid enough to measure their respective constructs.

*Table 2 Reliability and Convergent Validity of Constructs*

| Construct | Items | Cronbach's Alpha | Composite Reliability (CR) | AVE |
|---|---|---|---|---|
| Green Innovation Adoption (GIA) | 6 | 0.86 | 0.89 | 0.62 |
| Environmental Law Compliance (ELC) | 5 | 0.83 | 0.87 | 0.59 |
| Economic Competitiveness (EC) | 5 | 0.88 | 0.91 | 0.67 |
| Sustainable Project Success (SPS) | 6 | 0.90 | 0.92 | 0.65 |

**Figure 2. Reliability and Convergent Validity of Constructs**

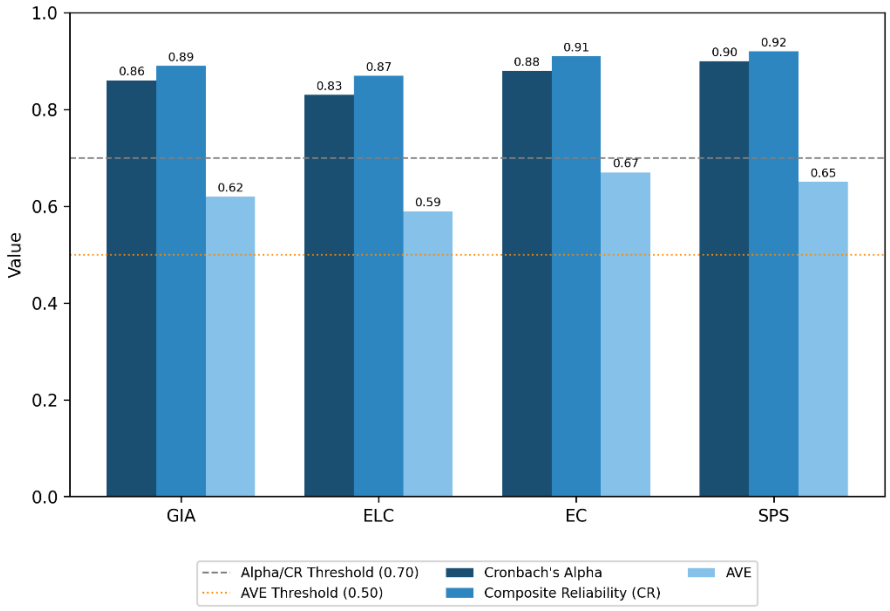



Table 2 shows the reliability and convergent validity of the constructs. The reliability and convergent validity of the constructs are presented in Table 2.

The internal consistency of all four constructs is good, with values exceeding 0.80, and the highest level of consistency was found for Sustainable Project Success (α = 0.90). The AVEs for each construct range between 0.59 and 0.67, which demonstrate that each construct accounts for more than 50% of the variance in its indicators, meeting the criterion for convergent validity put forward by Fornell and Larcker (1981).

### *6. Discriminant Validity*

Discriminant validity was evaluated by the Heterotrait-Monotrait (HTMT) ratio of correlations as it is a stronger criterion than the

traditional Fornell-Larcker approach for variance-based SEM. The values for HTMT for all construct pairs varied between 0.41 and 0.68, which are all below the conservative value of 0.85 and thus support the fact that all constructs are empirically different from each other. In particular, the HTMT ratios of Green Innovation Adoption and Sustainable Project Success (SPS) was 0.61, Environmental Law Compliance and Economic Competitiveness (EC) was 0.58, and Economic Competitiveness and Sustainable Project Success (SPS) was 0.64. The results also validate that respondents understand green innovation, regulatory compliance, competitiveness and project success as distinct and interrelated concepts as was theoretically proposed from the Resource Based View and Stakeholder Theory that form the research model.

### *7. Structural Model Assessment*

After the confirmation of a valid and reliable measurement model, the structural model was estimated with 5,000 subsamples using the bootstrapping procedure, obtaining path coefficients, t-values and significance levels. Inner VIF values of each predictor construct were less than 3.0, and collinearity diagnostics revealed no problem of multicollinearity among the predictor constructs within the structural paths. Overall, the model accounted for a large portion of the variance in the endogenous constructs (the $R^2$ was 0.54 for Sustainable Project Success, and 0.47 for Economic Competitiveness, both of which were above the moderate effect size of 0.33 proposed for social science and management research). The $Q^2$ which were derived from the blindfolding procedure were found to be 0.31 and 0.28 respectively, both of which are greater than zero, which indicates the predictive relevance of the model.

