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Key Challenges and Strategies Towards Sustainable Infrastructure Development in Malaysia

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Abstract: The world is fixated on climate change because of its damage to the environment and the ripple effect it can have on people's health and the economy. This study aims to delve into research focusing on sustainable infrastructure development in Malaysia, as well as the main obstacles and approaches to taking on such a task. This study used a mixed-methods system, which allowed for the collection a large amount of data and made it easy to compare results from different settings. The study found that more people are aware of sustainable impact assessment in infrastructure projects and familiar with resilient, sustainable development than sustainable performance evaluation. The studies also showed that the main problems in implementing sustainability include minimising adverse hazards, financial and budget investment issues, as well as inadequate governance and management. The proposed measures are broken down into monetary, institutional, and organisational themes. Possible steps toward a more sustainable infrastructure involve increasing green investment and financing, fostering green policies and environmental regulations, promoting green technologies and materials, and growing capacity through improved awareness and training. The findings of this study provide construction stakeholders with insight into an analysis of existing methodologies and strategies for integrating sustainable infrastructure development. Resolving obstacles and refining implementation tactics facilitated the effectiveness of the transformation towards a more sustainable infrastructure.

Keywords: Sustainable infrastructure, challenges, strategies, sustainable development, key drivers

1. Introduction

Sustainable development can be delineated as "development which meets the needs of the present without compromising the ability of future generations to meet their own needs" [1]. The aim is to have a beneficial impact that is evenly distributed across economic, social, and environmental sectors. The relevance of sustainable development has been highlighted in many fields, including infrastructure, over the past few decades [2]. The Copenhagen Resource Institute [3] estimates that the building industry consumes 40% of global energy, 30% of emissions of carbon dioxide and 40% of solid waste. Due to its complexity, infrastructure construction utilizes more natural resources and significantly impacts the surrounding ecosystem [4]. Besides, upgrades to infrastructure frequently impose high costs

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on society due to decreasing efficiency and an increase in accidents [5]. Therefore, a holistic strategy that considers environmental, social, and economic sustainability is required to build long-lasting infrastructure.

Completing an infrastructure project is crucial to a growing nation's economic and social development. Infrastructure sectors are vital as it drives economic growth due to the engagement in every industry's production process, such as telecommunications, energy, water, and transportation [6]. Nevertheless, the advancement of the sectors might deepen the gap between economic, social, and environmental sustainability. It was cited that environmental challenges compromising the efforts involve the depletion of natural resources, increasing temperatures, chemical pollution, and biodiversity loss [7]. Meanwhile, there is a massive infrastructural deficit in underdeveloped countries, with 4 billion people facing inadequate internet connection, 663 million people lacking access to safe drinking water, and 2.4 billion lacking access to modern sewage systems [8].

Malaysia is rapidly urbanising and evolving into a high-income nation, making it one of the emerging countries with the highest GDP growth. As a developing country amid rapid industrialisation and urbanisation, the country faces the daunting issue of economy boosting [9]. Enhancing people's standard of living, protecting natural resources, and combating climate change are all part of the development processes. The government of Malaysia has invested substantial funds in infrastructure development to stimulate economic expansion and social progress. The Malaysia Plans allocate the most public sector funds to infrastructure development, approximately US$13 billion, or 3.66% of GDP, was assigned to infrastructure in Malaysia in 2019 [10]. Many nations have yet to transition toward establishing sustainable infrastructure, despite the significant advantages and beneficial impacts of infrastructure expansion in developing countries [11], [12]. Limitations nonetheless constrain sustainable infrastructure in aspects like capacity building and technical resources, thus slowing down implementation [13].

Extensive study has been conducted on sustainable infrastructure in Malaysia, focusing on promoting green building practices through the development of management frameworks, notion exposure, policy procedures, and conceptual models [14]- [16]. Many researchers have addressed indicators or criteria for evaluating sustainable infrastructure [17]- [19]. Despite a few studies on the problems of implementing sustainable infrastructure [20], [21], Malaysia's knowledge and practises on sustainable infrastructure implementation are still vague. This study aims to fill that knowledge gap by analysing ongoing sustainable infrastructure projects as well as generating plans for implementing solutions in developing and emerging nations like Malaysia. This purpose tackles the research question: ‘To what extent is the adoption of sustainability in infrastructure projects in developing countries like Malaysia?’

