Guidelines for Managing Construction Industry Businesses with Sustainable Development Goals (SDGs)

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ABSTRACT

Driven by escalating investment flows within the construction sector, the industry has experienced the simultaneous expansion of established firms alongside the rapid emergence of new market entrants. Under these increasingly competitive conditions, construction operators are required to implement managerial frameworks aligned with the Sustainable Development Goals (SDGs) to sustain organisational viability and long-term operational resilience. Accordingly, this study investigates construction industry management approaches consistent with the SDGs and formulates a Structural Equation Model (SEM) to explain these relationships comprehensively. To establish the research instruments for the quantitative phase, in-depth interviews were undertaken with nine specialists possessing extensive expertise in the construction sector. Subsequently, a focused group discussion involving 11 experts was organised to formulate the numerical framework underpinning the investigation. For the quantitative component, questionnaire-based surveys were administered to 500 executives engaged in construction-related enterprises. The collected information was examined through descriptive, inferential, and multivariate statistical procedures. The findings demonstrate that SDG-oriented management approaches within the construction industry can be prioritised in descending order as follows: 1) environmental impact management sustainability ($\overline{X}$ = 4.48), particularly post-construction rehabilitation initiatives; 2) collaboration management sustainability ($\overline{X}$ = 4.47), emphasising cooperative engagement with stakeholders to resolve industry-related challenges and strengthen sectoral advancement; 3) innovation and technology management ($\overline{X}$ = 4.46), notably the development of mobile applications aimed at improving operational efficiency in field activities; and 4) organisational management sustainability ($\overline{X}$ = 4.39), especially succession planning strategies intended to maintain continuity in fieldwork administration. Furthermore, hypothesis testing revealed that the perceived importance of SDG-based construction business management approaches, when classified according to business size, did not differ significantly at the 0.05 significance level.

Keywords: Construction Industry Business, Sustainable Management, Environmental Impact, Construction Industry Collaboration, Innovation and Technology, Organization, Sustainable Development Goals (SDGs)

INTRODUCTION

Amid accelerating transformations associated with globalisation, driven by rapid economic expansion, changing social structures, particularly the emergence of an ageing global population, together with continuous advancements in industry, science, technology, and innovation, extensive depletion of worldwide resources has occurred over recent decades. In response to these escalating challenges, the United Nations (UN) convened an international conference in New York City during 2000 to encourage collective cooperation among nations in addressing such concerns. The conference involved participation from 189 countries, including Thailand, culminating in the establishment of the Millennium Development Goals (MDGs), which represented universal development objectives intended for achievement by 2015.

Between 2000 and 2015, the implementation of the MDGs generated substantial progress across numerous countries. Consequently, to sustain long-term developmental continuity, the 70th Session of the UN General Assembly adopted the 2030 Agenda for Sustainable Development on 25 September 2015, with endorsement from Thailand and 193 UN member states. This framework formally introduced the Sustainable Development Goals (SDGs) as an internationally coordinated guideline for collaborative global progress. The UN established 17 SDGs comprising: 1) poverty eradication, 2) elimination of hunger, 3) health and well-being promotion, 4) equitable education, 5) gender equality, 6) water and sanitation management, 7) affordable clean energy accessibility, 8) decent employment and economic expansion, 9) industry, innovation, and infrastructure development, 10) inequality reduction, 11) sustainable urban and community development, 12) responsible production and consumption, 13) climate action, 14) sustainable utilisation of marine resources, 15) protection of terrestrial ecosystems, 16) peaceful and inclusive societies supported by justice, and 17) partnerships supporting sustainable development. Collectively, these goals encompass 169 interconnected universal targets and 247 indicators designed to monitor developmental advancement. Moreover, the SDGs are organised into five interrelated dimensions, commonly identified as the 5Ps: 1) People, 2) Planet, 3) Prosperity, 4) Peace, and 5) Partnership. Achieving the SDGs by 2030 therefore necessitates extensive international cooperation among participating nations.

The construction industry is anticipated to expand consistently alongside the overall growth of construction investment value, with an average annual increase estimated at 4.5–5.5%. This expansion is primarily stimulated by large-scale governmental investment initiatives implemented to fulfil objectives outlined in the national 20-year strategic development plan. Particular emphasis has been placed upon projects associated with the Eastern Economic Corridor (EEC), especially infrastructure initiatives incorporated within Phase 2 of the EEC transportation infrastructure action framework covering 2022–2026. Simultaneously, construction investments from the private sector, including residential and commercial real estate developments, are projected to recover progressively due to improved purchasing capacity, favourable economic conditions, and continuing infrastructure advancement (Lata, 2024).

In addition, major contractors possess increasing opportunities to obtain projects within neighbouring countries where economic recovery trends and infrastructure expansion programmes remain ongoing under the accelerated implementation of Thailand's Construction Industry Development Action Plan 2023–2024. Concurrently, private-sector construction investments, including residential and commercial property developments, are expected to increase by approximately 3.0–3.5% due to strengthening purchasing power generated by economic recovery and infrastructure progress. Nevertheless, several constraints are likely to moderate industry growth, particularly escalating construction expenditures involving building materials, labour costs, and transportation expenses, all of which are expected to remain elevated due to prevailing energy price trends. Furthermore, climate change concerns together with net-zero greenhouse gas emission targets present additional operational challenges for construction enterprises, compelling organisations to accelerate technological adaptation strategies aimed at minimising inefficient utilisation of construction materials.

Medium- and small-scale construction enterprises are forecasted to maintain relatively stable revenues during 2024, while gradual recovery is anticipated throughout 2025–2026. Such recovery is expected to result from incremental improvements in economic conditions and purchasing power, particularly for medium-sized enterprises that are increasingly positioned to secure subcontracting opportunities from larger firms. However, persistent operational barriers, especially rising operational expenditures and labour shortages, continue to threaten business performance and may increase financial liquidity risks among contractors. During 2018–2024, total construction investment value represented an average of 8.0% of Gross Domestic Product (GDP) (Figure 1), with the majority attributed to domestic construction activities.

