1

Investigation of requisite measures for enhancing sustainable construction practices in Indonesia

Abstract:

Purpose: This study investigates the requisite measures for enhancing sustainability practices within the Indonesian construction industry based on professional perspectives.

Design/Methodology: This study used quantitative approach for data collection. A survey was conducted, using a questionnaire completed by 482 Indonesian construction professionals as a research instrument, and data were analyzed through reliability and exploratory factor analysis.

Findings: The findings suggest that for sustainability practices to become widely implemented within the Indonesian construction industry, certain measures are required. These include the need to raise awareness through education, development of standardized benchmarks, and the implementation of appraisal systems by the government, professional bodies, and academic institutions. These approaches are expected to build capacity and enhance the knowledge of sustainability among construction professionals and their clients. In addition, sustainable construction practices could be encouraged through a subsidized green market, which could be finalized supported by the government from financial penalties levied against non-sustainable practices.

Originality/Value: By implementing the underlying strategies within the Indonesian construction industry, the poor knowledge, awareness, implementation, and motivation for sustainable practices within the Indonesian construction industry could be addressed, thereby reducing the environmental impacts associated with buildings and construction activities.

Keywords: *Sustainable Construction; environmental impacts; Indonesia; green subsidies; sustainable design.*

1.0. Introduction

Notwithstanding that the construction industry is one of the vital sectors of the global economy, providing infrastructure and other resources on which other sectors of the economy depend, buildings are responsible for about 36% of energy consumption and 39% of GHG emissions (UNEP, 2017). Consequently, the construction industry significantly contributes to global climate change and environmental threats and thus is a major target for the global sustainability agenda. According to Darko *et al*. (2017), implementing sustainability principles

offers several benefits at the environmental, economic, and social levels, including quality improvement of air and water, operation and maintenance cost reduction, among others.

There is a growing interest in the sustainability of construction projects, which encompasses aspects of design and building management, sustainable material selection, technology and process, financing, and stakeholders' involvement. Langston and Ding (2001) stressed that it covers design, planning, procurement, and waste minimization, as a part of the sustainable development agenda. As a result, sustainable construction is interpreted as a resource-efficient and ecological concept used during a project's lifecycle, starting from planning, design, construction, and operation maintenance, to achieve a healthy built environment (Abidin, 2010).

Whilst the significance of sustainable construction to the global sustainability agenda is widely acknowledged (Ajayi *et al*., 2015; Oyedele *et al*., 2014), it has not become fully integrated into the core of the construction industry. Some researchers have studied the major barriers to sustainability adoption and found that a low level of sustainability awareness is a major challenge to its implementation (Aghimien *et al*., 2019). For instance, Tunji-Olayeni *et al.* (2018) investigated the barriers that prevent the adoption of sustainability practices within the Nigerian construction industry. The results found that poor level of awareness among construction professionals, high investment costs, lack of government support, and lack of client demand for sustainability implementation are the key barriers to sustainable construction practices. Lim *et al*. (2019) discussed the practices and level of awareness about sustainable construction, based on the perception of quantity surveyors (QS) in Australia. The study concluded that the three most significant barriers in adopting sustainable principles were the culture of the construction industry, clients' attitudes, and high initial investment costs. These echoed earlier studies relating to cultural barriers to innovation and changes within the construction, preventing the efforts towards waste minimization (Ajayi *et al*., 2016), an essential element of sustainable construction practices.

Whereas significant progress has been made in driving sustainability agenda within the construction industries of many developed nations, the concept is not widely adopted in many developing countries (Rwelamila and Ogunlana, 2015). This is notwithstanding that many developing nations are now surpassing the developed nations in terms of their negative environmental impacts. For instance, a study that recently tracked carbon emissions produced by megacities (Wei *et al*., 2021), suggests that 23 of the top 25 most polluting cities are in China, with only Moscow in Russia and Tokyo in Japan included on the list. Out of the 53 top polluting nations, several developing countries such as the Philippines, Thailand, Turkey, Indonesia, Venezuela, Brazil, Mexico, and South Africa are on the list (Wei *et al*., 2021). Similarly, when looking into booming construction activities, which are unfortunately associated with carbon emissions, many developing nations, such as China, India and Indonesia, are predicted to lead the global construction market by 2030 (PBC Today, 2019). This trend implies that, as the developing

1

nations are becoming increasingly significant to meeting the global sustainability targets, the need for integrating sustainability into the core of the construction industry has become more important than at any time in history.

Meanwhile, several sustainability standards, guidelines, policies, and education provisions have been used to drive sustainable construction in many developed countries, where some progress has been made. For instance, site waste management plans, code for sustainable homes, landfill tax, aggregate tax and several sustainable construction education programs have been used to drive sustainable construction practices in the UK (Ajayi *et al*., 2015). Several studies have also investigated the strategies for driving sustainable construction agenda in many developed nations (Pitt *et al*., 2009), with recent studies also focusing on some developing nations (Toriola-Coker *et al*., 2021; Windapo, 2014; Tunji-Olayeni et al., 2020). However, in Indonesia, a country featured on the list of the top pollution nations (Wei *et al*., 2021), there is a paucity of studies on the strategies for engendering sustainable construction practices. This is notwithstanding that the country is predicted to be the fourth largest construction market by 2030 (PBC Today, 2019). In addition, the Indonesian government's recent drive to revive the economy through infrastructure development implies that there would be a significant boom in the country's construction activities. Thus, this study aims to investigate strategies for engendering sustainability practices in the Indonesian construction industry. The study fulfils its objectives by establishing the underlying factors for driving sustainable construction practices based on professional perspectives within the Indonesian context.

Sustainability drivers and policies are argued to be context-based (Darko et al., 2017; Arif et al., 2008; Qi et al., 2010), implying that strategies developed for a nation may not be directly transferable to others because of differences in the social, cultural, economic, and legal framework. For instance, while government incentive is confirmed as the most efficient strategy for driving sustainability in Singaporean context (Hwang and Tan, 2012), evidence from Nigeria suggests that the best approach would be to provide sustainability education as a means of driving cultural changes (Toriola-Coker et al., 2021). Hence, this study is expected to fill knowledge gaps and provide guidance on sustainability to Indonesian construction players and policymakers. This study also offers guidance related to key measures for enhancing sustainability practices not only for the Indonesian context but also for other developing countries in similar contexts, especially those within the Asia-pacific regions. Findings of the study could also inform studies in other regions as the basis for their conceptual modelling and data collection system. The remainder of the paper is structured as follows. Section 2 provides a review of extant literature, which served as the sources of information and variables used for the questionnaire. This is then followed by the explanation and justification of the research method, data analysis and findings of the study in section 3. Before concluding the paper with the conclusion and implications in section 5, the findings of the study are discussed in section 4.

1

2.0. Sustainable Construction

Over the years, research related to sustainability practices within the construction industry has been growing, with sustainability interpreted as having three core dimensions at economic, environmental, and social levels (Goldman & Gorham, 2006). Accordingly, sustainability means producing products at the lowest cost (the economic perspective), minimizing the use of depleting and polluting resources (the environmental perspective), and balancing the delivery of opportunities as well as social amenities and gender equity (the social perspective). The concept of sustainability aims to decrease greenhouse gas (GHG) emissions, reduce energy consumption and waste, preserve water, and use ecologically responsible products and machinery (Roulo, 2009). Parkin (2000) stated there is a clear distinction between sustainability and sustainable construction (SC), in which SC is defined as a construction-focused process towards achieving sustainability as the main goal.

