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RESEARCH ARTICLE

# Governance in green construction: Assessment of safety and health risks among the construction stakeholders

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**ABSTRACT -** Over the past few decades, researchers have paid a substantial amount of attention to green building design as well as its assessment. Moreover, the increasing emphasis on sustainable construction practices necessitates a comprehensive understanding of the associated safety and health risks (SHRs). Due to changes in materials, technologies, and construction procedures, green construction may increase safety and health hazards. This study aims to investigate the level of knowledge, attitudes, and practices regarding SHRs among the green construction stakeholders (including engineers, architects, contractors, sustainability consultants, suppliers, and developers). Additionally, this work intends to enhance the governance framework in green construction by proposing the integration of a simulation model to assess stakeholder knowledge, attitudes, and practices concerning SHRs among construction stakeholders in Kuala Lumpur, Malaysia. This study employed a survey method involving a comprehensive framework, with survey instrumentation, data collection and analysis methodologies, and a random sample size using G-Power of construction stakeholders in Kuala Lumpur, Malaysia. The findings revealed that stakeholders demonstrate a relatively high level of knowledge regarding green building design and assessment; their attitude towards green building practices is highly positive and consistent across stakeholders. Furthermore, stakeholders consistently practice green building design and assessment. Despite the progress in green construction methodologies, there is a notable gap in addressing the ethical and governance aspects related to safety and health. The proposed simulation model will facilitate the identification and mitigation of potential hazards early in the construction process, ensuring a safer working environment, which better predicts, manages, and responds to SHRs, thereby promoting a culture of safety and sustainability in the construction industry.

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## 1. INTRODUCTION

Green construction is a topic that many in the construction business have been discussing for some time now because of the potential environmental, economic, and social benefits it could offer. On a construction site, "green practices" can be defined as "a practice or process that is characterized by constant changes that aim to improve and protect the natural environment, or the health and general well-being of the public, the construction workers, and generations yet to come." This definition describes "green practices" as "a practice or process that is characterized by constant changes that aim to improve and protect the natural environment." This is accomplished by making effective use of available resources, progressing towards one's financial objectives, and enhancing one's approach to the building process (Marjaba & Chidiac, 2016; Onubi, 2020).

The construction industry in Malaysia should experience steady growth over the next four quarters. It is anticipated that the Compound Annual Growth Rate (CAGR) would be 5.9% from 2022 to 2026. In particular, the output of buildings should reach MYR 228,680.8 million by the year 2026. Residential, commercial, industrial, transportation, and energy and utility construction (including renovations, demolitions, and new builds) are the main segments of Malaysia's construction industry. It is now abundantly clear, because of the growth of the construction industry in Malaysia, that for an organization to lead in the construction industry, it needs a diverse pool of energy and capabilities from its numerous stakeholders. Clients, members of the community, members of the operative and technical team, members of the directive team, the CEO, curatorship, financial institutions, and the government are the various parties that have been designated as stakeholders for construction projects. Therefore, numerous stakeholders need to acquire information, attitudes, and practices relating to environmentally friendly building.

Construction safety and health include many practices, rules, and regulations to prevent accidents, injuries, and illnesses. Hazard assessments, risk management, personal protective equipment (PPE) use, equipment safety, fall protection, emergency response planning, and worker training are some of the examples. Construction safety and health

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are paramount, especially because construction sites have heavy machinery, heights, restricted areas, electrical risks, and more. Accidents can cause catastrophic injuries, fatalities, project delays, financial losses, legal responsibilities, and reputational harm. Thus, construction safety and health are ethically, legally, and financially necessary. To protect construction workers, local, regional, and national legislation and best practices must be followed.

Furthermore, the aspect of environmentally conscious building that is the focus of this research is the safety and health of stakeholders. This concentration is based on the environmentally responsible building methodology. On any construction project, protecting the health and safety of the workers should be the top priority. It is important to consider these aspects from the start of a project and to examine them closely as it progresses. Keeping them in mind can help create a more secure and productive working environment. If health and safety regulations are not adhered to, this might result in unnecessary expenditures, wasted effort, and even direct bodily danger. For this reason, every individual in the building industry needs to be aware of the green construction movement. The procedures and components that are a part of green building may either have positive or negative effects on the health and safety of those involved in the construction process.

As of now, there is a relatively low level of public awareness regarding the positive effects that commercial buildings have on the environment and the reduction in the costs associated with their operation in Malaysia. Consumers are becoming more aware of the benefits of environmentally conscious building practices, which underscores the necessity of innovation in addition to the convenience of building occupants. Green building is an option for maintaining the sustainability of existing buildings to lessen the impact on the environment. Generally, green building design seeks to reduce indirect impacts on human health and the natural environment by safeguarding the health of workers and increasing their productivity. This is accomplished using environmentally friendly construction materials.

Conversely, governance in the context of green construction encompasses the policies, regulations, standards, and frameworks that guide the implementation of sustainable practices while ensuring safety and health. It involves the roles and responsibilities of various stakeholders, compliance with legal requirements, and the mechanisms for monitoring and enforcing ethical practices. Governance is critical in ensuring that knowledge, attitudes, and practices are aligned with the broader goals of sustainability, safety, and health in construction projects.

## 2. LITERATURE REVIEW

There is a paucity of research in Malaysia that investigates the viewpoints and activities of a wide variety of stakeholders regarding the design and evaluation of environmentally friendly buildings. In addition, there are many diverse stakeholders, each of whom may have a unique viewpoint on the design and evaluation of green buildings (Rosle, 2022).