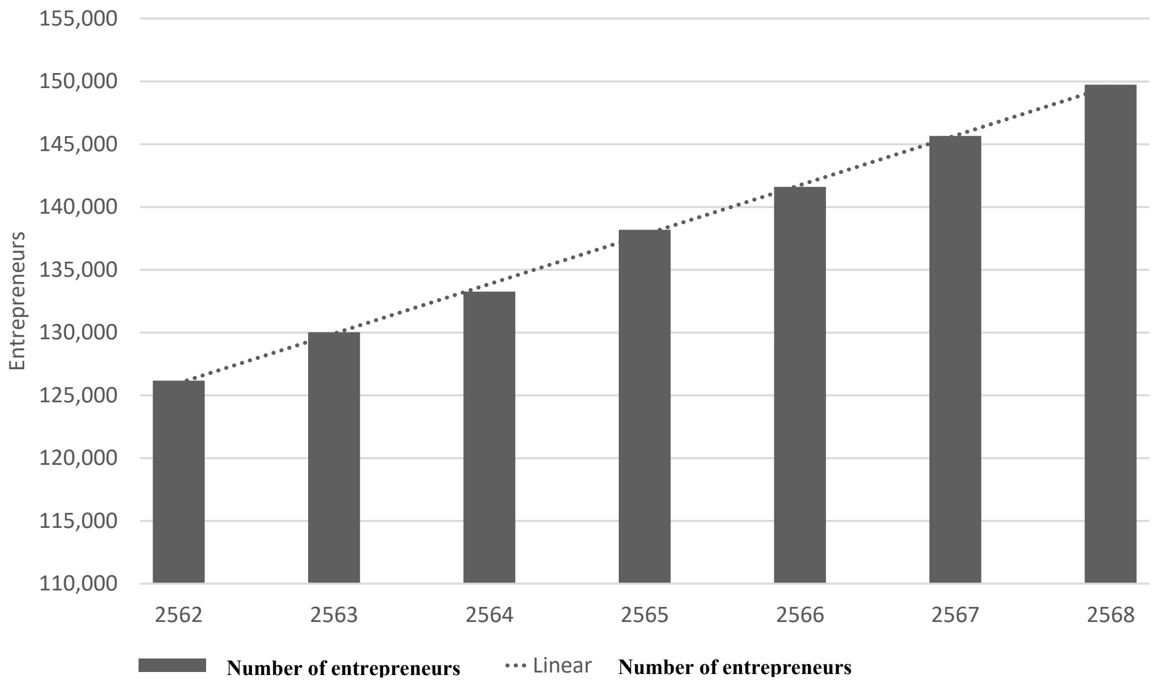

Figure 1: Investment Amount in the Construction Business, 2018-2025
Source: (Siam Commercial Bank, 2025, https://thestandard.co/tag/scb-eic/).

These projects were generally classified according to client category, namely public-sector and private-sector developments. The proportion of investment value within the construction industry was further segmented according to the number of approved construction projects and regional distribution patterns during 2024 (Figure 2). Nonetheless, the Coronavirus Disease 2019 (COVID-19) crisis throughout 2020–2022 significantly reduced the growth trajectory of total construction investments, primarily because of declining private-sector construction activity relative to 2019 levels. Conversely, public-sector construction investments continued expanding as governments accelerated infrastructure-related expenditure programmes, despite delays affecting several projects, to stimulate economic recovery and attract foreign investment inflows.

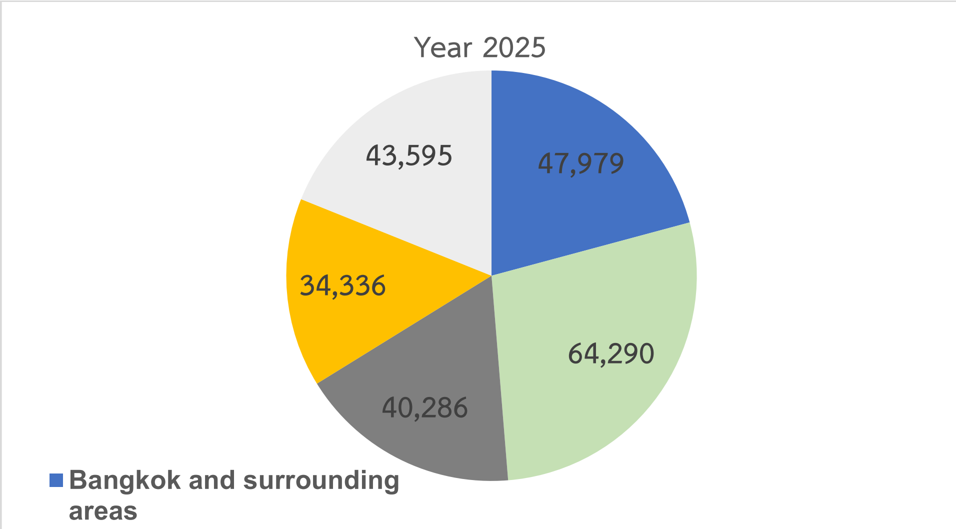

Figure 2: Number of Projects Granted Permission by Region in 2025

Source: (National Statistical Office, 2025, http://www.nso.go.th/nsoweb/survey_detail/26).

Based on investment information derived from both public-sector and private-sector activities, together with the increasing number of entrepreneurs operating within the construction business and the expanding classification of business categories, it is apparent that a collaborative participation principle should be systematically established between governmental authorities and the public sector. Such cooperation would enable both parties to gain a clearer understanding of mutual challenges and requirements, thereby encouraging broader public engagement in developmental activities and community-related initiatives while simultaneously strengthening community resilience. Participation therefore represents a fundamental mechanism for ensuring sustainable living conditions among populations within their respective communities. Accordingly, this study investigates the construction industry in alignment with the SDGs while examining methods for enhancing managerial approaches capable of achieving optimal levels of effectiveness and operational efficiency.

LITERATURE REVIEW

The escalating trade rivalry between the United States and China continues to exert substantial influence upon Thailand and the broader regional economy, particularly within areas characterised by geopolitical sensitivity where balanced diplomatic and economic relations with both countries must be carefully maintained. These developments have significantly altered global trade directions, investment flows, supply-chain configurations, and political-economic alliances. Due to Thailand's geographical proximity to China, a clearly defined economic development strategy is required for interconnected territories involving Thailand, the Laos, and China. Such strategic coordination would enable these nations to maximise benefits derived from transportation corridors linking Nong Khai and Chiang Rai through Laos into southern China. This approach would facilitate investment expansion, strengthen regional economic networks, and support the establishment of a more flexible trilateral trade system, particularly across north-eastern and northern Thailand, Laos, and southern Chinese provinces, thereby promoting integrated regional development.

Thailand must also accelerate investment activities to offset the severe economic consequences generated by the Coronavirus Disease 2019 (COVID-19) outbreak, which caused income losses exceeding three trillion baht. These economic disruptions delayed the country's transition towards high-income status while simultaneously increasing the population living below the poverty threshold to approximately 10 million individuals. Consequently, urgent expansion of new investment projects valued at no less than 600 billion baht annually is required to overcome the middle-income trap and stimulate sustainable economic growth. In parallel, inequality reduction measures must be intensified through strategic investments in transportation infrastructure connecting neighbouring countries, together with the decentralisation of economic centres beyond Bangkok into multiple regional areas nationwide.