According to the World Commissions on Environment and Development (WCED, 1987), sustainability is interpreted as a change meeting the needs of the current situation without affecting the needs of future generations. This is expected to be achieved through a balance between the environment, economy and social dimensions which are integrated into the business practices and strategies of construction businesses (Tan *et al*., 2011). From its environmental perspective, a construction project is expected to enable people to meet their needs without depriving the ecology of serving its function (Morelli, 2011), specifying the capability to sustain the qualities of physical surroundings. Social sustainability within the construction context implies meeting the requirements of stakeholders such as users, industry, and construction societies while promoting the social and cultural diversity of the society (Almahmoud & Doloi, 2018). For a construction project to fulfil the economic requirements of sustainability, it is essential to consider the total cost throughout the project's cycles in the long term, not just the initial cost or operational cost only (Tunji-Olayeni et al., 2020). Therefore, those three aspects should be covered in sustainable construction practices.

2.1. Enhancing Sustainability in Construction

To minimize the impact of construction projects on the environment, all stakeholders within the construction industry should develop strategies to effectively implement the principles of sustainability. In line with this need, some researchers have developed different strategies for driving sustainability practices. For example, Lee *et al.* (2014) focused on organizational strategies to achieve sustainable construction goals and developed the Organizational Transformation Model that can be used as a benchmark for construction companies to use in evaluating their progress as they adopt sustainable practices. Ding (2008) examined the roles and boundaries of existing environmental building assessment tools to develop a sustainability model

for project appraisal. Similarly, Al-Yami & Price (2006) developed a framework of sustainable construction by integrating soft value management and sustainability principles conducted during briefing projects. Plessis (2007) developed a framework for facilitating sustainable construction, consisting of three different enablers: technological, institutional and value system enablers. These sets of sustainability frameworks identified the need to bring all stakeholders on boards to facilitate and enhance project sustainability through activities and decisions made from inception to completion.

Notwithstanding that the lifecycle cost of sustainable buildings has been proven to be cheaper (Tunji-Olayeni et al., 2018)), the initial cost and efforts remains a major barrier to its implementation (Fitriani and Ajayi, 2022). Consequently, studies have suggested the need for governments across nations to provide the framework and enablers to facilitate the adoption and implementation of sustainable construction, through policies and legislation (Darko et al., 2017), and by establishing the minimum acceptable standards of sustainability (Ong et al., 2009). Studies across developed and developing nations established that sustainable construction could become widespread if project sustainability performance is benchmarked and monitored through rating and auditing tools (Davies et al., 2017; Plessis, 2007;) as well as sustainability training and certification for construction businesses (Hwang and Tan, 2012). According to Windapo (2014), these approaches, along with other penalties for poor sustainability performance, as suggested by Toriola-Coker et al. (2021) and Chen et al. (2017), are the major drivers of sustainability among construction businesses.

Apart from performance setting and penalties for poor performance, incentivising sustainability is a key requisite for facilitating its acceptance (Zhang et al., 2015; Darko et al., 2015). For instance, a poor market for sustainable material could hinder its specification and use in construction projects (Oyedele et al. 2014). As such, creation of a market for sustainable materials and showcasing such products would normalise their use in developing nations (Toriola-Coker et al., 2021; Chen et al., 2017). Similarly, as a way of introducing renewable resources to the industry in developing nations, the introduction of initial subsidy as implemented in many developed nations (Arif et al., 2009) would enhance their adoption, especially as the initial investment cost could discourage it. Sustainability as a criterion for public tendering (Tunji-Olayeni et al., 2018), in a similar way as the UK government facilitated BIM adoption, could motivate sustainability practices across the board.

While many studies have established the roles of government as an enabler of sustainability across industries and nations, the stakeholders within the construction industry have roles to play. Regarding this, Toriola-coker et al. (2021) and Plessis (2007) suggest the need for professional bodies to create an enabling environment for their members, by creating roles and certification for sustainability managers, bringing the developing nations on par with the developed nations. The studies further suggest the need for an industry advisory board, demonstration case studies

and best practices guidelines for sustainability approach, as well as compulsory modules on sustainable construction as parts of professional development programs. Through this leadership by the professional bodies, their members would become increasingly conscious of the requisites for delivering projects in more sustainable ways as parts of their professional commitments.

Clients, as the ones who pay the piper, play a significant role in driving construction projects from planning to completion. As they finance the projects and are responsible for selecting other project stakeholders, poor demand for sustainable approaches by the clients is recognised as a major barrier to sustainable construction practices in many developing nations (Djokoto et al., 2014). To address this, clients' sensitisation through formal and informal education (Darko et al., 2017), demonstration case studies and increasing awareness of whole life cycle costing rather than capital cost could enhance the adoption and implementation of sustainable approaches. With the negative consequences of poor sustainability practices on the environment, educating clients and other stakeholders about environmental issues and their responsibilities becomes more important (Sepetis et al., 2020).

Climate literacy and sustainability have become integrated into construction and general education in many developed nations. However, many developing nations, including Indonesia, are still lacking sustainability education, which is found to be a major barrier to sustainable construction practices (Fitriani and Ajayi, 2022). To address this anomaly, Davies et al. (2017) suggest the need to introduce sustainable construction in universities. A model that has been effective in building the capacities of the industry leaders and the general populace is enhanced collaboration and partnership between academic institutions and the industry (Fitriani and Ajayi, 2021; Hwang et al., 2021). Through this approach, the academic institutions could develop programs that could improve the capacity and expertise of project members, while the industry stakeholders could have input into the program development.

With the multifaceted nature of construction project delivery processes, studies suggest the need to integrate sustainability into an existing project management practice to remove complications. For instance, Lutzkendorf and Lorenz (2007) proposed integration of sustainability concepts and risk assessment of property assets toward market change, which would give added value for all stakeholders such as owner, developer, occupant, and lender. Atombo *et al.* (2015) also incorporated sustainability and project management to achieve project goals at the design stage, stressing the need for using sustainable materials during construction. Ajayi et al. (2016) argued that waste minimization is one of the most effective ways to achieve sustainability. A study by Manoliadis and Tsolas (2006) presented different types of sustainability drivers for change, which include conservation of energy, resource management, waste reduction, eco-friendly technology, indoor quality improvement, land use, education and training, incentive programs, and others. According to the studies, these drivers and familiar approaches could help stakeholders embrace sustainable design with lower embodied energy and emissions and integrate

1

more renewable material consumption into their building projects. Table 1 summarized the proposed strategies identified from the extant literature.