It has been stated that the lack of awareness is the most significant barrier to the development of green buildings (Ha et al., 2023). According to some projections, individual awareness of a topic is the most important factor in determining support for environmentally friendly building practices. There should be a positive association favourably made between support and awareness of green building. This assumption is based on the understanding of an individual's cognitive capacity, first to recognize and then support. Increasing support for causes and policies has historically been linked to raising public awareness of these causes and policies. Increased levels of support are sometimes attributed to greater public awareness and education, although there is scant evidence to support the claim that awareness alone is responsible for the improvement. The need for effective green building policies that state and local government agencies can embrace and promote to their citizens develops as they become more aware of the economic, health, environmental, and social benefits of green building. These policies should encourage green building practices among state and local government agencies.

One of the reasons that construction stakeholders in Malaysia find it difficult to execute environmentally green building practices is due to a lack of understanding (Ha, 2023). Even though numerous sources can be used as a guide on green construction, the public's reluctance to learn about it is one of the difficulties. One way to gain knowledge is by participating in interactive websites. Communities now have quick and simple access to a wide variety of tools and services thanks to the proliferation of these websites. They bring together concerns about the environment and information technology and examine how the two are connected.

The main problem is that green construction practices, despite being recognized as effective means to mitigate environmental consequences and promote sustainability, encounter hurdles in terms of their widespread acceptance. This recognition comes even though green construction practices have been around for a while. This may be the result of a few factors, including but not limited to worries regarding costs, a lack of awareness, opposition to change, and regulatory limits. These obstacles can make it more difficult to execute environmentally friendly building practices and lessen the impact that these practices have on promoting sustainable building practices within the construction sector and beyond. Finding solutions to overcome these hurdles and promoting the adoption of green construction practices is crucial for achieving sustainable development objectives and minimizing the negative environmental impacts of the construction industry. Finding these solutions is essential for achieving sustainable development goals and mitigating the negative environmental impacts of the construction industry.

In short, green building poses safety and health hazards that must be assessed and minimized. New and atypical materials like recycled or bio-based materials may pose health risks during manufacturing, installation, and maintenance. Additionally, solar panels and wind turbines may pose electrical and fall dangers during installation, operation, and maintenance. As such, it is important to understand green construction's safety and health hazards and whether these hazards can be mitigated. This requires risk assessments, planning, training, and safety compliance. Green buildings must be ecologically friendly and safe for workers, occupants, and communities.

## 2.1 Green Construction

Green construction, also known as sustainable construction or eco-friendly building, is the practice of designing, constructing, and operating structures in a way that minimizes their impact on the environment while simultaneously promoting energy efficiency, resource conservation, and occupant health and well-being. Green construction can also be referred to as "green building" or "eco-friendly building." It is the process of creating buildings that are ecologically responsible over their entire lifecycle by including environmentally responsible materials, energy systems, water conservation measures, waste reduction techniques, and renewable energy sources into the construction process. The goal of green construction is to create communities that are healthier and more sustainable by prioritizing environmentally responsible practices and technologies. Other goals include mitigating the effects of climate change and reducing pollution.

In different ways, green construction practices have the potential to reduce the dangers to people's health and safety. To begin, the use of non-toxic and low-emission materials in green buildings helps to minimise indoor air pollution. This, in turn, can enhance the interior air quality and reduce the health risks associated with poor air circulation and the presence of dangerous chemicals. Additionally, green buildings have a lower carbon footprint. Moreover, the emphasis placed on natural lighting and ventilation in green building design can improve the comfort and well-being of building occupants, as well as lessen the reliance on artificial lighting and mechanical systems, which can either contribute to noise pollution or pose potential safety risks. Green construction encourages the use of sustainable and long-lasting materials, which can improve the structural soundness of buildings and reduce the risk of accidents or structural breakdowns. In addition, the incorporation of energy-efficient systems into green buildings, such as fire-resistant insulation and cutting-edge fire detection systems, can strengthen the existing fire safety measures. In general, green construction places a higher priority on the health and safety of occupants. This is accomplished through designing settings that are beneficial to one's well-being and by minimizing the possible risks associated with more conventional building practices.

## 2.2 Safety and Health Risk

In the context of occupational health, a risk to health and safety refers to an assessment of the dangers that can lead to the harm, injury, death, or disease of a person in a particular workplace. These hazards can be caused by any number of factors. Even if each of these dangers is pointed out on its own, they are considered in conjunction with the others. The physical circumstances under which a given worker experiences a specific adverse reaction are considered the determining factor in a health and safety risk assessment. Many other metrics, such as the number of illnesses, injuries, and fatalities, are used to assess the level of safety on construction sites (Golovina, 2016). Injury rates, employee safety habits, and the overall safety climate can all be used to assess the efficacy of a company's health and safety initiatives. Some international best practices concerning health and safety on the job include providing fall protective systems and effectively scheduling construction site activities (Zhang & Mohandes, 2020); providing frequent safety training sessions for employees (Shen, 2017); and providing proactive warning systems (Omidvar, n.d.; Zhu, 2016) to prevent workers from being struck by mobile equipment, such as a crane, on the job.

It has been suggested by Kim (2017) that a high prevalence of accidents and other health hazards exists due to poor safety culture among construction organisations. However, these safety practices and policies are intended to reduce on-site health and safety problems. This conclusion was further supported by Zhang (2014), who stated that the level of safety performance in construction projects is highly connected with safety investments, safety culture, and the risk level of the project.

Most people working in Nigeria's construction industry do not adhere to these health and safety standards and best practices, and they are usually to blame for issues like the use of damaged or broken tools and equipment, a lack of safety training, and the failure to provide or use PPE (Waziri, 2018). According to Okoye (2018), Nigeria currently lacks official data on accidents or health and safety issues related to construction activities. Idoro (2011) performed a survey, and he stated that during the process of building in Nigeria, 5 out of every 100 workers were hurt, and 2 out of every 100 workers were involved in accidents during construction. In other words, 5 out of every 100 workers were harmed. On building sites, one of the issues being addressed to improve occupational health and safety is the "green practice" movement. However, there are mixed results regarding the efficacy of green construction practices in addressing health and safety concerns associated with construction projects. Some authors state that green practices have a good influence on the health and safety of workers, whereas others report that the same practices have a negative impact.