In efforts to further comprehend the context, Section 1 provides context for the topic of study, while Section 2 reviews existing literature on the subject of sustainable infrastructure development. Additionally, Sections 3 and 4 detail the procedures and data collection. Section 5 provides a summary and conclusion after discussing the strategies, tactics, and alternatives proposed for efficiently implementing sustainable infrastructure.

2. Literature Review

As a worldwide initiative, the Sustainable Development Goals (SDGs) seek to alter current paradigms to ensure any nation's long-term success. Three pillars of sustainability are achieved when a development infrastructure project generates jobs, stimulates economic activity, reduces poverty, and provides excellent community service. The project aims to strengthen living standards and human capital by constructing new infrastructure.

2.1 Key Critical Factors in Sustainable Infrastructure Development

Reviewing the literature on sustainable infrastructure reveals an emphasis on research on one particular facet of tool development for evaluating green infrastructure (i.e., indicator, criteria, sub-criteria, weightage, and certification process). Several recent academic publications have addressed establishing a sustainable indicator or requirement for infrastructure projects in Malaysia [18], [19], [22]. Additional technical studies have been performed to analyse economic, environmental, and social sustainability, with a core feature of integrating resilient infrastructure [18], [23] throughout all phases of the project cycle [24], [25].

Previous sustainable infrastructure study also addresses hurdles to achieving the three pillars of sustainability [2], [26], [27]. It was reported that the three primary challenges were the inadequacy of a directing mechanism, the multidisciplinary aspect of the term "sustainable," and a reluctance to collaborate and network. Moreover, system designers face various obstacles and hazards to long-term performance, including ageing, deterioration, insufficient funding, catastrophic events, and a growing population [28]. The rapidly expanding demand for new infrastructure development projects has increased the construction industry's adverse impact on the surrounding environment [4]. Despite this, it was stated that assessment rating tools strongly influence construction industry sustainability awareness and implementation [29], [30].

In addition to discussing the challenges of implementing a sustainable infrastructure, several published studies have highlighted fundamental enabling elements. Due to the broad scope of the term "sustainability," a recent study suggests acknowledging the issue as early as possible in the planning stages of a project and maintaining that commitment throughout the lifespan [2]. An earlier literature analysis emphasised and identified studies that evaluated potential solutions for constructing sustainable infrastructure. Elements of this method included innovative concepts

[31]- [33], the consolidation of terminology [26], [32], also the sharing of information and collaboration [33], [34]. Furthermore, financial factors also limit the construction industry's implementation of sustainable methods [35]. This demonstrates the necessity to educate builders, developers, and the general public about the long-term advantages of sustainable construction practices by raising awareness of the topic. Financial incentives have been identified as crucial motivators in various research, indicating the importance of the economic and financial categories [31], [36]. Previous research has shown that there are persistent obstacles in the way of tackling the problems from the bottom up. However, not enough research has focused on long-term sustainability, and even fewer studies have considered the health consequences and change management skills necessary for long-term success.

2.2 Sustainable Infrastructure Initiatives in Malaysia

Malaysia's rapid development has resulted in 12th Malaysia Plan as part of the country's efforts to maintain social stability and economic growth. The rapid development that has taken place in Malaysia has led to a strong association between economic progress and the development of the country. Skim Penilaian Penarafan Hijau JKR, a green rating instrument, was introduced by the Public Works Department in 2012 to evaluate the long-term viability of government development projects [37]. Besides, launched in 2014, the Malaysia Green Highway Index (MyGHI) is the nation's first to evaluate green infrastructure. The MyGHI is a performance benchmark system set to assess the sustainability of roads in Malaysia [38]. Sustainable INFRASTAR was created in 2019 by the Construction Industry Development Board of Malaysia (CIDB) to evaluate the sustainability measures implemented in Malaysian infrastructure projects, especially during the design and construction stages [39]. The government of Malaysia has announced plans to spend RM400 billion on infrastructure improvements and new construction projects throughout the 12th Malaysia Plan (2021-2025) [40]. Efforts by the government to persuade influential stakeholders to build eco-friendly infrastructure have intensified. As part of this policy, the Malaysian government has included climate action plans in the 10th Malaysia Plan (2011–2015), 11th Malaysia Plan (2016–2020), and 12th Malaysia Plan (2021–2025). Malaysia's commitment to environmentally friendly infrastructure is evident in the country's recent establishment of an assessment tool and framework [41]. Table 1 summarises the green assessment tool and framework in Malaysia. An initial framework describing green strategies and initiatives was the primary focus of an overview of Malaysia's approach to sustainable infrastructure development in the construction industry [42]- [45]. Sustainable infrastructure innovation was further discussed, and a monitoring strategy was proposed to lessen the environmental impact [42], [46]. There are also several studies on the effectiveness of sustainable infrastructure elements, particularly on transportation [47] and garbage collection [26].