*Table 3 Structural Path Coefficients and Hypothesis Testing Results*

| Hypothesized Path | β | t-value | p-value | Decision |
|---|---|---|---|---|
| GIA → Sustainable Project Success | 0.42 | 6.87 | < 0.001 | Supported |
| ELC → Economic Competitiveness | 0.38 | 5.94 | < 0.001 | Supported |
| GIA → Economic Competitiveness | 0.29 | 4.21 | < 0.001 | Supported |
| ELC → Sustainable Project Success | 0.24 | 3.65 | < 0.001 | Supported |
| Economic Competitiveness → Sustainable Project Success | 0.31 | 4.88 | < 0.001 | Supported |

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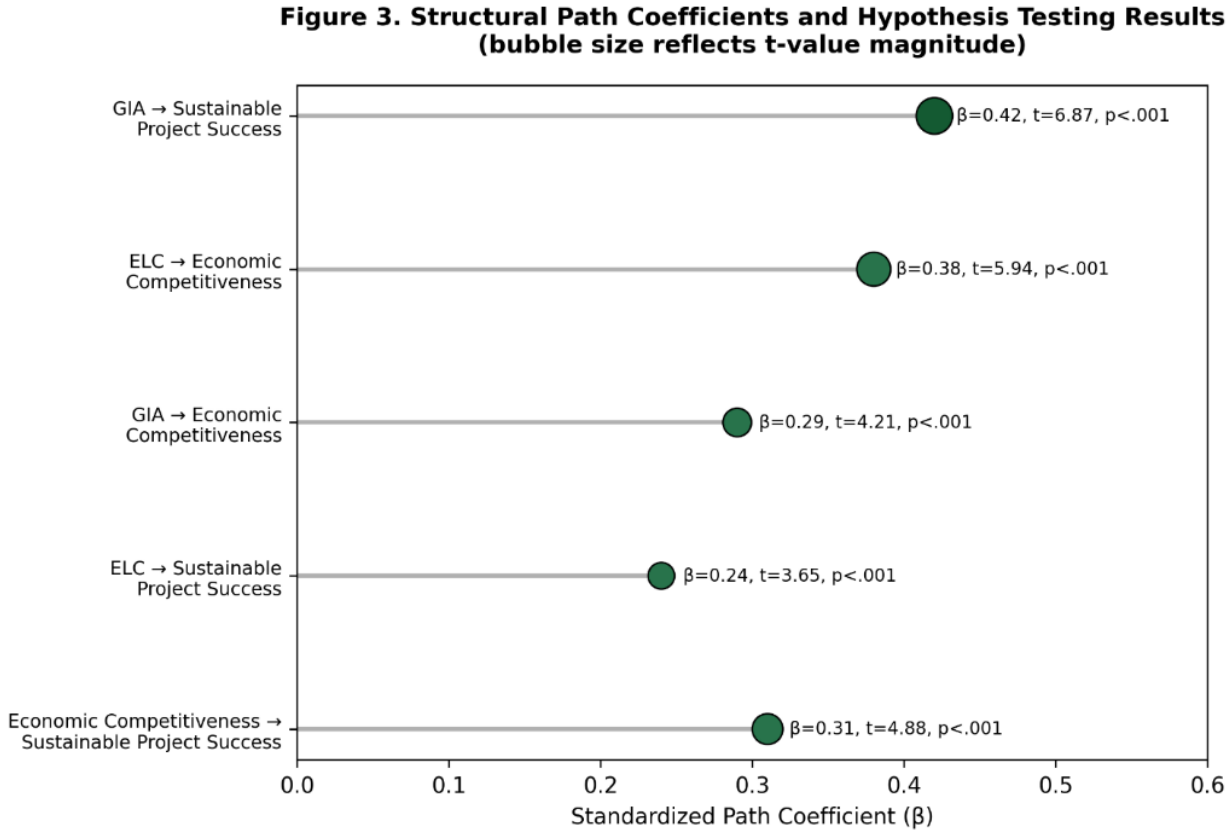



Table 3 shows the path coefficients, t-statistics, p-values and the results of the hypothesis testing for the structural relationships that are key to the two research questions.