For instance, Karakhan & Gambatese (2017) argued that green construction is typically coupled with potentially negative consequences on the safety of workers, even though the primary objective of green construction is to achieve overall sustainability. Recent studies have shown that green building projects pose a higher safety risk to workers than traditional projects. (Hwang, 2018). This situation raises questions about the validity of labeling a construction project as having performed admirably in terms of sustainability simply because it complies with several environmental performance standards. This situation raises questions about the value of an environmentally responsible building project. According to several studies (Karakhan & Gambatese, 2017), ensuring the health and safety of construction workers is an essential component of social sustainability. Based on Hwang (2018), the level of significance that is still placed on health and safety concerns in environmentally conscious construction projects is extremely low. Moreover, during the construction process, research on social concerns such as health and safety is often disregarded (Othman, 2018), even though many previous studies have placed a significant amount of emphasis on newly developed technologies that are related to sustainability and the environment.

Conversely, in the context of occupational health, safety, and health risks refer to the assessment of dangers that can cause harm, injury, death, or disease in the workplace. Governance plays a critical role in mitigating these risks by establishing and enforcing regulations, standards, and best practices designed to protect workers. Effective governance involves not only setting these standards but also ensuring compliance through monitoring, training, and proactive risk management strategies. The relationship between governance and safety is evident in the implementation of safety practices such as fall protective systems, regular safety training, and proactive warning systems, which have been shown to reduce the incidence of accidents and health hazards on construction sites. However, the success of these initiatives largely depends on the safety culture within construction organizations and their commitment to investing in safety measures. Despite these efforts, there remain challenges where adherence to safety standards is often lacking, leading to higher rates of workplace injuries and fatalities. The green construction movement aims to improve occupational health and safety. However, its effectiveness varies, with some studies reporting positive impacts and others noting potential risks associated with new materials and technologies. Thus, robust governance frameworks are essential to ensure that the benefits of green construction practices are realized without compromising worker safety.

### 2.3 Knowledge, Attitudes, and Practices (KAP) of Multiple Stakeholders on the Green Buildings

Individuals' actions and behaviors concerning potential dangers to their health and safety are heavily influenced by a combination of three elements known as knowledge, attitude, and practice (KAP). Literature on KAP in the context of safety and health risks (SHRs) comprises a wide spectrum of studies that investigate how individuals' knowledge, attitudes, and practices influence their comprehension of dangers, their perception of them, and their response to them. The purpose of this literature review is to provide an overview of the current understanding of the role that KAP plays regarding the potential dangers to both safety and health. In recent years, researchers in the field of green buildings have come to realize the significance of the research conducted from the perspectives of multiple stakeholders. This study shows how stakeholders' influence, interest, and involvement can improve decision-making and build environmental sustainability (Chileshe, 2018). Multiple points of view from many stakeholders' research are a significant field that contributes to a better understanding of the complex relationships and dynamic exchanges that take place between many parties. When it comes to environmentally friendly structures, the research on different stakeholders has been employed cautiously in the studies on sustainable development. Stakeholders' awareness of sustainable practices, the research has concentrated on the clients', users', and community members' points of view (Yang, 2015).

Few studies have examined the perspectives of a wide range of green building industry stakeholders in the existing body of KAP research. For instance, because of Hong Kong's high population density, researchers in the region have decided to perform a KAP study on the topic of zero-carbon buildings. Underestimating the significant differences between these stakeholders, this study categorized engineers, manufacturers, architects, contractors, and suppliers as belonging to the same stakeholder group. The same KAP framework was utilized by Azami (2018) to determine the hurdles to environmentally conscious construction in Malaysia from the point of view of the contractors. While in Zambia, Sichali and Banda (2017) conducted research to determine the level of understanding, attitudes, and views of green construction practices among the stakeholders involved in a residential project. The body of prior research has concluded that the KAP framework is significant. Nevertheless, this research has shown that the green building KAP research conducted by different stakeholders is still underestimated and disregarded. There does not appear to be any comparable research accessible for the context of New Zealand, as far as we are aware. Hence, it is a good idea to look into the KAP levels of different people in the New Zealand AEC business and determine how they feel about green buildings, as well as the reasons why they do not want to use green building certifications and what is stopping them from doing so. This can be done by looking at the KAP levels of different New Zealand AEC industry players in terms of green buildings.

Sustainable development studies have been conservative in their application of findings from diverse stakeholder research on green buildings (Pan & Pan, 2020). The study, for instance, has centred on the views of clients, users, and communities in its examination of sustainability knowledge. Accordingly, it can be understood that designers work in a constantly evolving setting during the design process and need to collaborate with technical engineers and architects to integrate diverse information into environmentally friendly design (Raouf & Al-Ghamdi, 2019). Green building design also emphasizes education and training in addition to the use of environmentally friendly methods (Hwang et al., 2017). This section presents a more in-depth study of the impact of government legislation on green practices and public recognition of building professionals. It examines the level of understanding, attitudes, and opinions towards green building practices among stakeholders in residential construction projects, as recommended by Sichali and Banda (2017). According to a study by Pan & Pan (2020), the primary drivers of green construction practices adoption by contractors are managerial concern and government regulatory pressure. Pan & Pan (2020) claimed that bringing about structural changes in the way buildings are constructed required more than only the development of green technologies and the surmounting of economic hurdles.