Table 1 - Sustainable assessment tool and framework [37]-[39]

Year	Initiatives Instruments	Descriptions
2012	JKR's pH (Skim Penilaian Penarafan Hijau JKR)	- A technique to measure the sustainability of government development programmes using non-residential building and road developments. - Six (6) assessment criteria: materials & resources, energy efficiency, sustainable site planning & management, indoor environment quality, water efficiency, and innovation.
2014	Malaysia Green Highway Index (MyGHI)	- A performance baseline standard designed to measure the level of the greenness of highways in Malaysia. - Five (5) criteria: social and safety, energy efficiency, environment and water management, sustainable design and construction activities, and material and technology.
2019	Sustainable Infrastructure Rating Tool (Sustainable INFRASTAR)	- A ranking platform to measure how a project addresses sustainability approaches implemented in an infrastructure project. - Six (6) criteria: energy and water management, land use planning and management, social and cultural protection, resource management, biodiversity and other ecosystem services and stakeholder coordination.

The 2030 Agenda for Sustainable Development Goals, also known as the 2030 Agenda, is a set of 17 goals and 169 targets for sustainable development that 192 countries have adopted. The plan lays out the country's top economic priorities, outlining large-scale, strategically placed infrastructure projects with the potential to attract foreign investment in these unprecedented times. Investment and development in infrastructure and utilities such roads, railroads, digital infrastructure, water, and electrical supply are priorities in the 12th Malaysia Plan. The East Coast Rail Link project, scheduled for completion in 2026, and the Rapid Transit System project, connecting the Bukit Chagar Station in Johor Bahru with the Woodlands North Station in Singapore, are both examples of large-scale transportation infrastructure developments that aim to address the infrastructure gap in the East Malaysian states. The Public Private

Partnership (PPP) 3.0 model, which would be used for future infrastructure projects, is also proposed in the 12th Malaysia Plan. The PPP implementation model aims to have the government spend as little money as possible. The government encouraged sustainable transportation, consumption, and production practices, which pushed private companies to embrace sustainable branding for next-generation technologies. The strategy emphasises the circular economy's essence to create more sustainable investment options, provide new economic potential, and expand the green market via enhanced, green-related incentive schemes. By instituting a carbon price mechanism, the Comprehensive National Energy Policy (CNEP) maintains its commitment to better energy management to benefit national economic growth and security.

3. Research Methodology

3.1 Research Process

The study collected data from various sources and methods using a mixed-methods approach to draw comparisons between the findings. Two (2) sources of information, a questionnaire survey and supplementary semi-structured interviews are employed to collect data using qualitative and quantitative methods. The context provided by this strategy is more transparent than that presented by the others. First, quantitative data on industry perspectives on adopting sustainable infrastructure, impediments, and strategies to accomplish sustainable infrastructure development were gathered via cross-section surveys. Then, ten (10) experts were interviewed semi-structured to get their thoughts on the biggest challenges, variables, and strategies for incorporating sustainability into infrastructure projects.

3.2 Questionnaire Survey

The outcome of this research is beneficial to yield relevant insights in guiding construction stakeholders participating in choosing the best strategies to integrate sustainability into projects. The extensiveness of this study's applicability is based on the analysis of the existing literature on difficulties faced and sustainable infrastructure approaches [2], [26], [48], [49]. There are three distinct parts to the questionnaire, which are as follows:

(i) Section A demonstrates demographic background.
(ii) Section B addresses respondent’s perceptions and knowledge towards implementing sustainability in the industry.
(iii) Section C emphasises respondent’s insights concerning the barriers towards successful sustainable infrastructure implementation. A Likert scale with five points, ranging from "strongly disagree" to "strongly agree," has been structured into 12 different items (the extent to which the respondents agree to the given statements).

Participants in the survey came from a diverse group of infrastructure stakeholders in Selangor, Malaysia. Criterion purposive sampling was used to pick respondents, a non-probability sampling method. The Krejcie and Morgan sampling technique generated 138 samples [50]. The approach was deemed appropriate since it permits the research to meet its objectives [51]. The survey was given in both online and in-person formats. A response rate of 35.9% was obtained from a total sample size of 384 people involved in infrastructure projects. These individuals included local governments, contractors, consultants, developers, and clients in the sectors. Previous research with response rates as low as 20% usually generates more reliable results [52]. Table 2 describes the demographics of the survey participants.