Table 1. Strategies identified from previous studies

No	Strategies	References
1	Educating stakeholders with environmental issues and responsibility	Sepetis et al. (2020), Parker (2018)
2	Sustainability record as a criterion for tender	Tunji-Olayeni et al (2018)
3	Showcase materials and technologies for sustainability	Ong et al (2009), Chen et al (2017)
4	Establishing minimum standards through legislation	Ong et al (2009)
5	Boosting efficient design and use of building materials	Ong et al (2009)
6	Support through government policies	Davies et al (2017), Hwang et al. (2017), Darko et al. (2017).
7	Improving client education	Davies et al (2017), Plessis (2007), Hwang et al. (2017), Darko et al. (2017)
8	Use of rating tool (benchmarking and assessment)	Davies et al (2017), Darko et al. (2017), Windapo (2014)
9	Introducing sustainable construction in the universities	Davies et al (2017), Plessis (2007)
10	Develop cooperation and partnership between industry and university	Plessis (2007), Hwang et al. (2017), Dahiru & Bala (2005)
11	Develop tools for auditing and accreditation of organizations and practitioners	Plessis (2007)
12	Improving capacity and expertise of project members	Hwang et al. (2017),
13	Monitor sustainability performance	Hwang et al. (2017),
14	Enhancing skills and training of project players	Darko et al. (2017), Chan et al. (2009), Zhang (2015), Hwang et al. (2017),
15	Making mandatory for sustainability certification by authority	Hwang & Tan (2012)
16	Providing incentives by the government	Hwang & Tan (2012), Hwang et al. (2017), Darko et al. (2017)
17	Penalties for poor sustainability practices	Chen et al (2017)
18	Introduction of subsidy for renewable energy resources	Arif et al (2009)
19	Creation of a market for sustainable materials	Toriola-Coker *et al.* (2021)
20	Training on designing with alternative materials	Toriola-Coker *et al.* (2021)
21	Introduction of polluter pay policy (landfill tax)	Toriola-Coker *et al.* (2021)
22	Creation of job roles for sustainability managers	Plessis (2007)
23	Demonstration projects and case studies by 4s	Toriola-Coker *et al.* (2021)
24	Inauguration of industry advisory board for sustainability	Toriola-Coker *et al.* (2021), Plessis (2007)
25	Compulsory Continuing Professional Development (CPD) by professional bodies	Toriola-Coker *et al.* (2021), Plessis (2007)
26	Best practices database for sustainability practices	Toriola-Coker *et al.* (2021), Plessis (2007)

Based on the selected studies and lessons above, incorporated with the need for engaging construction players, none of the studies has yet sufficiently explored the measures for driving sustainable construction practices within the Indonesian context. Therefore, this study fills the gaps in knowledge by examining the underlying strategies for driving sustainability practices within the Indonesian construction industry.

3.0. Research Method

This study adopted a quantitative method of data collection and analysis. According to Creswell (2003), this approach to data collection is employed when a study aims to collect quantifiable data that could be analyzed through statistical methods to establish a generalizable conclusion to a larger audience. With the purpose of this study being to establish strategies for engendering sustainability for the whole Indonesian construction industry, this approach is thus considered suitable. The factors were obtained based on literature review and then gathered into a list after being paraphrased. Informal brainstorming sessions were also held with six construction professionals to explore the exhaustiveness of the factors, which was confirmed with some minor suggestions to wordings to aid understanding by the targeted participants. The refined list of factors was then used in developing the questionnaire, as a research instrument. The methodological flow chart for the study is as presented in Figure 1.

3.1 Data Collection

Due to its ability to reach a wider audience within a short time, and in a cost-effective manner (Walliman, 2009), a questionnaire was used as a means of quantitative data collection for the study. A review of extant literature on strategies for engendering sustainability practices was carried out to establish the factors to be used on the questionnaire. The established variables were then rephrased to fit the rating scales, as recommended by Field (2013), with duplicate measures eliminated from the list before putting them into a questionnaire. To enable ranking of the various strategies for driving sustainable construction practices, the questionnaire was put on a five-point Likert scale, where 1 represents strongly disagree and 5 represents strongly agree. This, according to Nunnally and Bernstein (2007), also enables the participants' responses to be summarized, and the relative significance of the variables to be established. Overall, the questionnaire contains three sections, the first being the introduction and consent information, followed by ranking of sustainability practices and culminating in the participants' information, as summarized in Table 1. The questionnaire was administered in both English and Indonesian language to ensure an excellent understanding of the questionnaire items among the construction professionals.

Ahead of administering the questionnaire through links to Google Form, a pilot test was conducted to evaluate the instrument's content validity. Targeting Indonesian construction professionals as the research population, a list-based random sampling technique (Fricker, 2008), which Couper (2000) described as list-based samples of high coverage population, was used. To achieve this, databases of construction professional bodies were used to select research participants. These include (i) Indonesian Construction Safety Expert Association (PAKKI), (ii) Ikatan Arsitek Indonesia (IAI) - Indonesian Architects Association, (iii) Asosiasi Kontraktor Indonesia (AKI) - Indonesian Contractors Association, (iv) Lean Construction Institute Indonesia (LCII), (v) Ikatan Ahli Bangunan Hijau Indonesia (IABHI) -- Indonesian Green Building Experts

1

Association, (vi) Ikatan Ahli Manajemen Proyek Indonesia (IAMPI) - Indonesian Association of Project Management Experts and (vii) Indonesia Energy Efficiency and Conservation Society (IECES)

According to Soemardi and Pribadi (2021), there are about 1.21million permanent workers in the Indonesian Construction industry, with up to 9.5million other skilled and unskilled jobs. Taking 1.21million as the targeted population, a sample size of 385 is required at 95% confidence level (Kadam and Bhalerao, 2010). Targeting a response rate of about 40% as common in many studies, 1,000 potential respondents were approached. Links to the questionnaire were sent to the respondents using messaging platforms, including Emails and WhatsApp messaging services, and networking platforms such as LinkedIn once they were identified as members of the professional bodies with the required expertise. This yielded 487 responses out of 1,000 invitations made, with 482 responses used for data analysis after responses with excessive missing data were excluded. The demographic distribution of the respondents is presented in Table 2.

Table 2. Overview of the respondents

	Sample size	**% of Respondents**
Job roles		
Architect	29	6.0
Faculty/Professor	55	11.4
Builder	4	.8
Civil/Structural Engineer	129	26.8
Construction Manager	8	1.7
M&E Engineer	20	4.1
Project Manager	39	8.1
Quantity Surveyor	22	4.6
Site Manager	15	3.1
Material Supplier	9	1.9
Staff Officer	102	21.2
Environmental Engineer	22	4.6
Others	28	5.8
Total	**482**	**100.0**
Types of Organization		
Government officer	74	15.4
Architectural firm	10	2.1
Engineering consultancy	70	14.5
Contractor	132	27.4
Project Management Firm	9	1.9
Material supplier	10	2.1
University	56	11.6
State-owned Enterprises (BUMN)	49	10.2
Ministry of Public works	51	10.6
Others	21	4.4
Total	482	100.0

Size of Organization		
Fewer than 20 employees	74	15.4
21 to 100 employees	146	30.3
101 to 500 employees	109	22.6
501 to 1000 employees	51	10.6
1001 or more employees	102	21.2
Total	482	100.0