The relationship between governance and the KAP variables on SHRs among green building construction stakeholders is crucial for effective implementation and compliance with safety standards. Governance, in this context, involves the establishment and enforcement of policies, regulations, and best practices that ensure the safety and health of workers involved in green construction. For instance, governance significantly influences the level of knowledge among construction stakeholders. Regulatory bodies and governance frameworks are responsible for disseminating information about safety standards, green building techniques, and the risks associated with new materials and technologies. Studies have shown that sustainable development and green building design rely heavily on the education and training provided to stakeholders, which is often driven by government legislation and regulatory requirements (Hwang et al., 2017; Raouf & Al-Ghamdi, 2019). By mandating continuous education and certification, governance ensures that stakeholders are well-informed about SHRs, leading to more knowledgeable and compliant construction practices.

Furthermore, the attitudes of stakeholders towards green building practices and safety are also shaped by governance. Effective governance creates a culture of safety and responsibility by promoting ethical standards and encouraging positive attitudes towards sustainability and worker protection. Governmental pressure and managerial concern are key drivers for adopting green construction practices, as noted by Pan & Pan (2020). When governance frameworks emphasize the importance of safety and sustainability, they foster a positive attitude among stakeholders, leading to greater acceptance and proactive engagement with safety protocols. Moreover, governance directly impacts the practical implementation of safety and health measures on construction sites. By setting enforceable standards and conducting regular inspections, governance ensures that safety practices are not just theoretical but are actively applied. The practice of green building design, including the use of environmentally friendly materials and construction methods, is often regulated by government policies, which require adherence to specific safety protocols (Pan & Pan, 2020). Additionally, the establishment of best practices through governance frameworks helps in standardizing safety measures across the industry, reducing variability, and improving overall safety outcomes.

Conclusively, sustainable development studies have highlighted the conservative application of findings from diverse stakeholder research on green buildings, focusing primarily on clients, users, and communities (Pan & Pan, 2020). These studies suggest that effective governance must also consider the perspectives of technical engineers, architects, and other professionals involved in the design process. Moreover, Sichali & Banda (2017) recommend examining stakeholders' understanding, attitudes, and opinions towards green building practices to enhance the impact of governance on safety and health. Governance frameworks that integrate these three variables, knowledge, attitude, and pp0-practice, create a comprehensive approach to managing SHRs in green construction. By ensuring that stakeholders are educated, motivated, and equipped to implement safety measures, governance plays a pivotal role in enhancing the overall safety culture in the construction industry. In summary, the interplay between governance and the variables of KAP is critical for effectively managing SHRs in green building construction. Effective governance frameworks ensure that stakeholders are well-informed, positively disposed towards safety, and consistently apply best practices, thereby promoting a safer and more sustainable construction environment.

### 2.4 Simulation Model and Governance in Safety & Health Risks

Green construction, or sustainable construction, aims to minimize the environmental impact of building practices while promoting the health and safety of workers and occupants. The integration of simulation models into the governance framework of construction projects has emerged as a significant approach to enhancing safety and health benefits in this field. According to recent studies, simulation models can effectively predict potential SHRs by allowing stakeholders to visualize and analyze various construction scenarios before actual implementation. For instance, models can simulate the use of non-toxic materials, assess their impact on indoor air quality, and predict the likelihood of respiratory issues among workers and occupants (Ahn et al., 2013). This proactive risk assessment enables stakeholders to make informed decisions that prioritize safety and health, aligning with ethical governance principles by addressing potential hazards comprehensively. The application of simulation models in green construction governance also supports continuous improvement of safety protocols and construction methodologies. By incorporating real-time data on materials, construction techniques, and environmental conditions, these models provide a dynamic and detailed understanding of potential risks (Zhang et al., 2015). This not only helps in identifying and mitigating hazards but also fosters a culture of accountability and transparency among construction stakeholders. Additionally, the use of simulation tools can facilitate compliance with regulatory standards and promote best practices in the industry. As highlighted by Li et al. (2017), integrating simulation models into construction governance frameworks enhances the overall sustainability and safety of construction projects, ultimately contributing to the development of safer and healthier built environments.

To further enhance the safety and health benefits of green construction, it is proposed to integrate a simulation model into the governance framework of construction projects. This simulation model serves as a predictive tool to assess potential SHRs associated with various green construction practices. The hybrid simulation framework combines discrete event simulation (DES), agent-based simulation (ABS), and system dynamics (SD), allowing for a more natural representation of the complex dynamics in construction activities. By simulating different scenarios and construction methodologies, stakeholders can identify and mitigate potential hazards before they occur on-site. This approach not only enhances the safety and health outcomes but also aligns with ethical governance principles by ensuring all potential risks are thoroughly evaluated and addressed (Goh & Ali, 2016; Nasirzadeh et al., 2018).

The integration of such a simulation model into the governance framework supports more informed decision-making, fosters greater accountability, and ultimately leads to safer and more sustainable construction practices. For example, a Building Information Modeling (BIM)-based integrated framework includes relevant information for risk prevention against falls during the construction phase, optimizing production and safety scheduling (Rodrigues et al., 2017). Additionally, integrating BIM and LEED certification at the conceptual stage of building projects provides a framework for calculating potential LEED credits, thereby automating sustainability assessments and improving project planning (Jalaei et al., 2020). These proactive approaches contribute to reducing construction accidents and negative environmental impacts while promoting sustainable development within the industry (Zhang & Mohandes, 2020).