Moreover, the private sector should be provided with greater opportunities to participate in delivering services that maximise the efficiency and utilisation of transportation infrastructure investments. Investment in these infrastructure systems, combined with accelerated completion of Free Trade Agreements (FTAs), would significantly enhance the country's trade and investment value. At present, Thailand maintains 13 FTAs with 18 countries, accounting for approximately 63% of the nation's international trade activities. Therefore, it is essential to expedite negotiations involving economic, trade, and investment cooperation agreements with broader international partners, particularly comprehensive and progressive agreements involving Asia-Pacific economies, the European Union, and the United Kingdom. Such negotiations should secure conditions aligned with national priorities while supporting the principal objectives established under the 13th National Development Plan and National Strategy Goal 5. Thailand consequently positions itself as a strategic gateway for regional trade, investment, and logistics activities, consistent with the broader aims of national development planning.

The 2030 Agenda for Sustainable Development, within which the SDGs constitute the central framework, was formulated and implemented through inclusive multi-level participation processes ranging from national negotiation forums to online participatory mechanisms, as well as initiatives organised by Non-Governmental Organisations (NGOs) and Civil Society Organisations (CSOs) internationally. This participatory framework enabled diverse stakeholders and vulnerable populations worldwide to contribute directly to the establishment of the SDGs during 2015. During the United Nations General Assembly, 193-member states formally endorsed the 2030 Agenda for Sustainable Development and the associated UN development framework. Thailand, under the administration of Prayut Chan-o-cha, was among the participating signatory states adopting this developmental agenda. The UN subsequently designated these objectives as the principal global framework for sustainable development, comprising a total of 17 SDGs, as illustrated in Figure 3.

From 17th National Development Goals, 169 sub-goals (SDG targets) are universally applicable. The division of the SDGs into 17 goals does not mean that we should consider them as 17 separate parts but rather that it is a method of dividing the goals to communicate the complex topic of sustainability in the simplest way possible to the public. Researchers have studied research related to the SDGs, dividing the research into four aspects: (1) organisation management sustainability, (2) environmental impact management sustainability, (3) innovation and technology management, and (4) collaboration management sustainability. The key research related to each of these four aspects is examined as follows:

Figure 3: Sustainable Development Goals (SDGs)
Source: (National Economic and Social Development Council, 2023).

Laksmi and Saputra (2025) stated that they assessed progress in achieving the 17 SDGs, and Thailand had an overall average score of 74.19, with an average of 65.7 points for East and South Asian regions. The report states that Thailand has achieved SDG 1, eradicating poverty (no poverty), and that a significant proportion of SDG indicators have been achieved, with a tendency towards achieving long-term goals. Pranee et al. (2024) found that the overall and individual aspects of importance were at a high level, with community business management being the most important aspect. All pairs of independent variables had correlations between 0.477 and 0.770. The structural equation model test specified criteria. Community business management and business strategies positively influence the performance of community businesses and can predict their performance in the positive direction, both directly and indirectly. Carlsen and Bruggemann (2021) state that the United Nations has set SDGs for member states to achieve by 2030.

Educational reform should encompass the following: (1) reform of the educational structure and management system, (2) curriculum reform, (3) reform of teacher training and development, (4) reform of the teaching and learning process, (5) reform of assessment and evaluation of learning, and (6) improvement of the lifelong learning system. Cerciello et al. (2023) found that the financial industry group had the most effective operations in supporting the SDGs. The most common strategy adopted by companies is product development through innovation. Thiancharoen and Panyasiri (2023) found that in the Thai printing industry, various growth strategies are employed to address management challenges resulting from digital disruption and new innovations.

In addition, Dhliwayo et al. (2024) found that (1) the current situation, from economic, sociocultural, and technological factors, reflects the current business management of entrepreneurs, and (2) factors influencing the success of medium- and small-scale construction contracting businesses under the COVID-19 pandemic situation found that entrepreneurial characteristics in terms of innovative thinking (β = 0.174) and the marketing mix. In terms of distribution channels (β = 5.132) and the entrepreneur's business strategy regarding customer relationship management (β = 0.412), these had the greatest impact on success, with the equation having a 68% predictive power, and (3) business operation success.

RESEARCH METHODOLOGY

This investigation adopted a mixed-methods research design consisting of three integrated components: qualitative inquiry conducted through in-depth interviews, quantitative investigation undertaken using questionnaire-based survey data collection, and qualitative exploration implemented through group discussion sessions.

Population and Sampling

1. Qualitative research using in-depth interview techniques; the sample consisted of nine specialists selected through purposive sampling procedures. The qualifications of the experts were established by the Executive Committee of the Doctor of Business Administration Program, Industrial Business Administration Program, and the Faculty of Business Administration at King Mongkut's University of Technology North Bangkok. The participants were categorised into three groups comprising three entrepreneurs or business executives, three representatives from governmental and related agencies, and three academic experts.
2. Quantitative research employed in this investigation involved experts or managerial personnel at supervisory level and above within the construction industry. The target population included organisations registered with the Ministry of Commerce, members affiliated with the Thai Construction Industry Association under Royal Patronage, members of the Association of Siamese Architects under Royal Patronage, members of the Consulting Engineers Association of Thailand, and construction business entrepreneurs listed within the Office of Small and Medium Enterprises Promotion (OSMEP) database, totalling 8,926 individuals. Regarding factor analysis and SEM research standards, a sample size of 500 respondents was considered appropriate. Two categories of construction enterprises were selected according to organisational size: 250 medium- and small-scale construction businesses employing fewer than 200 workers, and 250 large-scale construction businesses employing more than 200 workers, resulting in a total sample of 500 enterprises. Thereafter, the lottery sampling technique was implemented for data collection from the selected respondents.
3. Qualitative Research: This investigation employed focus group discussion techniques for validation purposes. Participants from business and industrial sectors were selected using purposive sampling procedures. The expert selection criteria, as determined by the Doctor of Business Administration Program, Industrial Business Administration major, Faculty of Business Administration, King Mongkut's University of Technology North Bangkok, were applied in selecting 11 specialists to ensure that no overlap occurred with experts previously involved in the qualitative phase of the investigation.

Research Tools

1. Qualitative Research In-Depth Interview Techniques: The research instrument consisted of a structured interview guide developed across four core domains, namely organisational

management sustainability, environmental impact management sustainability, innovation and technology management, and collaboration management sustainability.

2. Quantitative Research using Survey Techniques: The research instrument was a questionnaire divided into four main sections as follows:

The questionnaire comprised four parts. Part 1 examined general construction industry business characteristics, consisting of five checklist-based items, including four structured items and one open-ended question. Part 2 focused on organisational structure and operational features of construction industry businesses in alignment with the SDGs, presented through a checklist containing 20 items. Part 3 outlined managerial guidelines for construction industry operations consistent with the SDGs framework. Part 4 captured respondents' opinions and recommendations regarding the SDGs through an open-ended questionnaire comprising five questions.