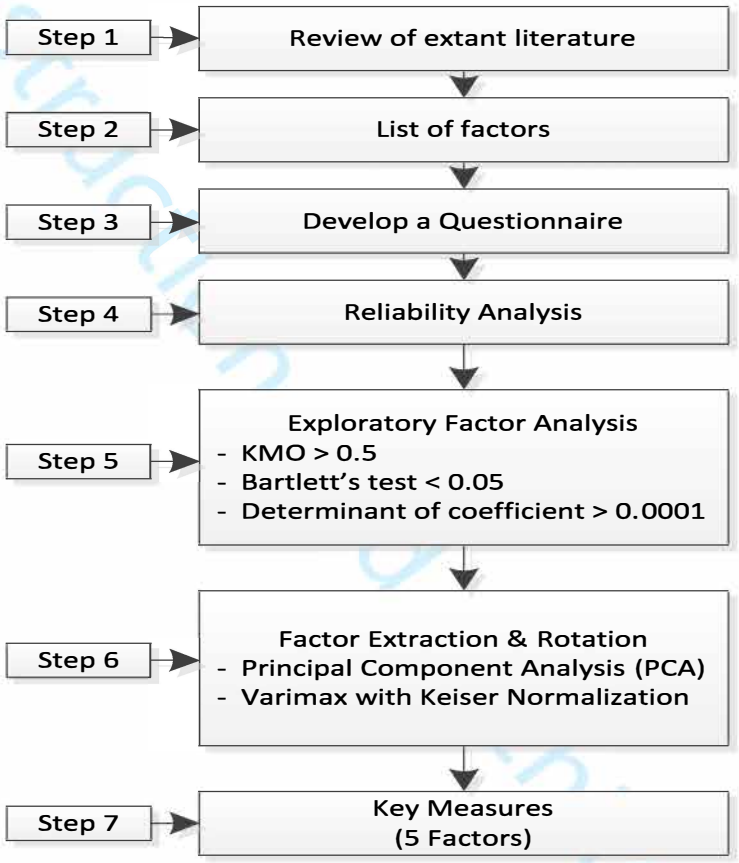

Figure 1. Research Methodological Flow Chart

3.2. Quantitative Data Screening and Reliability Analysis

According to Yockey (2010), a reliability analysis must be carried out on questionnaire responses with Likert scale, to help determine the extent to which the variables are related, exclude problem items from the data and establish the internal consistency of the scale. Confirming the relationship between the items measuring the construct is even more important when exploratory factor analysis is adopted (Field, 2013), as in this study. Consequently, SPSS 26 was used to estimate the internal consistency of the questionnaire through the Cronbach Alpha coefficient, which yielded a value of 0.97. With this being above 0.7, the data is considered to possess an excellent internal consistency, according to Field (2013).

1

3.2. Exploratory Factor Analysis

Exploratory factor analysis is a dimension reduction approach employed when the goal is to remove redundant attributes from the data and replace a dataset with a more manageable number of uncorrelated factors, while retaining much of the original information (Flannery *et al*. 2021). This helps to establish the latent underlying factor variables (Field, 2013), which in this case is the underlying strategies for engendering sustainable construction practices.

To test the appropriateness of the data for factor analysis, Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy, Bartlett's tests of sphericity and the determinant of coefficient matrix test are expected to be carried out (Field, 2013). For the analysis to be valid, the KMO must be greater than 0.5, Bartlett's test of sphericity coefficient must be less than 0.05, and a coefficient matrix above 0.0001 would confirm that the dataset is not negatively affected by multicollinearity (Field, 2013). The initial factor analysis returned 0.961, 0.0001 and 1.633E-13 for KMO, Bartlett's test and coefficient matrix, respectively. While the results satisfied the KMO and Bartlett's test benchmark requirement, they initially failed to meet the threshold for the coefficient matrix, suggesting some level of multicollinearity in the data. To address the multicollinearity problem, Field (2013) suggests that the diagonal of anti-image correlation matrix and the determinant of the correlation matrix should be checked to eliminate variables with values below 0.5. Through this, seven variables that caused multicollinearity problems were excluded from the analysis to achieve a determinant of Coefficient Matrix of 9.199 E-5, which meets the required threshold.

Once the suitability of the data for factor analysis was ascertained, with reduced data containing 30 strategies for engendering sustainable construction practices in Indonesia, the factor extraction and rotation were carried out using Principal Component Analysis (PCA) and Varimax with Kaiser Normalization, respectively, requiring that a minimum Eigenvalue of 1 be retained. The analysis produced a five-factor solution, suggesting that five underlying measures are essential for driving sustainability within the Indonesian construction industry. The five-component factor explained 65.728% of the variance, which meets the required threshold of 60% as recommended by Hair *et al.* (2012). The component factors were then interpreted and labelled accordingly using their contributing variables: Factor 1 as "raising awareness through education and standardized benchmark" (20.442% of total variance), factor 2 as "professional bodies intervention" (14.360% of total variance), factor 3 as "building capacity and appraisal systems" (12.019% of total variance), factor 4 as "encouragement through subsidized green market (11.239% of total variance), and factor 5 as "penalizing non-sustainable practices" (7.668% of total variance). Table 3 presents the results of the factor analysis.

1

Table 3. Results of Factor Analysis

NO.	Extracted and Rotated Components	Eigen Value	% of Variance	Factor loading
COMP 1	**Raising awareness through education and standardized benchmark**	**7.563**	**20.442**	
	Educating stakeholders about environmental issues and responsibility			.736
	Showcase materials and technologies for sustainability			.554
	Establishing minimum standards through legislation			.632
	Boosting efficient design and use of building materials			.677
	Support through government policies			.750
	Improving client education			.623
	Use of rating tool (benchmarking and assessment)			.579
	Introducing sustainable construction in universities			.681
	Develop cooperation and partnership between industry and university			.682
COMP 2	**Professional Bodies Intervention**	**5.313**	**14.360**	
	Creation of job roles for sustainability managers			.613
	Demonstration projects and case studies by 4s			.647
	Sustainability record as a criterion for tender			.702
	Inauguration of industry advisory board for sustainability			.618
	Compulsory Continuing Professional Development (CPD) by professional bodies			.697
	Best practices database for sustainability practices			.594
COMP 3	**Building Capacity and Appraisal Systems**	**4.447**	**12.019**	
	Develop tools for auditing and accreditation of organizations and practitioners			.564
	Improving capacity and expertise of project members			.680
	Monitor sustainability performance			.622
	Enhancing skills and training of project players			.677
COMP 4	**Encouragement through Subsidized Green Market**	**4.158**	**11.239**	
	Providing incentives by the government			.574
	Introduction of subsidy for renewable energy resources			.700
	Creation of market for sustainable materials			.650
	Training on designing with alternative materials			.542
COMP 5	**Penalizing Non-Sustainable Practices**	**2.837**	**7.668**	
	Making mandatory sustainability certification by the authority			.605
	Penalties for poor sustainability practices			.658

1

	Introduction of polluter pay policy (landfill tax)			.634

4.0. The Underlying Strategies for Driving Sustainable Construction Practices

Based on the findings from exploratory factor analysis, this section discusses the underlying strategies for driving sustainable construction practices within the Indonesian construction industry.