Thus, the integration of simulation models in the governance framework of construction projects significantly enhances the management of SHRs. Simulation models, such as the hybrid approach combining DES, agent-based modelling (ABM), and SD, provide a comprehensive method for assessing safety risks dynamically and proactively. These models allow stakeholders to simulate various construction scenarios, identify potential hazards, and implement mitigation strategies before actual on-site activities commence, leading to safer construction environments (Xu et al., 2020). Furthermore, the implementation of BIM integrated with safety management frameworks facilitates the visualization and planning of safety measures, improving both safety outcomes and project efficiency (Rodrigues et al., 2017). This advanced simulation and modeling techniques offer a robust mechanism for enhancing decision-making processes, ensuring better safety practices, and promoting sustainable construction operations (Al-Kaissy et al., 2020; Xu et al., 2020; Rodrigues et al., 2017).

## 3. METHODOLOGY

This study employed a quantitative research design, utilizing a survey method grounded in a comprehensive framework that includes detailed survey instrumentation, robust data collection, and analysis methodologies. G-Power was used to determine the appropriate sample size. A random sample of construction stakeholders in Kuala Lumpur, Malaysia, was selected. The focus was to investigate the levels of SHR assessments among these stakeholders, specifically examining the three dimensions of KAP. This approach ensured that the data collected was statistically significant and representative, allowing for accurate analysis and conclusions regarding the current state of SHRs management in the green building sector. Through this method, the study aims to identify gaps and areas for improvement in stakeholder awareness and implementation of safety protocols, ultimately contributing to enhanced governance and sustainability in construction practices.

### 3.1 Research Framework

Figure 1 depicts the research framework with three dependent variables (DV), namely KAP of green building design and assessment, and one independent variable, namely health and safety risk. The hypotheses based on these three DV are constructed as follows:

- H1: The knowledge of green construction design significantly influences safety and health awareness among construction stakeholders.
- H2: The attitude of green construction design significantly influences safety and health awareness among construction stakeholders.
- H3: The practice of green construction design does not significantly influence safety and health awareness among construction stakeholders.

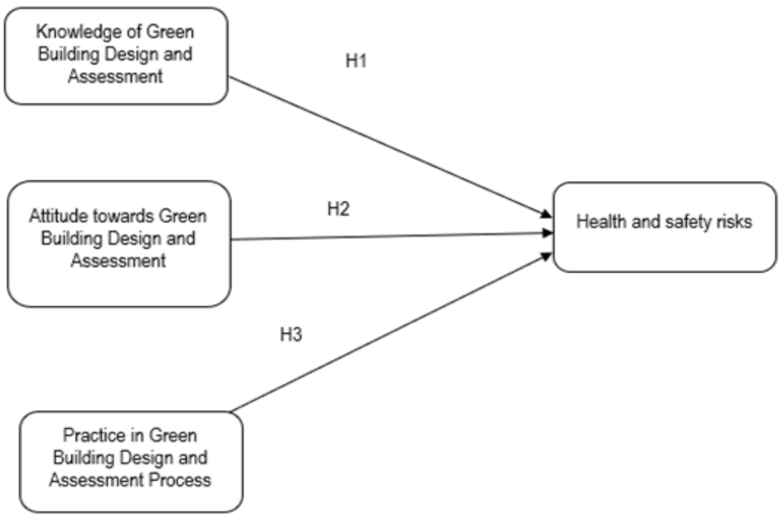


Figure 1. The research framework and constructed hypotheses

This questionnaire comprised four sections. Table 1 presents the questionnaire items for the survey instrument. The first section collected demographic information, including details such as the purpose of the project and the size of the team involved. Sections 2, 3, and 4 focused on assessing the knowledge about health risks associated with designing and evaluating green buildings. The information collected from the survey may inform future research models and the composition of questionnaire items. Each element of the questionnaire was constructed based on its theoretical foundation. Respondents were asked to rate the significance of each variable on a Likert scale ranging from one to five points, with 1 indicating strong disagreement, 2 indicating disagreement, 3 indicating neutrality, 4 indicating agreement, and 5 indicating strong agreement.

Table 1. Questionnaire items

| Construct/ Variable | Description |
|---|---|
| Safety and health risk<br>(Onubi, 2020)<br>(Adopted) | • The implementation of risk reduction strategies has taken place.<br>• Performance in terms of safety was proportional to the level of experience possessed by the craft workforce.<br>• The public's safety was not compromised in any way by the ongoing construction work.<br>• According to the established baselines, the expected level of project safety performance was achieved.<br>• Health and safety regulations were complied with. |
| Knowledge of Green Building Design and Assessment<br>(Abdelaal & Guo, 2021)<br>(Adapted) | • I know about the main sources of green building knowledge.<br>• I know about the concept of green construction or sustainable building practices.<br>• I know that the safety and health of occupants is the primary goal of green construction.<br>• I am aware of any specific safety risks associated with conventional construction practices.<br>• I am aware of any certifications or standards related to green construction and safety/health.<br>• I am aware of any challenges or barriers to implementing green construction practices in terms of safety and health. |
| Attitude towards Green Building Design and Assessment<br>(Abdelaal & Guo, 2021)<br>(Adapted) | • I consider that SHRs in construction projects are very important.<br>• I have a positive attitude toward green construction practices.<br>• I believe that green construction practices contribute to improved safety on construction sites.<br>• I perceive that the impact of green construction practices can reduce health risks for workers and occupants.<br>• I am aware of any specific safety or health risks associated with green construction practices.<br>• I am very confident that green construction practices can address or mitigate potential SHRs. |
| Practice in Green Building Design and Assessment Process<br>(Abdelaal & Guo, 2021)<br>(Adapted) | • Noise pollution poses significant SHRs associated with conventional construction practices.<br>• I always use the specific safety practices or protocols unique to green construction that I have implemented.<br>• Following specific guidelines and regulations is one of the key aspects of safe handling and disposal of materials during green construction projects.<br>• It is important to believe that green construction practices, with their focus on safety and health, have a positive impact on the well-being of building occupants.<br>• Enhanced safety measures are the potential long-term benefits of incorporating green construction practices in terms of safety and health. |

## 4. RESULTS AND DISCUSSION

The results and discussion section presents the findings from the survey, analyzing the levels of knowledge, attitudes, and practices related to SHRs among green building construction stakeholders in Kuala Lumpur, and interprets their implications for governance and sustainability in the industry.