3. Qualitative Research using Focus Group Discussion technique and research tool of the discussions.

Data Collection

1. Qualitative research was conducted through the formulation of interview guidelines and discussion topics, supported by an official letter of recommendation issued by the researcher from the Faculty of Business Administration, Doctor of Business Administration Program, Industrial Business Administration Department, King Mongkut's University of Technology North Bangkok. Data collection involved structured interviews with selected experts in accordance with a predetermined framework. The qualitative process utilised standardised recording forms for documentation. In addition, a moderator facilitated the sessions by introducing discussion themes designed to stimulate idea generation, encourage participants to express diverse perspectives, and support comprehensive, detailed, and in-depth dialogue.

2. Quantitative Research: Respondents were selected through a random sampling procedure using the lottery method, guided by an official introductory letter issued by the researcher from the Faculty of Business Administration, Doctoral Program in Industrial Business Administration, King Mongkut's University of Technology North Bangkok. The collected data were subsequently compiled for statistical analysis.

Data Analysis

Qualitative research was carried out through in-depth interview techniques combined with content analysis, whereby SDGs were systematically classified according to their respective components. Quantitative research analysis involved the examination of general baseline data using descriptive, inferential, and multivariate statistical techniques, implemented through SPSS and AMOS software. The research approach was further refined by incorporating modification indices (M.I.) as suggested by Arbuckle. In conjunction with program outputs and established theoretical principles, inappropriate observed variables were systematically removed, and the revised model was re-estimated. This iterative procedure was repeated until the structural equation model achieved consistency with empirical data. Furthermore, model evaluation required consideration of specified assessment criteria. Arbuckle proposed four key criteria for evaluating model fit, as presented in Table 1. Qualitative research using focus group discussions was employed to synthesise and summarise participants' opinions, perspectives, and recommendations in a structured manner.

Table 1: Criteria for Evaluating the Consistency of Variables

Evaluating the Data–Model Fit	Criteria
CMIN–p	<0.05
CMIN/DF	>2.00
GFI	<0.90
RMSEA	>0.08

RESULTS

The results reveal that SDGs comprise four components as follows:

1) Organization Management Sustainability
2) Environmental Impact Management Sustainability
3) Innovation and Technology Management
4) Collaboration Management Sustainability

Data Analysis Regarding the General Status of the Construction Industry

Data analysis on the size of construction contracting organizations revealed that medium- and small-sized construction industry organizations, with no more than 200 personnel, accounted for 50.00%, while large-sized construction industry organizations, with more than 200 personnel, also represented 50.00%. Additionally, data analysis of business registration indicated that the most common business registration form was a limited company at 45.40%, followed by a limited partnership at 29.20%, and a public limited company at 25.40%. Analysing the shareholder structure of organizations showed that the predominant structure was all Thai shareholders, making up 33.60%, followed by more Thai shareholders than foreign shareholders at 29.60%, more foreign shareholders than Thai at 21.60%, and all foreign shareholders. Furthermore, data analysis on registered business organizations in the area revealed that the highest number of registered businesses was in the provinces outside Bangkok, accounting for 58.40%, while Bangkok and its surrounding areas accounted for 41.60%. Lastly, the duration of business operation indicated that the most common duration was 30 years, representing 37.80%, followed by 10–20 years at 25.20%, 21–30 years at 22.00%, and less than 10 years at 15.00%.

Analysis of the Structure and Operational Characteristics of the Construction Industry in Accordance with SDGs

Data analysis regarding the integration of SDGs into current business processes revealed that the most common practice was referencing SDGs in organisational communication documents at 29.00%, followed by incorporating SDGs into organisational strategy and planning for implementation at 28.40%, learning about SDGs through online and offline channels and implementing them within the organisation at 26.20%, and fully integrating SDGs into all business processes at 16.40%. Additionally, data analysis on investment and development of green industries showed that the most common practice was having pilot green innovation projects supported by external agencies at 29.40%, followed by allocating a portion of revenue to explore green technologies at 24.60%, creating new innovations and commercialising them, including industry recognition at 23.40%, and establishing an innovation research unit to develop environmentally friendly technologies at 22.60%.

The most frequently implemented occupational safety and health management practices for construction workers included developing a risk monitoring and surveillance system with regular improvements at 27.80%, followed by annual safety training and provision of basic protective equipment at 26.80%, developing specific risk prevention technologies and fostering a safety culture at 25.40%, compliance with minimum safety regulations without further action at 10.20%, and providing personal protective equipment (PPE) to workers at 9.80%.

In terms of environmentally friendly uses of construction materials, developing innovative new materials that systematically reduce environmental impact was most prominent at 37.00%, followed by establishing a clear and consistent green material policy at 26.20%, selecting and using recycled or local materials at 19.80%, and exploring and studying environmentally friendly alternative materials at 17.00%. The most popular response for creating a circular economy network with business partners accounted for 39.20%, followed by initiating waste categorisation at 20.80%, developing an initial waste reduction plan at 27.60%, and implementing waste collection programmes at 12.40%. Analysis of personnel skill and potential development revealed that the most popular approach was creating a continuous learning and development system covering the entire organisation at 33.20%, followed by developing systematic individual potential development plans at 29.80%, providing training based on job and position needs at 28.80%, and conducting a one-time onboarding orientation at 8.20%.

In terms of support for diversity and equality in employment, the most popular approach was having a policy of gender equality and equal opportunities in the workplace at 33.20%, followed by accepting people with disabilities in limited positions at 26.40%, actively promoting employment for disadvantaged groups at 24.40%, and developing an inclusive and fair employment platform at 16.00%. Analysis of community participation and support revealed that the most frequent activity was organising annual social activities at 31.40%, followed by participatory long-term community development planning at 28.60%, occasional monetary or resource donations at 21.40%, and strategic partnerships in sustainable community development at 18.60%.

The analysis of renewable energy in the construction process indicated that setting clear clean energy targets was the most frequent activity at 29.80%, followed by preliminary exploration and study of alternative energy sources at 25.60%, developing a renewable energy infrastructure throughout the organisation at 23.20%, and installing partial renewable energy systems in the process at 21.40%. In sustainable supply chain management, the most frequently cited practices included having sustainability requirements to select business partners at 28.60%, continuously evaluating and developing the capabilities of business partners at 22.80%, establishing initial criteria for selecting business partners at 22.40%, selecting business partners primarily based on price at 20.40%, and building socially and environmentally responsible business networks at 5.80%.