Table 2 - Demographic profile of respondents

	Respondent Characteristics	Number of Respondents (total= 138)
Years of experience	Less than five (5) years	38
	Between 6 and 10 years	29
	Between 11 and 15 years	41
	More than 16 years	30
Designation	Project managers	9
	Engineer	79
	Assistant Engineer	28
	Site Supervisor	12
	Designer	2
	Surveyor	5
	Technical staff	3

3.3 Interviews

Throughout the study, quantitative data from cross-sectional surveys and case studies are supplemented and then interpreted by semi-structured interviews in an explanatory sequential approach. Quantitative measures and outcomes offer a comprehensive insight into the topic, allowing for a more thorough investigation.

After careful deliberation, ten industry experts were chosen to address infrastructure project sustainability. The main criterion for the selection is based on prior involvement in infrastructure projects. The responses consist of two (2) developers, two (2) consultants, three (3) contractors and three (3) project managers. The total number of interviews conducted is supported by those who agree that between 10 and 15 respondents should be relevant to the selection's information depth and analytical capabilities, not the study's participants. The following is a description of the semi-structured questions aimed at giving respondents the opportunity to contribute personal thoughts regarding implementing measures to reduce emissions effectively.

(i) The extent of sustainability implementation in infrastructure projects in Malaysia.
(ii) The challenges that hinder achieving sustainability in projects and initiatives should be implemented toward successful sustainable infrastructure projects.
(iii) An intriguing question enables the participant to contribute or address related concerns.

The data sufficiency has been reached or appears to have hit a saturation point or redundancy once no new information was discovered during the interview sessions [53], [54].

3.4 Data Analysis

Descriptive statistics were obtained using frequency distribution, content analysis, mean, standard deviation, and reliability analysis.

3.4.1 Reliability Test

The 16 variable items in Section C of the questionnaire (strategies and impediments to emissions management) were analysed for reliability, yielding a Cronbach's alpha score of 0.891. Any value greater than 0.70 was deemed appropriate [55].

3.4.2 Content Analysis

Analysis of data for descriptive purposes is a frequent qualitative research technique. It consists of conventional, summative, and directed approaches [56]. In this research, typical content analysis was used. Simple coding guidelines were established from the gathered data. This involves an exploratory process in which codes are rearranged until themes reflect the data's patterns and correlations [57]. This strategy enhanced the integration of the core theoretical premises since it was designed to reflect and assess major themes and data connection. Hence, the responses provided by the participants were analysed by first converting the raw narrative data (notes, audiotapes) into semi-processed data (transcripts) through manual transcription.

4. Results

4.1 Survey Questionnaire Findings

This section contains the data collection from participant remarks through the application of questionnaire forms. The information obtained is vital to determine the comprehension level regarding the significance of emission management concepts and the measures currently being implemented. The outcomes are then further analysed using percentage frequency distributions.

4.1.1 Types of Infrastructure Projects That Respondent’s Organisation Involved

Fig. 1 displays the distribution of potential infrastructure project categories for sustainable development, with roads, highways, and railways (39%) leading the pack, followed by water (16%), buildings (15%), energy (12%), waste (10%), and earthwork (8%).

4.2 Respondent’s Awareness of Sustainable Infrastructure Project

Surveys were designed to evaluate the respondent's familiarity with sustainable construction concepts. Fig. 2 presents the findings of an effect assessment on sustainable development in an infrastructure project conducted among the participants. A staggering 44% of respondents reported a high level of familiarity, while the highest percentage (35%) have some familiarity with sustainable impact assessment in infrastructure. Nonetheless, a few respondents have "poor awareness" (10%) or "no awareness at all" (2%). The data provide further evidence that an understanding of the notion of sustainability plays a critical element in implementing sustainable infrastructure. All stakeholders, including

the community, must be adequately informed on all sustainability issues to achieve it [2]. This highlights the potential importance of programmes aimed at raising public awareness.

The participants were further questioned regarding incorporating resilience as a benchmark for measuring sustainable development. According to Fig. 3, the results demonstrate that 43% of respondents understood the implementation of perseverance in sustainable development. Among those polled, only 2% claimed ignorance while 16% reported only a "poor" level of awareness. Malaysia must establish "smart infrastructures" that reconcile the necessity for economic growth with preserving the country's precious natural resources and ecological balance [58]. Consequently, infrastructure that is durable, accessible, and environmentally friendly aids in boosting the quality of life.