### 4.1 Demographic Analysis

The demography is essential since it provides information about the people who are participating in the research and answering the questionnaire. The first component of this test comprised general information questions, followed by three further tests based on the responses to those questions. In demographic analysis, the frequency of respondents is determined based on factors such as gender, age, and years of experience in the workforce. The following table provides a summary of the frequencies and percentages of answers to the measurements.

Table 2. Questionnaire items

| Demographic Items | | Frequency | Percentage (%) |
|---|---|---|---|
| Gender | Male | 58 | 45.70 |
| | Female | 69 | 54.30 |
| | Total | 127 | 100.00 |
| Age (years) | 20-30 | 80 | 63.00 |
| | 31-40 | 38 | 29.90 |
| | 41-50 | 7 | 5.50 |
| | 51-60 | 2 | 1.61 |
| | Total | 127 | 100.00 |
| | 20-30 | 80 | 63.00 |
| Year of Working Experience | 1-5 | 77 | 60.60 |
| | 6-10 | 43 | 33.90 |
| | 11-15 | 7 | 5.50 |
| | Total | 127 | 100.00 |

As illustrated in Table 2, the first demographic item was the gender of the respondents. Up to 54.3% of female respondents contributed, compared to 45.7% of male respondents. The second demographic item was the age of the respondent. Most respondents were between 20 and 30 years old, accounting for 63.0% of the overall respondents. The second highest respondent was from the age group 31-40 years old, with a percentage of 29.9%. The lowest respondent was from the age group 41-50 years old, with a percentage of 5.5%, followed by respondents from the age group 51-60 years old, with a percentage of 1.6%. The second demographic item was the years of working experience. Most respondents had 1-5 years of working experience, with 60.6% of the overall respondents. Followed up with the respondent with 6-10 years of working experience, 33.9%. Respondents with 11-15 years of working experience made up the lowest percentage, which was 1.6%.

### 4.2 Descriptive Analysis

Descriptive statistics were used to provide quantitative representations of the minimum value (Min), maximum value (Max), mean value, and standard deviation, which serve to simplify large amounts of data reasonably. Consequently, the researcher employed an interval scale ranging from 1 to 5 in Sections A to D of the questionnaire. This study included a sample size of 127 respondents from the construction industry.

Table 3 presents the descriptive statistics necessary for researching the KAP regarding green construction and its implications for SHRs among construction stakeholders in Kuala Lumpur, Malaysia. Mean values were used to assess the levels of KAP towards green construction and their SHRs implications. At the same time, the standard deviation expresses the variability in these responses. Table 3 shows that the mean value of SHRs was 3.885, with a standard deviation of 0.616. The mean value for Knowledge of Green Building Design and Assessment (K) was 3.974, with a standard deviation of 0.733. The mean value for Attitude towards Green Building Design and Assessment (A) was 4.029, with a standard deviation of 0.693. Lastly, the mean value for Practice of Green Building Design and Assessment (P) was 4.000, with a standard deviation of 0.673.

Table 3. Descriptive statistic

| Construct/ Item | Mean | Standard Deviation (SD) |
|---|---|---|
| Safety and Health Risk | 3.885 | 0.616 |
| Knowledge of Green Building Design and Assessment | 3.974 | 0.733 |
| Attitude of Green Building Design and Assessment | 4.092 | 0.693 |
| Practice of Green Building Design and Assessment | 4.000 | 0.673 |

The normality test, as described by Hair et al. (2019), evaluates whether the data follow a normal distribution. When the normalcy assumption is correct, the estimation procedure is more accurate and unbiased. Additionally, researchers need to conduct a normality test since skewness and kurtosis statistics provide distinct measurements of deviation from normality. The acceptable range for skewness is from -2 to 2, while the acceptable range for kurtosis is from -7 to 7 (Hair et al., 2019). Therefore, all variables in this study were considered acceptable.

### 4.3 Measurement Model Assessment

The approach of Partial Least Squares Structural Equation Modelling (PLS-SEM) was employed in this study for analysis and result output. SmartPLS was used to analyze the measurement model's convergent and discriminant validity. Figure 2 depicts the basic research model, which includes the dependent variable, SHR, and three independent variables: K, A, and P.