4.1 Raising awareness through education and standardized benchmark

The first component, with a total variance of 20.442%, was labelled as 'raising awareness through education and standardized benchmark' based on the items contributing to the component. This suggests a need to have a standardized benchmark, which will ultimately drive policies and legislation and serve as a reference for educating industry stakeholders. Sustainability benchmarking is developed as a tool enabling an organization to assess its impact on the environment (ISEAL Alliance, 2019). The benchmarking is relatively complex, offering a wide variety of benefits such as developing building portfolios, comparing buildings' performance, recognizing areas of improvement, and establishing new policy and legislation (Clarke & Bosteels, 2010). With the government being an essential driver towards sustainability practices, they are expected to drive the implementation of such benchmarks (Ajayi and Oyedele, 2017).

BREEAM and LEED, for example, are the types of tools and methods of assessment developed in the UK and USA to measure the sustainability and building performance criteria that are widely used internationally. The categories in the BREEAM and LEED include different types of environmental categories such as energy, water, material, pollution, land use, waste, transport, and management. BREEM offers a reliable reporting measurement for sustainability, which can support organizations in fulfilling emission reduction targets. GBC Indonesia (2021) developed GREENSHIP rating tools as a building certification system, enabling a project team to adopt an innovative method towards achieving a green building. However, the practice of GREENSHIP in Indonesia is still very limited and it needs to be elaborated throughout project stages to enhance sustainability.

The low level of sustainability awareness has become a significant barrier in developing countries (Tunji-Olayeni *et al*, 2018). Even by having the standardized benchmark, there is still a need to raise sustainability awareness through education. Shutaleva *et al.* (2020) emphasized the need for environmental education as lifelong learning towards sustainable development practices. Alsaati *et al.* (2020) investigated sustainability awareness and behaviours among college students and found that there is a lack of knowledge about sustainability. Therefore, it is critical to promote sustainability awareness among stakeholders through education.

Caeiro *et al.* (2020) highlighted sustainability benchmarking and assessment as an important step towards Education for Sustainable development (ESD). In the case of Indonesia, sustainability education in higher education institutions still lags as seen by the unavailability of frameworks, standards, and policies that can be used by universities to implement sustainability practices for their core activities (Jusuf *et al*., 2020). Only a small number of Indonesian universities have released sustainability reports as outcomes of sustainability practices, which indicates an inadequate university performance in terms of implementing sustainability within their organizations. Therefore, there should be a robust commitment from university management to lead the way towards sustainability practices. This aligns with the study of Parikesit & Withaningsih (2018), indicating that it is important to integrate the sustainability concept into university teaching and curriculum as well as develop research policies that focus on sustainability matters. This will help stimulate the adoption of the sustainability concept in universities and enhance sustainability awareness and understanding.

4.2 Professional Bodies Intervention

The professional bodies play an important role in professional practice within the construction industry by providing educational routes and setting the curricula of degree programs (Martin & Hall, 2002). Their role in driving sustainability within the Indonesian construction industry is reflected by the second component of this study, named "professional bodies intervention", which has a total variance of 14.360%. In the UK, professional bodies like the Engineering Council have been actively updating the code of professional practices by adding sustainability criteria into the course accreditation requirements. Through involvement in professional bodies, individuals are required to perform according to certain standards while conducting their activities, guiding not only safety, technical, and economic performance, but also resource consumption and general sustainability practices. Moreover, professional bodies are also in charge of developing frameworks and training to build professional capacity for sustainable practices. For instance, the UK's Chartered Institute of Buildings (CIOB) offers professional development courses in sustainability as part of their Continued Professional Development (CPD) program for members.

The Green Building Council Indonesia (GBCI) is a self-governing organization that promotes transformation towards sustainable construction, especially in building projects, ranging from green marketing, training and education, certification, and stakeholder engagement (GBCI, 2021). By embracing GREENSHIP rating tools, GBCI has been able to certify different types of buildings, including new and existing ones. However, the role of GBCI needs to be further improved by collaborating with construction professionals and companies to promote green building practices in Indonesia (Wiryomartono, 2015).

1

Apart from the GBCI, other professional bodies within the Indonesian construction industry are expected to provide leadership for sustainable construction practices. For example, The Indonesian Energy Conservation and Efficiency Society (MASKEEI) is a non-profit organization that promotes the efficiency of energy use and renewable energy in all economic sectors including transportation, buildings, industry, and household. In addition, the Institute of Certified Sustainability Practitioners (ICSP) is dedicated to promoting sustainability practices, intensifying awareness of sustainable development and facilitating sustainability framework. Along with the National Committee on Sustainability Reporting (NCSR), ICSP is expected to enhance its role in establishing ethics boards, examination and certification boards, Continuous Professional Accreditation, and annual sustainability reporting awards (ICSP, 2021).

It is expected that professional bodies will continue working on sustainable development by supporting and motivating professionals as they work towards the achievement of sustainable practices for the long-term future. For instance, by enhancing Compulsory Continuing Professional Development (CPD), the professional bodies will be able to enhance their members' skills and proficiency through workshops, training, conferences, and e-learning. Furthermore, professional bodies are also expected to set minimum requirements for sustainability knowledge and competencies for new members, create case studies, and develop professional guidelines and best practices scenarios.

4.3 Building Capacity and Appraisal Systems

Capacity building is essential to driving sustainable construction practices; this is especially as poor knowledge and awareness of sustainable construction are established as major barriers to sustainable construction practices in many nations, and across different professions (Aghimien *et al*., 2019). Based on a total variance of 12.019%, this study confirms that the component factor named "building capacity and appraisal systems" is an important requisite for driving sustainable construction practices in Indonesia. Building capacity starts with building institutional and human capital capacities (Al-Roubaie, 2013). To sustain development, capacity building should focus on enhancing knowledge to drive the sustainability performance of the industry.

Due to the need to build capacity among project members, all stakeholders involved in the projects must be fully committed to developing their knowledge and awareness of sustainability practices. For instance, the project managers could play an important role in incorporating the concept of sustainability into the building process during the design and construction stages by facilitating communication and coordination among stakeholders involved in the projects. The project managers could also be the drivers of change from traditional processes into sustainable construction practices by encouraging the adoption of new processes and innovative technologies, involving collaboration with other stakeholders such as engineers, designers, land planners, and clients throughout the design and construction process (Delnavaz, 2012).

Capacity building at the community level is also required to assist the local community (Franco & Tracey, 2019). In this instance, higher education institutions could help with capacity-building by offering courses and training that support the broader community with comprehensive sustainability practices. In developed countries like the USA, higher education institutions have incorporated sustainable practices into their organizations and operations to accelerate the sustainability implementation effectively (Blanco-Portela *et al*., 2018). This has not been adequately embraced by Indonesian universities as universities should be at the forefront in driving societal changes. Thus, universities should be the front-runners in augmenting capacity building through education, research, and innovation, as well as expanding their key role in the development of social change.