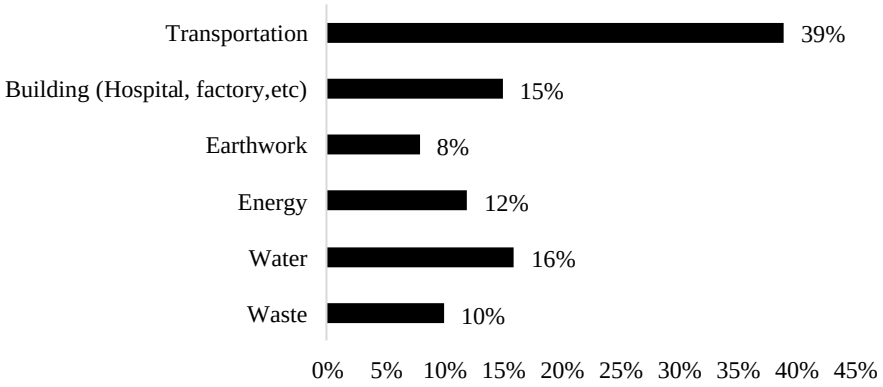

Fig. 1 - Type of infrastructure project of respondent's organisation

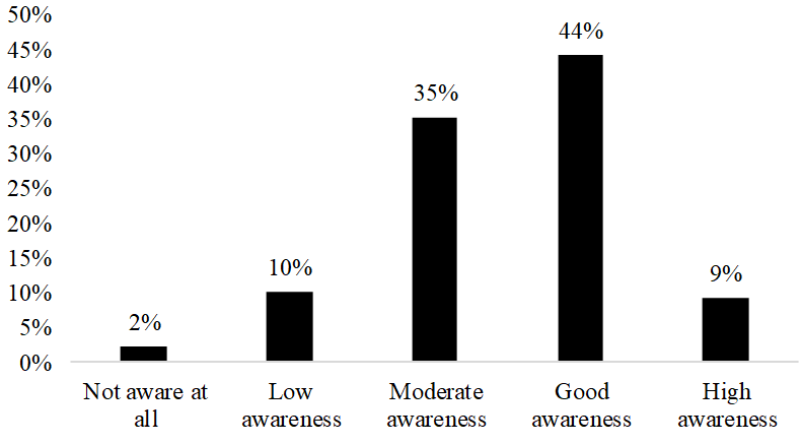

Fig. 2 - Awareness of sustainable impact assessment in infrastructure project

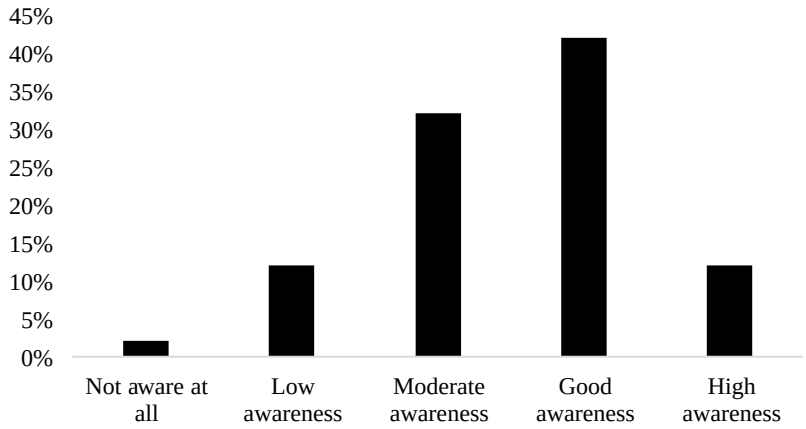

Fig. 3 - Awareness of sustainable development incorporate resilience

It has been revealed that the sustainable features incorporated into new construction is positively correlated with the level of public knowledge concerning the topic [59]. Additionally, referring to Fig. 4, 43% of participants are

moderately familiar with applying sustainable performance assessment techniques for infrastructure projects. Then, just 18% of respondents demonstrated adequate knowledge, while only 15% were "completely unaware" of the existence of sustainable performance assessment methods. Despite the rise of sustainable building practises attributable primarily to rising public awareness of the world's environmental issues, the construction industry, particularly in underdeveloped regions, shows a striking lack of familiarity with these approaches.