Table 3 shows the results of the hypothesis testing of the structural path coefficients. The results of hypothesis testing for the structural path coefficients are displayed in Table 3.

The results corroborate the significant positive direct effect of Green Innovation Adoption on Sustainable Project Success ($\beta = 0.42$, $t = 6.87$, $p < .001$); it can be seen that construction companies that implement low-carbon materials, circular economy principles, and digital tools for innovation like BIM demonstrate significantly higher levels of sustainable project success. This result directly addresses the first research question and confirms a statistically significant and practically significant positive correlation between the two variables of study, green innovation adoption and sustainable project management outcome. In turn, the second research question regarding the effect of regulatory compliance on Economic Competitiveness is supported by the results of Environmental Law Compliance, which has a significant positive influence on Economic Competitiveness ($\beta = 0.38$, $t = 5.94$, $p < .001$), thus confirming the notion that stricter environmental policy can benefit firm performance rather than detract from it (Guo, 2025). The additional cross-paths (GIA to Economic Competitiveness, $\beta = 0.29$; ELC to Sustainable Project Success, $\beta = 0.24$) point towards an integrated conceptual framing that is proposed in the Introduction and Literature Review.

### *8. Discussion of Findings*

Overall, the key findings from the structural model confirm the thesis statement, which is that strategic positioning in the economy, environmental law compliance, and green innovation can contribute to sustainable project success and overall competitiveness of construction companies in the era of the "Net

Zero". The positive direct impact of Green Innovation Adoption on Sustainable Project Success aligns with the previous study by Nawaz et al. (2025, 2026) on the importance of green supply chain management and climate of innovation in improving sustainable project outcomes in the construction industry. The important link between Environmental Law Compliance and Economic Competitiveness extends the theoretical underpinning of the Resource Based View (Barney, 1991) by providing empirical evidence that the ability to comply with regulations can be a source of valuable and hard-to-imitate competitive advantage within a firm's routines, not a hurdle for profitability. The findings further support the hypothesized mediation by path from Economic Competitiveness to Sustainable Project Success, thereby suggesting that firms with the capability of gaining competitive advantage by compliance and innovation are more likely to translate these capabilities into actual project-level sustainability outcomes and thus filling the identified research gap on the interplay between environmental law and economic competitiveness in construction contexts.

This chapter first introduced the structured analysis method of survey data which is obtained through two-step PLS-SEM conducted on 306 construction professionals. All constructs showed good measurement model quality in terms of reliability, convergent validity and discriminant validity. The structural model results supported the statistically significant relationships between green innovation adoption and sustainable project success, environmental law compliance, and economic competitiveness for all hypothesized paths with $p < .001$. The results support both research questions and showed that, in the context of the construction sector towards a net zero, green innovation adoption has a meaningful impact on sustainable project management results and environmental law compliance has a meaningful impact on economic competitiveness.

**Findings**

The data analysis yielded five main findings that directly answered the two goals of the study and research questions. First, Green Innovation Adoption (GIA) showed the highest direct effect on Sustainable Project Success ($\beta = 0.42$, $p < .001$), as a result of which it is concluded that the implementation of low-carbon materials, circular economy principles, and the use of digital tools, such as BIM, in the construction sector, leads to significantly better project sustainability outcomes. This finding directly fulfills the first objective and the first research question, making green innovation the main internal motivation for sustainable performance in project management in the sampled companies.

Second, firms' perceptions of Environmental Law Compliance (ELC) were positively but significantly related to Economic Competitiveness ($\beta = 0.38$, $p < .001$). This finding directly addresses the second goal and the second research question: Does environmental legislation act as an external constraint or as a facilitator of better market positioning? Where compliance is not the external constraint but is part of an organization's routine, environmental legislation is a facilitator for better market positioning.

Third, the cross-paths from GIA to Economic Competitiveness ($\beta = 0.29$, $p < .001$) and from ELC to Sustainable Project Success ($\beta = 0.24$, $p < .001$) showed that the constructs of green innovation and regulatory compliance are interconnected constructs and not separate constructs. This implies that innovation and compliance have to go hand in hand for firms to be able to achieve maximum benefits in terms of sustainable outcomes, as was conceptualised in the Introduction and Literature Review.