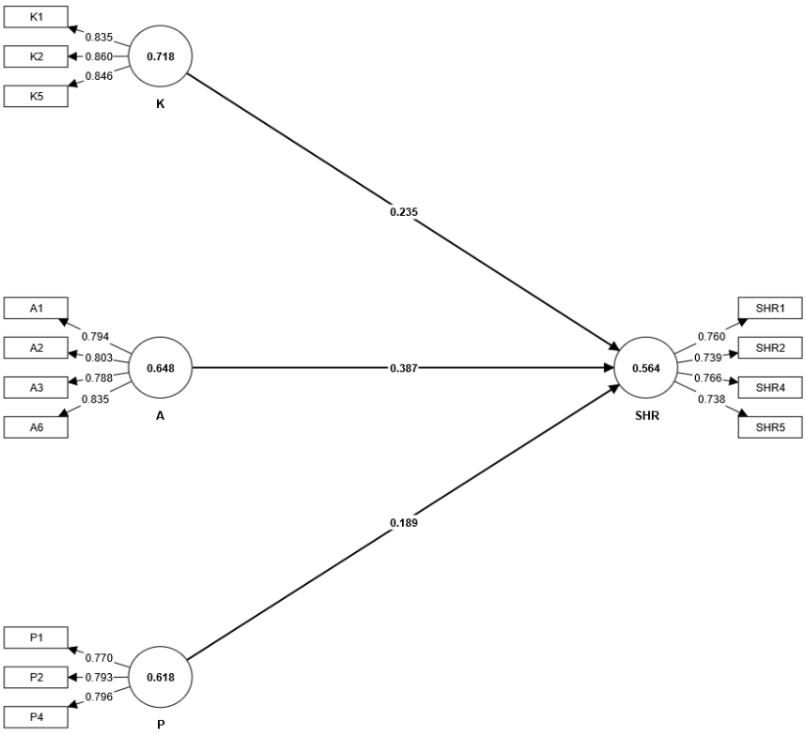


Figure 2. Initial path PLS model

According to Hair (2019), researchers must assess the factor loading value to ensure that the measurement items are appropriate to achieve internal consistency. A measurement item is considered acceptable if its outside loading number is 0.5 or above. An outside loading value greater than 0.7 is considered very satisfactory (Memon & Rahman, 2014). If the factor loading is below 0.5, it must be eliminated. Since all of the measured items in this study surpassed a threshold of 0.5, they are all deemed acceptable. Table 4 presents the convergent validity of Outer Loading, Cronbach's Alpha, Composite Reliability (CR), and the Average Variance Extracted (AVE). Convergent validity, as defined by Sarstedt and Cheah (2019), refers to the degree to which one measurement is positively associated with additional measurements of the same concept. In order to evaluate convergent validity, it is necessary to establish the AVE with outer loadings for each latent construct (Carole et al., 2017; Hair et al., 2019). The presence of high outer loadings on the structure suggests that the linked indicators include multiple properties encompassed by the construct. In order to be deemed acceptable, the outer loading of latent variables must be no less than 0.7. The study found that the outer loadings for the dependent variable SHRs in item SHR03 and the independent variable P (Practice) in item P01 were rejected because they were below the threshold of 0.7. All other items for the variables were deemed acceptable, as all outer loadings surpassed the threshold of 0.7.

CR is the name of an additional evaluation that may be performed on the measurement for internal consistency. CR stands for "composite reliability. As stated by Hair et al. (2019), the critical value must exceed 0.70 in order to be approved. On the contrary, CR and Cronbach's Alpha were utilized to estimate the construct's internal consistency. There was not a single figure that fell outside of the permitted ranges for either the factor loadings or the composite reliability. This study demonstrated that convergent validity has been attained. According to Hair (2019), the value of AVE must be more than 0.5 to qualify as legitimate convergence.

Table 4. Internal consistency, reliability, and convergent validity results

| Constructs | Items | Loadings | $\rho_c$ | AVE |
|---|---|---|---|---|
| Safety and Health Risk (SHR) | SHR01 | 0.740 | 0.838 | 0.564 |
| | SHR02 | 0.727 | | |
| | SHR04 | 0.762 | | |
| | SHR05 | 0.715 | | |
| Knowledge of Green Building Design and Assessment (K) | K01 | 0.837 | 0.884 | 0.718 |
| | K02 | 0.856 | | |
| | K05 | 0.848 | | |
| Attitude of Green Building Design and Assessment (A) | A01 | 0.783 | 0.881 | 0.648 |
| | A02 | 0.803 | | |
| | A03 | 0.793 | | |
| | A06 | 0.840 | | |
| Practice of Green Building Design and Assessment (P) | P01 | 0.777 | 0.829 | 0.618 |
| | P02 | 0.788 | | |
| | P04 | 0.794 | | |

The extent to which the experimental specifications differentiate development from other factors is what is meant by the term "discriminant validity." As a result, producing discriminant validity presupposes that the development in question is singular and that it is capable of capturing characteristics that are not addressed by the model's other latent components. According to Kamis (n.d.), the researcher generally utilizes the Fornell-Larcker criterion and the Heterotrait Monotrait Ratio (HTMT) to test discriminant validity. Fornell-Larcker specified that the square root of each construct's AVE value must be greater than its highest correlation coefficient with any other construct. While the ideal value of HTMT is less than 0.9, a value greater than 0.9 indicates that the construct lacks discriminant validity.

The Fornell-Larcker criterion is presented in Table 4. It demonstrates that the correlation coefficients of all of the constructs were lower than the square root of AVE, which is bolded and exhibited along the diagonals of the graph. Because they were lower than 0.9, the average correlations between the variables match up with all of the pairwise correlations between the variables, resulting in discriminant validity. As concluded, this implies that the discriminant validity was not satisfied because some of the variables had a correlation coefficient above 0.9.

Table 5. Discriminant validity result (HTMT ratio)

| | A | K | P | SHR |
|---|---|---|---|---|
| A | | | | |
| K | 0.830 | | | |
| P | 0.864 | 0.869 | | |
| SHR | 0.851 | 0.795 | 0.825 | |

**Hypothesis Testing**

Hypothesis tests were analyzed using the Preliminary PLS Path Model. Three hypotheses were tested in this research to find out the relationship between the indicators of implementation risk evaluation. The current investigation indicated a direct and indirect relationship between the following factors:

- H1: The knowledge of green construction design significantly influences safety and health awareness among construction stakeholders.
- H2: The attitude of green construction design significantly influences safety and health awareness among construction stakeholders.
- H3: The practice of green construction design does not significantly influence safety and health awareness among construction stakeholders.

Comparable to standardized coefficients in regression analysis, path coefficients in PLS are a measure of the strength of an association between two variables. To evaluate the significance of the hypothesis, the value of the standard Beta coefficient was utilized. The value represented the expected variation in the endogenous latent construct in comparison to the unit variance in the external latent construct. Calculations were made to determine the coefficient for each path in the proposed model. If the absolute value of the coefficient is high, then the concept of endogenous latent variability is significantly impacted to a higher extent. Using the t-statistic test, the significance of the coefficient needs to be evaluated before it can be used. The bootstrapping approach was employed to assess the importance of each hypothesis (Hair, 2019).