Analysis of HRM strategies aligned with the SDGs in the construction industry showed that the most frequently cited strategy was local employment at 31.40%, followed by promoting diversity and equality at 22.20%, creating a safe workplace at 21.20%, training and developing workforce skills at 13.80%, and improving worker welfare and quality of life at 11.40%. For approaches to reducing environmental impact in construction projects, systematic waste management was identified as the most important factor at 25.00%, followed by energy-efficient building design at 24.80%, the use of recycled materials at 23.40%, the adoption of clean technologies at 14.00%, and carbon emission control at 12.80%.

The analysis revealed that collaboration with educational institutions was the key factor in fostering innovation for sustainable development in the construction business at 27.00%, followed by research funding at 26.20%, creating an open-minded organisational culture at 21.60%, investing in new technologies at 13.00%, and providing incentives for innovation at 12.20%. Digital technology's role in driving SDGs in the construction industry showed that efficient resource management was the most important factor at 30.20%, followed by developing safety systems at 25.80%, monitoring environmental impacts at 22.20%, fostering community participation at 16.40%, and enhancing learning and skills at 5.40%.

Effective mechanisms for creating social responsibility in the construction business indicated that sustainability reporting was the most effective mechanism at 31.00%, followed by local community involvement at 27.40%, supporting social projects at 20.40%, building collaborative networks at 16.80%, and creating community sustainability at 4.40%. The analysis of the application of Internet of Things (IoT) systems in monitoring environmental impacts from construction revealed that linking real-time air and water quality monitoring systems was the most effective mechanism at 37.80%, followed by integrating IoT systems with intelligent data analysis platforms at 28.00%, installing basic dust and noise sensors at 23.40%, developing an automatic alert and control system when standards are exceeded at 8.60%, and creating an IoT ecosystem that connects all stakeholders at 2.20%.

Financial strategies supporting sustainable development in businesses revealed that investments in social projects were the most important strategy at 26.40%, followed by green fundraising at 23.80%, environmental risk management at 22.60%, value creation through innovation at 19.80%, and financial product development at 7.40%. Approaches to creating a sustainable organisational culture indicated that communicating organisational values was the most important strategy at 25.00%, followed by continuous training at 24.60%, motivation and rewards at 23.40%, involvement of all levels of management at 22.20%, and opportunities for all personnel to participate at 4.80%. The role of research and development in supporting the SDGs most beneficial to organisations emphasised addressing social and environmental problems as the key strategy. Finally, strategies for communicating and raising awareness of SDGs among stakeholders revealed that preparing sustainability reports was the most popular strategy at 28.20%, followed by using social media at 24.20%, organising public events at 21.80%, building collaborative networks at 19.60%, and conducting study tours and exchanging experiences at 6.20%.

Analysis Results of the Structure and Operational Characteristics of the Construction Industry Businesses in Accordance with the SDGs

Classified by the size of the construction industry organizations found that:

The analysis of SDG integration into existing business operations (P = 0.07) indicates that the incorporation of SDGs is not significantly influenced by firm size at the 0.05 significance level. The examination of investments in green innovation (P = 0.00) shows that such investments and developments are significantly associated with the scale of construction firms at the 0.05 level. The assessment of occupational safety and health management for construction workers (P = 0.91) reveals no significant relationship between safety practices and company size. The evaluation of environmentally friendly construction materials (P = 0.30) indicates that their utilisation is not significantly affected by organisational scale. The analysis of waste and pollution management during construction activities (P = 0.60) demonstrates that these practices are not dependent on firm size. The examination of employee skill and capacity development across construction firms of varying scales yielded a P-value of 0.25, suggesting that workforce development is not statistically related to organisational size at the 0.05 significance level.

The results for support for diversity and equality in employment (P = 0.09) show that such practices are not dependent on the size of construction industry organisations at the 0.05 significance level. Community participation and support for development (P = 0.02) revealed a statistically significant relationship, indicating that community engagement practices are dependent on organisational size at the 0.05 level. Renewable energy use in the construction process, categorised by organisational size (P = 0.73), shows no significant dependency on firm scale. Sustainable supply chain management (P = 0.20) is also not significantly influenced by organisational size. Human resource management strategies aligned with SDGs in the construction industry (P = 0.12) likewise show no significant dependency on firm size at the 0.05 level.

Effective environmental impact reduction strategies in construction projects, categorised by organisational size (P = 0.42), do not differ significantly according to firm size. Key factors in fostering innovation for sustainable development in the construction business (P = 0.38) also show no significant dependence on organisational scale. With a P-value of 0.54 (> 0.05), digital technology adoption in driving SDGs is not significantly associated with construction organisation size. Effective mechanisms for creating social responsibility in the construction business (P = 0.26) similarly indicate no significant dependence on firm size. The application of Internet of Things (IoT) systems in monitoring environmental impacts from construction (P = 0.10) shows no statistically significant relationship with organisational size. Financial strategies supporting sustainable development in the construction business (P = 0.10) also do not depend significantly on firm size at the 0.05 level.

The analysis of approaches to creating a sustainable organisational culture (P = 0.66) reveals no significant relationship with construction firm size. Research and development in supporting SDGs (P = 0.13) similarly shows no statistically significant dependence on organisational scale at the 0.05 level. Finally, communication and awareness-building strategies regarding SDGs among stakeholders (P = 0.96) indicate no significant association with organisational size in the construction industry at the 0.05 significance level.

Results of the Analysis of the Importance Level of the SDGs Components

The data were analysed using the mean ($\bar{X}$) and standard deviation (S.D.). The importance level of SDGs components was found to be high overall (mean = 4.45), indicating that all aspects were perceived as highly significant. Collaboration management sustainability was rated at a high level overall, with a mean of 4.47; at the item level, mean values ranged from 4.51 to 4.43. Similarly, innovation and technology management was also assessed as highly important overall (mean = 4.46), with individual item means ranging between 4.54 and 4.40. In addition, organisational management sustainability was considered highly important, with an average score of 4.39, while item-level scores ranged from 4.47 to 4.29.

Analysis of the Importance Level of SDGs Components

Classification of construction industry and business organization found that:

The classification of construction industry organisations indicated that medium- and small-sized construction businesses perceived SDGs as highly important, with an average score of 4.47, and consistent importance across all dimensions. Large-sized construction businesses also reported a high level of importance, with an average score of 4.43, reflecting similarly high evaluations across all aspects. In the environmental impact management for sustainability dimension, medium- and small-sized construction businesses rated SDGs as highly important, with a mean of 4.49; item-level scores ranged from 4.56 to 4.43. Large-sized construction businesses also indicated a high level of importance overall, with a mean of 4.47, and item-level scores ranging from 4.56 to 4.37.