Fig. 5 illustrates the extent of an organisation's implementation of environmentally sustainable measures. An overwhelming majority of respondents (58%) work for companies that have established at least some sustainable practices in infrastructure projects. About 20% have long-established sustainable practices, whereas the remaining 17% are less. Sustainable building, as articulated by its applicable definitions and qualities, necessitates effective activities and the commitment of all stakeholders associated with construction projects, including the government, service providers, and the community as users. The critical role of organisational leadership was highlighted in supporting sustainable construction practices by developing policies, establishing procedures, and sharing best practices [60]. Besides, the inclusion of sustainable construction approaches in the project life cycle, such as land use planning, design of environmentally favorable projects, use of sustainable building materials, efficient consumption of water or natural resources, and minimal construction waste during development can optimise housing development catastrophe susceptibility [61].

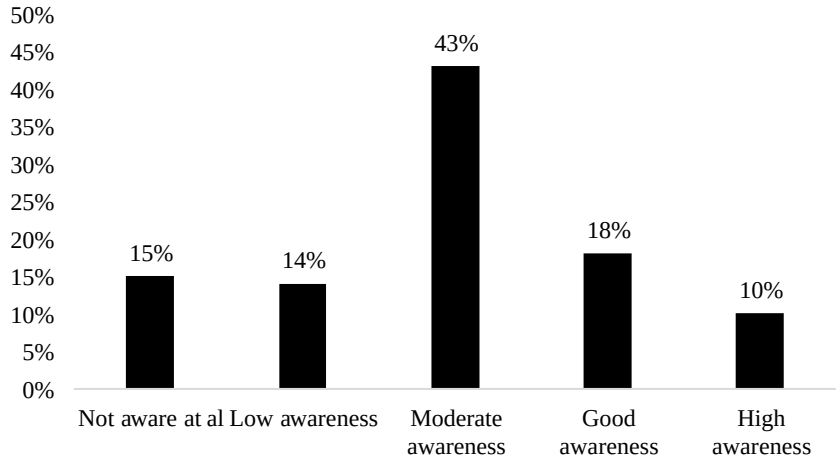

Fig. 4 - Awareness of implementation of sustainable performance assessment tools

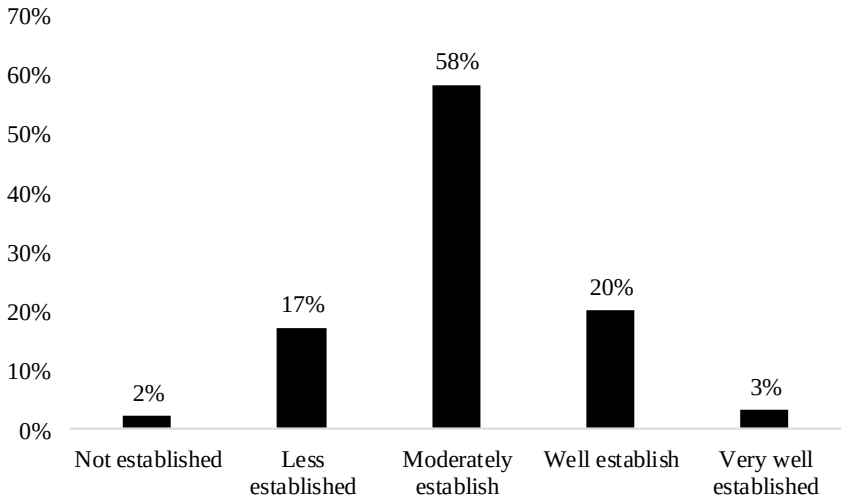

Fig. 5 - Awareness of organisation's implementation of sustainable practices

4.3 Barriers to Implementing Sustainability in Infrastructure Project

The constraints are prioritised according to their mean values for establishing the most substantial obstacles to implementing sustainable infrastructure. Table 3 revealed that "building promotes ecological deterioration, habitat disruption, pollution, and biodiversity loss within ecosystem" (M = 3.983; SD = 1.0785) to be the most major impediment to development. The second-highest rated problem was "providing infrastructure services while rapidly cutting carbon and adjusting to the implications of climate change" (M = 3.9352; SD = 1.0916). In addition, the third

and fourth most common issues were the "over-intense exploitation of land and deterioration of natural forest and heritage places" (M = 3.7167; SD = 1.1790) and the "imbalanced of economic, societal, and environmental advantages in development" (M = 3.7167; SD = 1.0583). Meanwhile, the "public funding is insufficient to fulfil the growing demand for green infrastructure with limited resources and budget" (M = 3.5873; SD = 0.9958), and the "the current COVID pandemic may challenge existing public investment provided by the government and ensuing economic crisis" (M = 3.4883; SD = 1.0637) are both significant financial challenges.