The finding further suggests that another means of building capacity is to develop a system of appraisal that will make people aware of the key elements and requirements for attaining sustainability in construction projects. Sustainability appraisal normally consists of development plans, regional level plans, national policy guidance and other strategic actions (Thérivel & Minas, 2002). Sustainability appraisal can be used to enhance the established sustainable objectives during the planning stage, providing rules and guidance to identify proposals that are acceptable or not. To encourage the use of the Indonesian GREENSHIP appraisal tool for evaluating sustainability performance, it is expected that the GREENSHIP rating tool could be implemented for many more new and existing buildings. Therefore, the commitment from all stakeholders is essential to publicize the potential impact of GREENSHIP in supporting sustainable construction.

4.4 Encouragement through a Subsidized Green Market

Component 4, with a variance of 11.239%, was named as "encouragement through subsidized green market." This suggests the need for a sustainable materials market and the use of subsidies and incentives to drive the adoption of sustainable materials and technologies. Having a developed and well-established market is important for adopting sustainable construction practices and materials (Oyedele *et al*., 2014). Green marketing helps to stimulate eco-friendly products as products are advertised and marketed based on their perceived environmental benefits. Through this, potential end-users are aware of the environmental benefits of the products they will buy (Dangelico and Vocalelli, 2017), and it is becoming a way through which businesses as users or supporters of green products can showcase their environmental credentials. A green market is required to increase environmental quality and customer satisfaction, and it covers different activities such as modification of products, packaging changes, production process changes, and advertisement modification (Choudhary & Gokarn, 2013).

The government should promote a subsidized green market to foster a sustainable culture and enhance the marketability of sustainable products and services. This is especially important

because of the widespread assumption that green products are more expensive, which often serves as a barrier to the adoption of such products and practices (Oyedele *et al*., 2014). The government should also develop monetary incentive programs by adopting subsidies, tax rebates, loans, fee reductions, and grants to drive a sustainable construction market (Gou *et al*, 2013). A subsidized green market can help form and generate significant opportunities for the development of green products and energy efficiency and resource use.

4.5 Penalizing Non-Sustainable Practices

The last component, which is labelled as 'penalizing non-sustainable practices,' had a total variance of 7.668%, and it suggests the need to use stringent measures to drive a sustainability agenda within the Indonesian construction industry. This aligns with Ajayi and Oyedele (2017), which suggests the need for an increasing stringency of fiscal policies by increasing penalties for poor performance as an effective approach for driving waste minimization. Penalties are critical for environmental public policy and are considered as a way of minimizing negative environmental performance. Wang *et al*. (2019) suggest that the penalty imposed on a targeted company could increase its environmental investment, which will lead to a deterrent effect to avoid getting a further penalty for non-compliance with the legislation.

As learnt from the UK construction practices, for example, the landfill tax is an effective fiscal measure supporting construction waste diversion from landfills (Ajayi and Oyedele, 2017). Another type of fiscal provision aiming to decrease construction waste in the UK is the use of an aggregate levy as an environmental tax due to the commercial utilization of virgin gravel, sand, and rock. This tax is aimed at incentivizing construction projects to recycle aggregates instead of dumping aggregate waste into landfills (Ajayi *et al*., 2015).

Indonesia, as a country with growth potential in infrastructure development, will eventually generate more construction waste. It is believed that construction waste management and other aspects of sustainable construction practices have not gained adequate attention in Indonesia even though there has been an enormous use of natural resources for construction activities (Sembiring, 2018). Thus, it is expected that the Indonesian government should enforce those types of "polluters pay policies" to prevent more construction waste disposal to landfills. Through fining for non-sustainable practices, waste minimization and other aspects of sustainable construction practices could be embraced by the industry stakeholders. Therefore, the government is expected to play an essential role in establishing stringent policy measures for driving sustainability practices.

1

5.0 Conclusion

The awareness of sustainability is increasing within all sectors of the global economy, including the construction industry, due to its significance for environmental, social and economic health. Notwithstanding the increasing significance of developing nations in meeting the global sustainability agenda, and the roles of the construction industry in driving sustainability, studies focusing on strategies for enhancing sustainable construction practices are still very limited. With Indonesia being one of such countries with massive potential for booming construction activities, and its increasing contribution to global warming potentials, this study investigates strategies for driving sustainability practices in the Indonesian construction industry based on professional perspectives. Using a questionnaire as the research instrument, the data was analyzed through reliability and exploratory factor analysis.

The findings suggest that five underlying strategies are essential for cultivating sustainability in the Indonesian construction industry. More significantly, the study established the need to raise awareness through education and a standardized benchmark, as well as through professional bodies' leadership. To attain this, educational institutions must be the pioneers in promoting sustainability education and awareness through teaching, research, and innovation, along with community engagement. Educators should drive sustainability competence by incorporating this into their teaching curricula. The professional bodies should also continue engaging professionals to drive sustainability through Continuing Professional Development (CPD) and establishing best practice databases and case studies. Such standardized benchmark could be used as a reference to educate construction players, while also providing key performance indicators in terms of environmental performance.

Along with the engagement of universities and professional bodies in building the awareness that will motivate the adoption of sustainable construction by industry stakeholders, it is essential to address environmental concerns through framework enhancement and capacity building. To sustain development, capacity building should focus on the means of enhancing knowledge, which is an important requisite for adopting sustainable approaches to construction. The government as an enabler should prioritize policy that would support capacity development among the construction professionals. The government should also be a key player in setting out a set of strategic goals, requiring the professional institutes and industry bodies to integrate sustainable development criteria into their professional accreditation and development plans.

In addition to the other underlying strategies, the availability of a market structure is important to drive awareness, adoption, and implementation of sustainable construction. Green marketing could stimulate the use of eco-friendly products by emphasizing the potential environmental benefits through advertisement and promotion. However, it is recognized that the adoption of green marketing is relatively expensive and is considered to be a barrier to

sustainability practices. Therefore, the government should stimulate the growth of a green market by offering subsidies to foster a more robust sustainability culture and improve marketability which can be achieved by imposing stringent fiscal policy through penalties on poor sustainability practices. In this instance, a penalty as a stick approach would serve as a means of funding the subsidies which serve as the carrot incentivizing sustainable construction practices.

Due to the need for curbing the impacts of global warming and facilitating a healthy built environment, adopting sustainability practices is an essential element of the global construction industry. Consequently, it is essential for the Indonesian construction industry to actively promote and commit to the implementation of sustainability through the proposed strategies. This study has explored the underlying strategies for driving sustainability practices based on professionals' perspectives within the Indonesian context and is expected to fill knowledge gaps and provide guidance on how to promote sustainability practices. However, notwithstanding that the findings of this paper uncovered many factors that bear similarities to the current situations in many other developing nations, it is limited to the Indonesian context only with findings emanating from Indonesian construction professionals. Further research could explore its applicability to other nations.

References

Abidin, Z. N. (2010). Investigating the awareness and application of sustainable construction concept by Malaysian developers. Habitat International 34, 421-426.

Aghimien, D. O., Aigbavboa, C., Ngcobo, N., & Thwala, W. D. (2019). Challenges of Sustainable Construction: A Study of Educational Buildings in Nigeria. 13th Built Environment Conference.