In the collaboration management sustainability dimension, medium- and small-sized construction businesses demonstrated a high level of importance, with an average score of 4.48, while item-level means ranged from 4.54 to 4.44. Likewise, in innovation and technology management, medium- and small-sized construction businesses reported high importance, with an average score of 4.47 and item-level scores ranging from 4.55 to 4.40. Finally, in the organisational management sustainability dimension, medium- and small-sized construction businesses indicated a high level of importance, with an average score of 4.42, while individual item scores ranged from 4.53 to 4.33.

Comparison of the Differences in the Importance Levels of SDGs Components

Classification of size and construction industry businesses found that:

The results indicate that there is no statistically significant difference between the groups when assessed at the 5% significance level. Similarly, none of the individual dimensions exhibited meaningful variation across the groups. Across all examined aspects, the findings consistently demonstrate an absence of statistically observable differences under the 0.05 criterion, suggesting that small-, medium-, and large-scale construction firms assign a comparable level of importance to the Sustainable Development Goals (SDGs).

Hypothesis Testing Results on Differences in the Importance of SDGs Components

Classified by the size of construction industry businesses found that:

The hypothesis testing results produced an overall P-value of 0.53, indicating that when the overall importance of SDGs is classified by the size of construction industry businesses (H6), there is no statistically significant difference between medium- and small-sized construction industry businesses and large-sized construction industry businesses. Both groups therefore place a comparable level of importance on SDGs at the 0.05 significance level.

Analysis of Comments and Suggestions on the SDGs

The guidelines for managing the construction industry in accordance with the SDGs indicate that the most frequently recommended SDGs are aligned with prevailing business management approaches within the construction sector, particularly in relation to risk management and governance, environmental stewardship, strategic partnerships, occupational safety, community development, and broader social well-being. To support effective implementation, governmental bodies should formulate targeted policies and supportive measures that encourage construction industry actors to integrate SDGs into their operational frameworks, thereby creating appropriate incentives for businesses to prioritise sustainability-oriented practices.

Moreover, the private sector within the construction industry demonstrates a general level of awareness and understanding of the SDGs; however, several key challenges and implementation barriers persist within the sector. To overcome these constraints, the establishment of structured cooperation mechanisms among government agencies, private enterprises, and civil society organisations is essential in order to drive the successful adoption and implementation of the SDGs within the construction industry.

Results in Accordance with the SDGs Before Model Modification

In the Unstandardized Estimation and Standardized Estimate modes before model improvement, as shown in Figures 4–5.

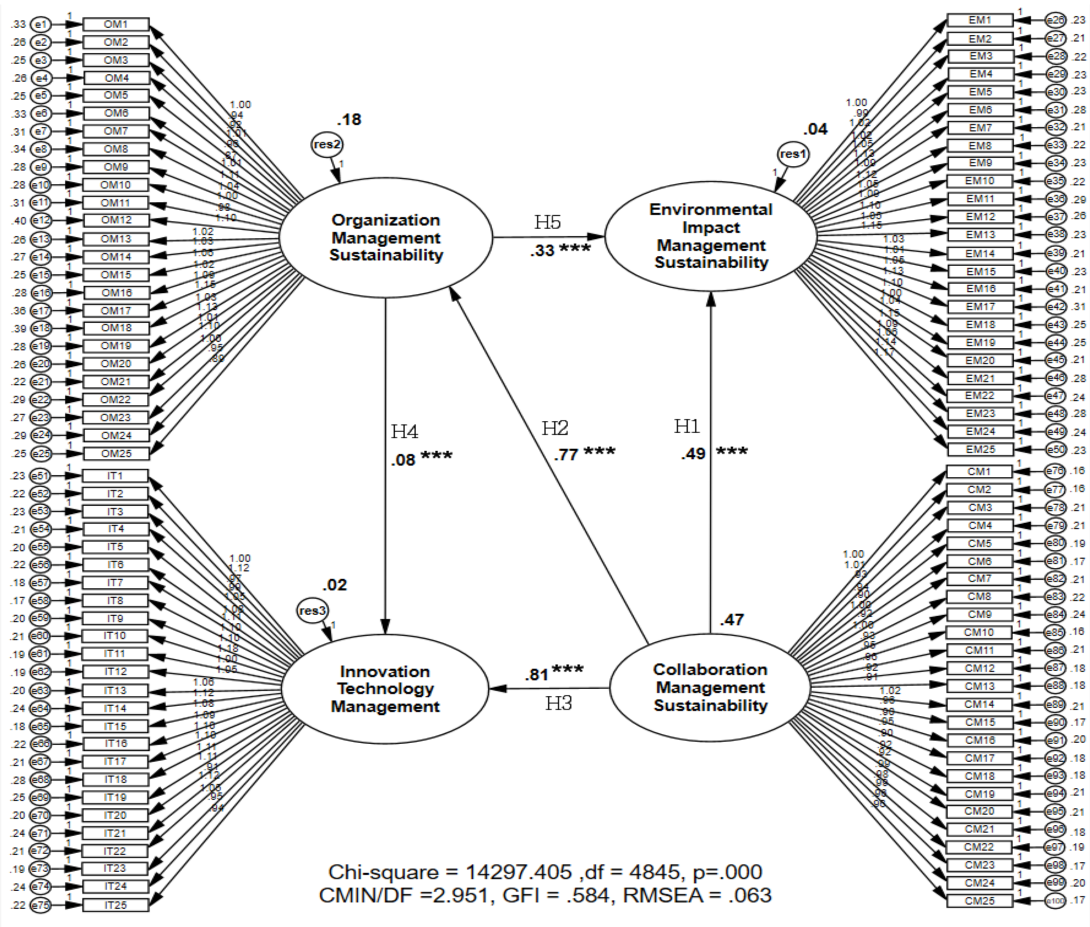

Figure 4: Structural Equation Modelling for Construction Industry Business Management

Approaches, in Accordance with the SDGs in Unstandardized Estimate Mode, Before Model Modification