Table 3 - Descriptive statistics of the mean (M) and standard deviation (SD) for the barriers to sustainable infrastructure implementation

Key Barriers to Implementing Sustainable Infrastructure	Mean	Std. Deviation	Rank
Providing infrastructure services while rapidly reducing carbon and adapting to climate change impacts.	3.9352	1.0916	2
Construction causes ecological deterioration, habitat disturbance, pollution and loss of biodiversity within ecosystems.	3.9843	1.0785	1
Public funding is insufficient to meet the growing demand for green infrastructure with limited resources and budget.	3.5873	0.9958	4
The current COVID pandemic and ensuing economic crisis may challenge the existing public investment made by the government.	3.4883	1.0637	5
Difficulties in delivering social value and serving communities.	3.1128	0.9573	10
Managing ageing infrastructure assets.	3.1927	0.9325	9
Ineffective governance and inadequate regulatory strategies and plan for sustainability development.	3.3744	1.4315	7
Incomprehensive sustainable assessment tools and impact assessment studies.	3.4169	0.9928	6
Over-intensive exploitation of land and deterioration of natural forests and heritage sites.	3.7167	1.1790	3
Imbalanced of economic, societal and environmental benefits in the development.	3.7167	1.0583	3
Resistance to change from the use of traditional methods and techniques.	3.3281	0.9723	8
Lack of organisation’s commitment toward sustainability.	3.4169	1.1252	6

4.4 Interview Findings

Table 4 compiles the insights of ten (10) subject experts directly involved in infrastructure projects to aid in discussing the findings from the in-depth interviews.

Respondents offered five (5) recommendations for ensuring a smooth rollout of sustainability initiatives within infrastructure projects. Key drivers in improving sustainability in infrastructure projects were identified, including a “scale-up of investment in sustainable infrastructure”, “uniform and relevant policies and stricter regulation and standard”, “promotion and education”, “effective project planning and management”, and a “assessment and monitoring mechanism”.

5. Discussion: A Way Forward Towards Sustainable Infrastructure Development in Malaysia

This chapter offers suggestions for improving sustainable construction in Malaysia. The findings are based on the integration of survey responses from 138 people and in-depth interviews with ten subject-matter experts. The

information gleaned from the interviews as well as the surveys, was put through a series of comparisons to ensure an optimum coverage level. The strategies outlined have been grouped into three (3) categories: financial, organisational, and institutional, based on the most pressing barriers to establishing sustainable infrastructure.

Table 4 - Strategies are based on participant's opinions to improve the implementation of sustainability in infrastructure projects

Key Strategies	Respondent's Opinions	Key Responsibility
Scaling up of investment in sustainable infrastructure	- It is vital for scaling-up investment in sustainable infrastructure to set Malaysia on a sustainable course for the long run. - Encourage green investment and sustainable finance, including (green bonds and green loans) that commit to climate and environmental projects focusing on public funding and Public Private Partnerships (PPP) ventures since the government heavily support infrastructure development.	Government, banks, PPP, investors, financial institution
Uniform and relevant policies and stricter regulation and standard	- Nurturing a regulatory environment and policies that facilitate green and innovative development (i.e., using green technology and materials in construction projects) to meet environmental commitments. - More stringent construction regulations of construction procurement and mandatory reporting process should be implemented to achieve sustainable development standards.	Government, local authority
Promotion and education	- Educating, promoting, and creating awareness on the benefits of sustainable development and setting the organisation's objective and goals to embrace social and environmental objectives and not only based on economic concerns -Provide relevant training related to sustainability and the environment and appoint a sustainability officer within companies focusing on green and sustainable initiatives	Construction companies, government, semi-governmental agencies, NGOs, educational institutes.
Effective project planning and management	- Incorporating sustainability targets in operational and activity planning will direct the company towards an effective sustainability monitoring process. - Implementing sustainable site management to manage waste, material, resources, and equipment effectively would also reduce emissions.	Construction stakeholders
Assessment and monitoring mechanism	- Establishing an effective assessment tool to measure sustainability and a standardised monitoring mechanism will help the industry understand the criteria and target. - It is no standardised assessment and monitoring mechanism in infrastructure projects.	Government, construction stakeholders, academia and research institutes

The impacts of climate change on infrastructure planning are far-reaching. Anthropogenic contributions to global warming are presently among the world's greatest threats. Rising global temperatures are a root cause of climatic catastrophes such severe rain shortages and ocean acidification [62]. Ergo, future mitigation solutions are improbable to be determined without first understanding how far infrastructure development contributes to or is impacted by these concerns.