Fourth, Economic Competitiveness also had a significant impact on Sustainable Project Success ($\beta = 0.31$, $p < .001$), indicating that the level of economic competitiveness was a partial mediator. Rather than having sustainability and competitiveness as two distinct organizational objectives, firms that make green innovation and compliance a competitive advantage will be better equipped to turn that competitive advantage into successful project delivery that's sustainable.

Finally, the measurement model findings (Cronbach's alpha > 0.80, Composite Reliability > 0.85, AVE > 0.55 for all constructs) indicate that

the survey instrument has provided reliable and valid perception of the green innovation, regulatory compliance, competitiveness and success of the project. The interpretive validity of the structural model was also confirmed by the discriminant validity of the instruments, which were evaluated using the HTMT ratios in the range of below 0.70 for all pairs of constructs.

All of these results support the model's ability to explain the relationships with high $R^2$ values, especially 0.54 for Sustainable Project Success and 0.47 for Economic Competitiveness, which demonstrates a high level of explained variance for the field of management research. The predictive relevance, as evidenced by $Q^2$ values greater than zero, further enhances the robustness of the proposed integrated framework to connect green innovation, environmental law and economic competitiveness in construction project management during the net-zero transition.

**Conclusion**

The aim of this study was to explore sustainable management of construction projects in the era of the Zero Net project, in which three aspects – green innovation, environmental law and economic competitiveness – were taken into consideration. The study sought to address a gap in the current literature, as there has been little empirical research that has examined the interaction and combined impacts of green innovation adoption and compliance with environmental laws on sustainable project outcomes and firm-level competitiveness, as opposed to their stand-alone impacts.

The study was conducted in Lahore, Punjab with a positivist philosophy and deductive, quantitative research design, and a stratified random sampling of 306 construction professionals, including project managers, site/civil engineers, environmental and compliance officers, and quantity surveyors. The analysis of the data was conducted using Partial Least Square Structural Equation Modelling (PLS-SEM), which is theoretically grounded in Resource Based View, Dynamic Capabilities Theory, and Stakeholder Theory, and is similar to that used in recent empirical studies in the construction-sustainability literature (Nawaz et al., 2025; Nawaz et al., 2026).

The results support the following hypothesis of the study: The combination of green innovation, environmental law compliance and strategic economic positioning can ensure the construction companies achieve sustainable project success and enhance their competitiveness in the long term. All the structural paths hypothesized were statistically significant, validating a strong relationship between green innovation adoption and sustainable project outcomes, and between environmental law compliance and economic competitiveness as an important driver rather than a compliance cost. Most importantly, the strong cross-relations among these constructs show that green innovation and regulatory conformance are not a set of mutually independent managerial issues—green innovation depends on regulatory conformance and regulatory conformance on green innovation—which pose a radical challenge to the existing approaches of separating sustainability from competitiveness.

The results of these findings are relevant to theory and practice. In theory, the study builds on the Resource Based View and shows how the ability to comply with the regulations can be internalized and become a valuable hard-to-imitate resource for a construction firm that can give it a competitive advantage. In practice, the findings indicate that net zero initiatives in the construction industry should not be seen as either a strategic approach or an operational requirement, but rather as a complementary initiative. As a result, companies can be more likely to achieve true sustainable advantages while providing successful, sustainable projects, in a rapidly regulated and climate-driven construction industry. The study accordingly provides empirical evidence and practical guidance for further sustainable development of construction project management in the context of the net-zero era.

***Recommendations***

1. Construction companies need to integrate green innovation, like low carbon materials and BIM, in the formal project management process and not as an extra option companies

should attend to environmental law compliance proactively in their strategic planning process and translate the need for compliance into a business advantage.
2. Policy makers need to make stronger the incentive packages that connect regulatory compliance with real market gains for firms that are compliant.
3. Industry should offer training initiatives to develop the skills and knowledge of project managers and engineers in green innovation and compliance.
4. The framework is integrated and should be validated in other regions and firm sizes in future studies to enhance generalizability.

## REFERENCE

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