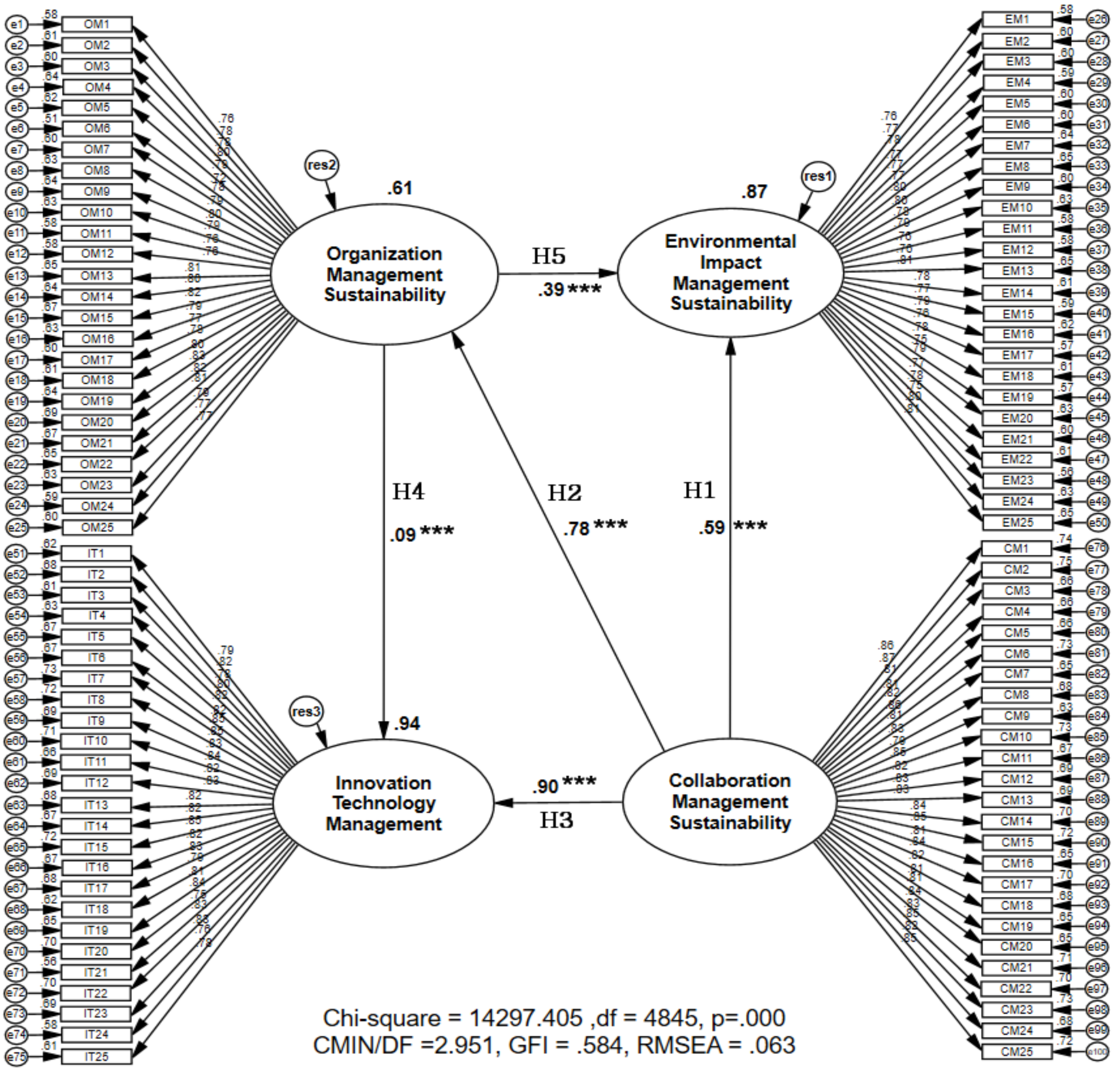

Figure 5: Structural Equation Modelling for Construction Industry Business Management Approaches in Accordance with the SDGs, in Standardized Estimate Mode, Before Model Modification

Results in Accordance with the SDGs, After Model Modification

The SEM results demonstrated an adequate model fit (χ^2 = 233.950, df = 204, p = .074; CMIN/DF = 1.147; GFI = .958; RMSEA = .017), confirming the appropriateness of the modified model. The findings indicate that collaboration management sustainability exerts a strong positive effect on innovation and technology management (β = .83–.94) and also significantly affects environmental impact management sustainability (β = .24–.25). Furthermore, organisation management sustainability was found to have a significant positive influence on environmental impact management sustainability (β = .61–.69) as well as on innovation and technology management (β = .16). Overall, following model modification, the SEM confirms a satisfactory fit and highlights that collaboration management sustainability and organisational sustainability are the most influential determinants driving innovation, technological advancement, and environmental impact management within SDG-aligned construction industry practices.

Results of the Goodness-of-Fit Assessment of the Structural Equation Modelling Model in Accordance with the SDGs, Before and After Model Modification

The equation model improvement shows that the root mean square error of estimation index (RMSEA) was 0.063, which met the criterion for acceptable goodness-of-fit with empirical data. However, other indices, including the chi-square probability level (CMIN-ρ) of 0.000, the relative chi-square index (CMIN/DF) of 2.951, and the goodness-of-fit index (GFI) of 0.584, did not satisfy the acceptable model fit criteria. After model refinement was completed, substantial improvement in fit indices was observed. The chi-square probability (CMIN-ρ) increased to 0.074 (> 0.05), the relative chi-square (CMIN/DF) decreased to 1.147 (< 2.00), the GFI improved to 0.958 (> 0.90), and the RMSEA reduced to 0.017 (< 0.08). These results confirm that all four statistical criteria fall within acceptable thresholds, thereby validating the adequacy and overall goodness-of-fit of the final revised model.

Hypothesis Testing Results Analyse the Causal Influence Between Latent Variables in the Structural Equation Model of Construction Industry Business Management Approaches in Accordance with the SDGs

H1: The Collaboration Management Sustainability component significantly influenced the Environmental Impact Management Sustainability component at a statistical significance level of 0.001, with a standardized regression weight of 0.25, supporting the research hypothesis.
H2: It was found that the Collaboration Management Sustainability component has a direct and significant influence on the Organization Management Sustainability component at a statistical significance level of 0.001, with a standardized regression weight of 0.76, supporting Hypothesis 2.
H3: The finding that the Collaboration Management Sustainability component has a direct and significant influence on innovation and technology management at the 0.001 statistical significance level, with a standardized regression weight of 0.83, supports H3.
H4: The results showed that the organization management sustainability component had a significant direct influence on the innovation and technology management component at the 0.001 level, with a standardized regression weight of 0.16, supporting H4.
H5: The results showed that the organization management sustainability component had a direct influence on the environmental impact management sustainability component at the 0.001 level, with a standardized regression weight of 0.69, supporting H5.

The overall effect of the Collaboration Management Sustainability component demonstrates an indirect influence through the Innovation and Technology Management component with a value of 0.95 (0.83 + 0.12). Pairwise analysis of the relationships among variables revealed that all 231 variable pairs were statistically significant. The strongest associations were observed among collaboration practices, social responsibility initiatives, and advanced digital technologies such as Internet of Things (IoT) and blockchain systems, whereas the weakest relationship was identified between formal sustainability commitments and the installation of pollution-monitoring sensor systems. The research model received unanimous approval, supported by expert validation and constructive feedback. Overall, sustainable construction organisations are encouraged to adopt long-term strategic approaches that integrate balanced

Environmental, Social, and Governance (ESG) practices, resilient governance structures, green operational systems, technology-driven and data-oriented innovation, and multi-stakeholder collaboration aligned with the SDGs across the entire value chain.