Expanding sustainable investment financially depends on Malaysia's effort to implement green towards the economy. Policies that incentivise public investment in environmental infrastructure can put Malaysia on a long-term sustainable path, conveying a positive signal to the industry and facilitating access to alternative funding sources. Consequently, strengthening the investment in the environment and encouraging green financing can assist in funding sustainable infrastructure in meeting targets [10].

Current sustainable infrastructure initiatives for institutions should involve reconstructing old infrastructure and emphasise adopting new sustainability guidelines to benefit the entire community positively. For this reason, the carbon footprint, climate resilience, shifting consumer behaviour, and increased awareness of social and environmental governance should all contribute to a reassessed perspective on infrastructure development [63]. Boosting and

grasping the knowledge depth in the current industry is crucial for developing efficient techniques for constructing sustainability [64]. Following the results, the government or professional institutions should promote, train, and educate construction companies on sustainable strategies and strengthen applicable legislation on green and sustainable construction standards and regulations.

Sustainability as an element of organisational plans would motivate corporations to fight climate change to prevent bad publicity and keep existing brand recognition images. On the other hand, supporting sustainability in program management strategy not only aims to generate economic profits, but these methods also consider reducing biodiversity, maintaining natural resources, creating social value, and supporting communities [65]. Furthermore, incorporating the construction assessment projects into the 17 Sustainable Development Goals (2015-2030) is a critical approach to achieving sustainability via the adaptation of standardised and comprehensive assessment methods and monitoring mechanisms [66]. Economic, social, and environmental sustainability must be integrated into the design and assessed throughout the infrastructure lifetime for projects to contribute to the SDGs.

6. Conclusion

In addition to discussing the ways for incorporating sustainability into infrastructure projects and the problems encountered in doing so, this study examines the knowledge of construction stakeholders regarding sustainable infrastructure projects. The data triangulation was supplemented by gathering from 138 people actively participating in infrastructure initiatives and conducting in-depth interviews with ten experts in the field.

The findings demonstrate that while sustainable impact assessment and sustainable development incorporating resilient elements are more widely known, sustainable performance assessment is less common. It was also discovered that the company's implementation of sustainable practices in the construction project was still fairly established. Hence, a significant influence may be played by raising awareness at the individual or institutional level.

Findings also drew attention to the fact that inadequate governance and managerial practices and the difficulty of allocating funds and implementing new programmes are among the biggest obstacles to implementing sustainability practices. Leveraging up green investment and funding, nurturing green policies and environmental regulations, promoting green technologies and materials, and creating capacity through enhancing awareness and training are all critical factors towards developing sustainable infrastructure. The proposed efforts are separated into three themes: financial, organisational and institutional.

This research contributes significantly to current understanding of the key difficulties and factors influencing sustainability development in Malaysia, as well as the industry's existing knowledge and strategies for incorporating sustainability into an infrastructure project. This study's results are beneficial in resolving issues related to sustainability adoption and developing efficient plans to advance sustainability in Malaysia. In addition, the research findings serve as a basis for further debate regarding promoting awareness at all levels to achieve Sustainable Development Goal (SDG) 9: Industry, Innovation, and Infrastructure, SDG 11: Sustainable Cities and Communities, and SDG 13: Climate Change. Moreover, this is essential for bolstering the government's goals of transforming Malaysia into a low-carbon nation by 2025, as outlined in the country's 12th Malaysia Plan 2021-2025.

Nonetheless, there are constraints on this research. This research was restricted in its capacity to acquire quantitative data from sustainability indicators for construction projects because it relied on statement-based research methods. Future sustainability studies should involve the evaluation of sustainable parameters from infrastructure projects to establish the desirable output. This study relies solely on a carefully selected sample of residents from the designated area of Selangor, Malaysia, and thus has a relatively minimal engagement. Consequently, the outcomes cannot be extended to research areas beyond this particular research's purview. Ergo, as Malaysia's development in terms of sustainability continues to progress, future research may advance the current population to a greater extent.

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