Ajayi, S. O., Oyedele, L. O., Bilal, M., Akinade, O. O., Alaka, H. A., Owolabi, H. A., & Kadiri, K. O. (2015). Waste effectiveness of the construction industry: Understanding the impediments and requisites for improvements. *Resources, Conservation and Recycling*, *102*, 101–112. https://doi.org/10.1016/j.resconrec.2015.06.001

Ajayi, S.O. and Oyedele, L.O. (2017). Policy imperatives for diverting construction waste from landfill: Experts' recommendations for UK policy expansion. *Journal of cleaner production*, *147*, pp.57-65.

Ajayi, S.O., Oyedele, L.O., Akinade, O.O., Bilal, M., Owolabi, H.A., Alaka, H.A. & Kadiri, K.O. (2016). Reducing waste to landfill: A need for cultural change in the UK construction industry. *Journal of Building Engineering*, *5*, pp.185-193.

Almahmoud, E. and Doloi, H.K. (2018). Assessment of social sustainability in construction projects using social network analysis. Journal of International Business Research and Marketing, Vol. 3 No. 6, pp. 35-46.

Al-roubaie, A. (2013). Building Knowledge Capacity for Sustainable Development. *International Journal of Innovation and Knowledge Management in Middle East and North Africa*, *2*(1), 7–20.

Alsaati, T., El-Nakla, S., & El-Nakla, D. (2020). Level of sustainability awareness among university students in the Eastern province of Saudi Arabia. *Sustainability (Switzerland)*, *12*(8), 1–15. https://doi.org/10.3390/SU12083159

Al-Yami, A.M & Price. A.D.F. (2006). A Framework for implementing sustainable construction in building briefing project. In: Boyd, D (Ed) Procs 22nd Annual ARCOM Conference, 4-6 September 2006, Birmingham, UK, 327-337.

Arif, M., Egbu, C., Haleem, A., Kulonda, D., Khalfan. (2008). *State of green construction in India: drivers and challenges*. Journal of Engineering, Design and Technology, 7(2), 223 - 234

Atombo, C., Cudjoe, J., Dzantor, K., & Agbo, A. A. (2015). Integration of Sustainable Construction in Project Management: A Case Study in Ghana. *International Journal of Construction Engineering and Management*, *4*(1), 13–25. https://doi.org/10.5923/j.ijcem.20150401.02

Blanco-Portela, N., R-Pertierra, L., Benayas, J., & Lozano, R. (2018). Sustainability leaders' perceptions on the drivers for and the barriers to the integration of sustainability in Latin American Higher Education Institutions. Sustainability (Switzerland), 10(8). https://doi.org/10.3390/su10082954

Caeiro, S., Hamón, L. A. S., Martins, R., & Aldaz, C. E. B. (2020). Sustainability assessment and benchmarking in higher education institutions-a critical reflection. *Sustainability (Switzerland)*, *12*(2), 1–28. https://doi.org/10.3390/su12020543

Choudhary, A., & Gokarn, S. (2013). Green Marketing: a Means for Sustainable Development Introduction. *International Refereed Research Journal,* *3*(3), 26–32. www.researchersworld.com

Clarke, P. & Bosteels, T. (2010). Sustainability benchmarking toolkit for commercial buildings. *Principles for Best Practice*, 31. http://www.betterbuildingspartnership.co.uk/download/bbp_benchmarking_paper_final.pdf

Couper, M.P. (2000). Review: web surveys: a review of issues and approaches, The Public Opinion Quarterly, 64 (4): 464–94.

Creswell, J. W. (2014). Research Design: Qualitative, Quantitative and Mixed Methods Approaches. SAGE.

Dangelico, R.M. & Vocalelli, D. (2017). Green Marketing: an analysis of definitions, strategy steps, and tools through a systematic review of the literature. *Journal of Cleaner Production*, *165*, pp.1263-1279.

Darko, A., Zhang, C., & Chan, A. P. C. (2017). Drivers for green building: A review of empirical studies. *Habitat International*, *60*, 34–49. https://doi.org/10.1016/j.habitatint.2016.12.007

Davies, O. O. A., Davies, I. O. E., Davies, O O A and Davies, I. O. E., Davies, O. O. A., & Davies, I. O. E. (2017). Barriers to Implementation of Sustainable Construction Techniques. *MAYFEB Journal of Environmental Science*, *2*, 1–9.

Delnavaz, M. (2012). Project Managers' Role in Sustainable Building Process. *Chalmers*, 50. http://publications.lib.chalmers.se/records/fulltext/161485.pdf

Ding, G. K. C. (2008). Sustainable construction - The role of environmental assessment tools. Journal of Environmental Management, 86(3), 451–464.

Djokoto, S. D., Dadzie, J., & Ohemeng-Ababio, E. (2014). Barriers to sustainable construction in the Ghanaian construction industry: Consultants perspectives. *Journal of Sustainable Development*, *7*(1), 134–143. https://doi.org/10.5539/jsd.v7n1p134

Field A. (2013). Discovering Statistics using IM SPSS Statistics. London: SAGE.

Fitriani, H. and Ajayi, S. (2021). Preparing Indonesian civil engineering graduates for the world of work. Industry and Higher Education, p.09504222211046187.

Flannery, J., Ajayi, S.O. & Oyegoke, A.S. (2021). Alcohol and substance misuse in the construction industry. International journal of occupational safety and ergonomics, 27(2), pp.472-487.

Franco, I. B., & Tracey, J. (2019). Community capacity-building for sustainable development: Effectively striving towards achieving local community sustainability targets. *International Journal of Sustainability in Higher Education*, *20*(4), 691–725. https://doi.org/10.1108/IJSHE-02-2019-0052

Fricker, R.D. (2008). Sampling methods for web and e-mail surveys. The SAGE handbook of online research methods. London: SAGE Publications Ltd.

GBCI. (2021). https://gbcindonesia.org/

Goldman, T & Gorham, R. (2006). Sustainable urban transport: Four innovative directions. Technol. Soc, 28, 261–273.

Gou, Z., Lau, S. S. Y., & Prasad, D. (2013). Market readiness and policy implications for green buildings: Case study from Hong Kong. *Journal of Green Building*, *8*(2), 162–173. https://doi.org/10.3992/jgb.8.2.162

Hair, J.F., Black, W.C., Babin, B.J. & Anderson, R.E. (2010). Multivariate data analysis: A global perspective, 7th edition. Upper Saddle River, NJ: Prentice-Hall.

ICSP. (2021). Institute of Certified Sustainability Practitioners. https://www.institute-csp.org/

ISEAL Alliance. (2019). *Sustainability Benchmarking Good Practice Guide*. *July*, 0–36.

Jusuf, E., Herwany, A., Kurniawan, P. S., & Gunardi, A. (2020). Sustainability Concept Implementation in Higher Education Institutions of Indonesia. *Journal of Southwest, 55(1)*

Kadam, P. and Bhalerao, S., 2010. Sample size calculation. *International Journal of Ayurveda research*, *1*(1), p.55.

Kats, G., Alevantis, L., Berman, A., Mills, E., & Perlman, J. (2003). The Costs and Financial Benefits of Green Buildings A Report to California's Sustainable Building Task Force. *Building*, *October*, 134. http://www.usgbc.org/resources/costs-and-financial-benefits-green-buildings-report-california?s-sustainable-building-task

Langston, C. A. & Ding, G. K. (Eds.). (2001). Sustainable practices in the built environment. Butterworth-Heinemann: Oxford.