DISCUSSION

This study concentrates on the determinants of sustainable industrial organisational management, sustainable environmental impact management, sustainable innovation and technology management, and sustainable collaboration management. Collectively, these dimensions are oriented towards the development of environmentally responsible services that enhance long-term survivability and competitive advantage. The findings indicate that environmental impact management sustainability recorded the highest mean score of 4.48, signifying its primacy among all examined dimensions. This outcome is consistent with Shajidha and Mortula (2025) and K. Zhang et al. (2023), who emphasise that sustainable construction waste management focuses on minimising environmental burdens through the implementation of the 3R principles (reduce, reuse, recycle). It also corresponds with the five-R waste management framework discussed by Rani et al. (2021) and Bageis et al. (2023), who underline construction environmental governance as a critical determinant encompassing occupational health, safety, ethical compliance, moral responsibility, and regulatory adherence.

The empirical results further revealed that the most significant item within SDG-aligned construction management practices was post-construction site rehabilitation and improvement, with a mean score of 4.54. This aligns with SDG 11 (Sustainable Cities and Communities), SDG 12 (Responsible Consumption and Production), and SDG 15 (Life on Land). This finding is consistent with Afzal and Lim (2022) and Q. Zhang et al. (2023), who highlight that reducing environmental and community disruption during construction, particularly through post-project restoration, is essential for advancing organisational social sustainability. Similarly, Cerciello et al. (2022) emphasise that reducing resource consumption while enhancing operational efficiency constitutes a core sustainability strategy, directly supporting site rehabilitation initiatives that prioritise resource optimisation and waste minimisation. Overall, post-construction restoration is strongly aligned with integrated sustainability dimensions, including economic efficiency, social responsibility, and environmental protection, thereby reinforcing SDG achievement through structured waste management, strategic planning, and competitive advantage creation.

The SEM results for SDG-aligned construction industry management demonstrate that Collaboration Management Sustainability exerts the strongest direct effect on Innovation and Technology Management (standardised regression weight). This provides empirical evidence that collaboration with academic institutions, research organisations, and innovation agencies facilitates technological advancement, cross-border research networks, and cooperation with national innovation bodies. This is consistent with Babalola and Harinarain (2021), who argue that effective policy mitigation requires robust stakeholder information exchange to support evidence-based decision-making.

Further SEM analysis after model adjustment confirmed that Collaboration Management Sustainability remains the dominant determinant of Innovation and Technology Management. This indicates that inter-organisational collaboration plays a pivotal role in enabling knowledge transfer, research funding access, technical capacity development, and resource sharing. The pairwise relationship analysis further identified the strongest correlation (0.737) between coordination with government agencies to promote sustainable development (CM21) and the implementation of corporate social responsibility (CSR) projects with network partners (CM22).

In a broader context, collaborative networks among enterprises across industries and trade associations, particularly at the national cluster level, represent a strategic mechanism for business expansion and sectoral growth, as evidenced in the Thai printing industry under new normal conditions (Kanchanamai et al., 2023; Kokkhangplu et al., 2024; Pholphirul et al., 2023). Similarly, in the education sector, effective reform implementation requires coordinated engagement among government bodies, private organisations, and other stakeholders to ensure alignment with policy frameworks and sustainable development outcomes (Cai & Wolff, 2022). The hypothesis testing results further indicate that the overall SDG-based construction management approach does not vary significantly across construction industry organisation categories, with no statistically significant differences observed across all dimensions.

SDG integration within the construction industry has increasingly emerged as a central paradigm for sustainability-oriented project management and operational transformation. Alawneh et al. (2024) emphasise the development of assessment and management systems aligned with SDG principles, reflecting the growing institutionalisation of sustainable practices within the sector. Likewise, Martinez Esguerra et al. (2025) highlight that the interaction between climate policy and social inequality varies across project sectors, necessitating integrated sustainability considerations at all decision-making levels. Mansell et al. (2020) further argue for redefining engineering roles in alignment with SDGs, supporting the findings of Batool et al. (2024), which stress the necessity for construction firms to adapt to transformative sustainability-driven urban development. Additionally, Phung et al. (2025) demonstrate that sustainability adoption enhances both project performance and stakeholder engagement. A broader infrastructural perspective is presented by Moshood et al. (2023), while Singh and Rahman (2021) advocate for multi-stakeholder frameworks integrating corporate sustainability with SDG objectives. Collectively, these studies demonstrate the progressive institutionalisation of sustainability within the construction sector, aligning it with global development imperatives.

The increasing emphasis on sustainability within construction highlights the necessity of adopting innovative frameworks and technologies to address environmental challenges effectively. Llorente-García et al. (2025) emphasise the role of life cycle assessment and advanced materials such as nanoparticles in optimising construction sustainability. Similarly, Gyadu-Asiedu et al. (2021) propose a systemic sustainable construction development framework grounded in stakeholder integration and regulatory compliance. In relation to climate resilience, Silva et al. (2021) highlight the importance of climate adaptation in infrastructure planning, while Oruc et al. (2024) emphasise adaptive strategies to mitigate climate-induced performance risks. The integration of renewable energy systems is further supported by Lin et al. (2020).

Moreover, environmental restoration strategies such as brownfield redevelopment are discussed by Hou et al. (2023), contributing to urban sustainability enhancement. From a project management perspective, Kineber et al. (2024) underscore the importance of agile methodologies in achieving sustainable residential construction outcomes. Similarly, Emere et al. (2025) emphasise the significance of effective project execution frameworks in strengthening sustainability performance. Overall, these studies collectively demonstrate a decisive transition in the construction industry towards sustainability-oriented practices that enhance environmental performance, operational efficiency, and long-term project viability.

CONCLUSION

This study used a mixed-methods approach to develop construction industry management models aligned with the United Nations SDGs. In the qualitative phase, experts identified four key components: organisational sustainability management, environmental impact management, innovation and technology management, and collaboration sustainability management, comprising 100 indicators in total. Survey results showed an even distribution between medium–small and large construction firms, with limited liability companies being the most common form. Many organisations in provincial areas had operated for over 30 years. Overall, SDG-aligned practices were rated highly, with environmental management (waste control, eco-friendly materials, and digital monitoring) playing a central role, alongside innovation, human resource development, financial strategies, and stakeholder engagement. SEM was used to test the framework. The initial model showed partial fit, but refinement improved all fit indices and confirmed model adequacy. Hypothesis testing supported all proposed relationships, with collaboration sustainability management emerging as the strongest influence. Finally, a focus group of 11 experts reviewed and unanimously approved the final model.

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