Lee, K.H., Ahn, Y.H., Jeon, M. and Suh, M.J., 2014. Organisational strategies to support sustainability in the construction company. the World SB14.

Lim, B. T. H., Liu, A. Z. J., & Oo, B. L. (2019). Awareness and practices of sustainable construction in Australia: Consultant quantity surveyors' perception. *AIP Conference Proceedings*, *2124*(July).

Lützkendorf, T., & Lorenz, D. (2007). Integrating sustainability into property risk assessments for market transformation. Building Research & Information, 35(6), 644–661. doi:10.1080/09613210701446374

Manoliadis, O., Tsolas, T. & Nakou, A. (2006). Sustainable construction and drivers of change in Greece: a Delphi study. Construction Management and Economics, 24, 113-120.

Martin, S., & Hall, A. (2002). Sustainable development and the professions. *Planet*, *5*(1), 17–18.

Morelli, J. (2011). Environmental sustainability: a definition for environmental professionals. Journal of Environmental Sustainability, DOI: 10.14448/jes.01.0002.

Nunnally, J.C., and Bernstein, I.H. (2017). Psychometric Theory.

Ong, K. C. G., Anggadjaja, E., & Soh, S. L. Y. (2009). Sustainable Construction Strategies: A Singapore Perspective. *CMS2009: Conference on Construction Material Stewardship - Lifecycle Design of Buildings, Systems and Materials*, *323*, 8–13. http://www.irbnet.de/daten/iconda/CIB14269.pdf

Oyedele, L.O., Ajayi, S.O. & Kadiri, K.O. (2014). Use of recycled products in UK construction industry: An empirical investigation into critical impediments and strategies for improvement. *Resources, Conservation and Recycling*, *93*, pp.23-31.

Parikesit, & Withaningsih, S. (2018). The need for sustainability science education in Indonesia. *AIP Conference Proceedings*, *2019*(October). https://doi.org/10.1063/1.5061863

Parkin, S. (2000). Sustainable development: the concept and the practical challenge, Proceedings of the Institution of Civil Engineers: Civil Engineering, Vol. 138 (special issue 2), pp. 3-8.

PBC Today (2019). Which countries are investing the most in construction? (online). Available through: https://www.pbctoday.co.uk/news/planning-construction-news/countries-investing-construction/54507/. Last accessed: 15th July 2021.

Pitt, M., Tucker, M., Riley, M. & Longden, J. (2009). Towards sustainable construction: promotion and best practices. *Construction innovation*.

Plessis, C. Du. (2007). A strategic framework for sustainable construction in developing countries. *Construction Management and Economics*, *25*(1), 67–76. https://doi.org/10.1080/01446190600601313

Qi, G. Y., Shen, L. Y., Zeng, S. X., & Jorge, O. J. (2010). The drivers for contractors' green innovation: An industry perspective. *Journal of Cleaner Production*, *18*(14), 1358–1365. https://doi.org/10.1016/j.jclepro.2010.04.017

Roulo, C. (2009). Federal buildings to achieve zero-net energy by 2030. Retrieved from http://contractormag.com/news/federal-buildings-net-zero- 1209/.

Rwelamila P. D, & Ogunlana, S. (2015). *W107 - Construction in Developing Countries*: Research Roadmap Report for Construction. International Council for Research and Innovation in Building and Construction.

Sembiring, F. T. (2018). Study of recycling demolition waste material product in Jakarta, Indonesia. *E3S Web of Conferences*, *74*, 1–5. https://doi.org/10.1051/e3sconf/20187404007

Sepetis, A., Goula, A., Kyriakidou, N., Rizos, F., & Sanida, M. G. (2020). Education for the Sustainable Development and Corporate Social Responsibility in Higher Education Institutions (HEIs): Evidence from Greece. *Journal of Human Resource and Sustainability Studies*, *08*(02), 86–106. https://doi.org/10.4236/jhrss.2020.82006

Shutaleva, A., Nikonova, Z., Savchenko, I., & Martyushev, N. (2020). Environmental education for sustainable development in Russia. *Sustainability (Switzerland)*, *12*(18), 1–26. https://doi.org/10.3390/su12187742

Soemardi, B.W. and Pribadi, K.S. (2021). The Indonesian Construction Industry, 1995–2019. In: Anson, M., Chiang, Y.H., Lam, P. and Shen, J. eds., 2021. Construction Industry Advance and Change: Progress in Eight Asian Economies Since 1995, p.63-87. Emerald Publishing Limited.

Tan, Y., Shen, L., Yao, H. (2011). Sustainable construction practices and contractors' competitiveness: A preliminary study. Habitat International 35, 225-230.

Thérivel, R., & Minas, P. (2002). Ensuring effective sustainability appraisal. *Impact Assessment and Project Appraisal*, *20*(2), 81–91. https://doi.org/10.3152/147154602781766717

Toriola-Coker, L.O., Alaka, H., Bello, W.A., Ajayi, S., Adeniyi, A. & Olopade, S.O. (2021). March. Sustainability Barriers in Nigeria Construction Practice. In *IOP Conference Series: Materials Science and Engineering* (Vol. 1036, No. 1, p. 012023). IOP Publishing.

Tunji-Olayeni, P. F., Mosaku, T. O., Oyeyipo, O. O., & Afolabi, A. O. (2018). Sustainability strategies in the construction industry: Implications on Green Growth in Nigeria. *IOP Conference Series: Earth and Environmental Science*, *146*(1). https://doi.org/10.1088/1755-1315/146/1/012004.

Tunji-Olayeni, P., Kajimo-Shakantu, K., & Osunrayi, E. (2020). Practitioners' experiences with the drivers and practices for implementing sustainable construction in Nigeria: a qualitative assessment. Smart and Sustainable Built Environment, 9(4), 443–465.

UNEP (2006). Sustainable Building and Construction Initiative. Information Note. Available online: http://www.uneptie.org/pc/pc/SBCI/SBCI_2006_InformationNote.pdf

UNEP. (2017). Global Status Report: Towards a zero-emission, efficient, and resilient buildings and construction sector.

USGBC Research Committee. (2007). A national green building research agenda. http://www.usgbc.org/ShowFile.aspx?DocumentID=3402. Retrieved January 10, 2010.

Walliman, N. (2019). Your Research Project: Designing, Planning, and Getting Started.

Wei, T., Wu, J. & Chen, S. (2021). Keeping track of greenhouse gas emission reduction progress and targets in 167 cities worldwide. *Frontiers in Sustainable Cities*, *3*, p.64.

Windapo, A. O. (2014). Examination of green building drivers in the South African construction industry: Economics versus ecology. *Sustainability (Switzerland)*, *6*(9), 6088–6106. https://doi.org/10.3390/su6096088

Wiryomartono, B. (2015). Green building' and sustainable development policy in Indonesia since 2004. *International Journal of Sustainable Building Technology and Urban Development*, *6*(2), 82–89.

World Commissions on Environment and Development (WCED). (1987). Our common Future, Oxford University Press, Oxford.

Yockey, R.D. (2010). SPSS Demystified: A Step by Step Approach. Routledge