In this investigation, the bootstrap method was utilized to investigate the importance of route coefficients and t-statistic values derived from 5000 subsamples in the absence of any indication of change. Additionally, testing with only one tail was carried out in this study. Furthermore, a level of significance of 5% was used throughout this inquiry. According to Sarstedt and Cheah's research from 2019, the critical value for one-tailed tests with a significance level of 5% is 1.645. For the coefficient to be significant at the significance level, the t-value must be greater than the critical value, which in this case was (>1.65). In addition, the p-value was used to determine the level of significance associated with each hypothesis. Given that the level of significance for this investigation is set at 5%, the p-value ought to be either lower than or equal to 0.05. Table 5 shows the results for the directional hypothesis. K had a positive impact on SHR, with an SD of 0.108, a p-value of 0.003, and a t-value of 2.174. This assumes that there is a significant effect on the relationship between K and SHR. So, hypothesis 1 is supported.

Next, for hypothesis 2, which is A, also has a positive impact on SHR. The SD was 0.140, with the p-value of 0.015 and a t-value of 2.762. This hypothesis for this relationship suggests a positive impact. So, this hypothesis is supported. Similarly, the relationship for hypothesis 3, which is P, between SHR, with an SD of 0.140, a p-value of 0.015, and a t-value of 2.762. As such, hypothesis 3 is not supported because the p-value should be less than 0.05, but the p-value for this relationship was 0.079, which is higher than 0.05. The null hypothesis has been rejected as the p-value exceeded 0.05, indicating that it is not supported. This suggests that there is no statistically significant impact of P on safety and health awareness among construction stakeholders in Kuala Lumpur, Malaysia. Table 3 presents the descriptive statistics necessary for researching the KAP regarding green construction and its implications for SHRs among construction stakeholders in Kuala Lumpur, Malaysia. Mean values were used to assess

### 4.4 Effect Size ($f^2$)

In this study, Table 6 indicates that the $f^2$ of K was 0.053, indicating a small influence. In contrast, the $f^2$ of A was 0.144, indicating a medium effect between them. Finally, the $f^2$ for P was 0.036, indicating no significant effect. Thus, from Table 6, it can be concluded that hypotheses H1 and H2 are supported, while hypothesis H3 is not supported.

Table 6. Significance of hypothesized relationships (direct)

| Relationships | VIF | $\beta$ | SD | *t* - value | *p* - value | Confidence Interval | | Effect Size ($f^2$) | Explanatory Power ($R^2$) | Decision |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | LL | UL | | | |
| H1: K → SHR | 2.127 | 0.235 | 0.108 | 2.174 | 0.003 | 0.063 | 0.421 | 0.053 | 0.504 | Supported |
| H2: A → SHR | 2.147 | 0.387 | 0.140 | 2.762 | 0.015 | 0.146 | 0.599 | 0.144 | | Supported |
| H3: P → SHR | 2.019 | 0.189 | 0.121 | 1.560 | 0.059 | -.003 | 0.395 | 0.036 | | Unsupported |

*Note. SD = Standard Deviation, LL = Lower Limit, UL = Upper Limit, VIF = Variance Inflation Factor

This study's objective was to investigate the relationship between the KAP of green buildings and the SHR implications among stakeholders in Kuala Lumpur, Malaysia. Specifically, the study focused on exploring the relationship between these three factors. Among the various stakeholders in the construction industry in Kuala Lumpur, Malaysia, the primary objectives of this study were to assess the potential health and safety risks. In this particular investigation, there were three hypotheses, and each of them was examined using consistent PLS bootstrapping. The entire set of hypotheses was examined, and while two of them were supported, one was not.

Upon analyzing the results, the researchers concluded that there are linkages between knowledge and attitude among various stakeholders concerning the design and evaluation of environmentally friendly buildings. However, there are no links between the behaviors of various stakeholders regarding green building design and evaluation, including the obstacles to adoption and the best practices. This is because the hypothesis was not validated. In light of this discovery, it has been determined that the stakeholders in Kuala Lumpur, Malaysia, possess both knowledge and attitudes regarding the implications of green construction concerning safety and health issues. Conversely, the stakeholders in the construction firm do not use or practice this strategy on their construction project.

In addition, the findings demonstrated that the various stakeholders in Kuala Lumpur, Malaysia, maintained a favourable attitude towards environmentally friendly structures. It is generally the case that the various stakeholders' motives for green buildings tend to be "intangible motivations," such as lowering the environmental impacts of buildings and enhancing the quality of life. This is the case regardless of the absence of "tangible motivations," such as financial rewards and incentives. This displays a high level of mindfulness concerning both the environment and society. As a result of these findings, it can be deduced that the potential effects on the health and safety of stakeholders are minimal. This is because stakeholders possess both information and an attitude about environmentally friendly building practices.

## 5. CONCLUSIONS

The goal of green construction, also known as sustainable construction or environmentally friendly construction, is to lessen the destructive effects that structures have on their surrounding environments. It is vital to consider any potential dangers associated with green construction practices, although these practices typically have beneficial effects on health and safety. The use of non-toxic materials is generally given priority in green construction, which is a good aspect because it lowers people's exposure to potentially hazardous compounds. This feature is very advantageous for the well-being of those working on the building as well as the people who will eventually live there. The risk of respiratory problems and allergy reactions can be considerably decreased by avoiding items that contain volatile organic compounds (VOCs) or other dangerous chemicals.

To further enhance the safety and health benefits of green construction, it is proposed to integrate a simulation model into the governance framework of construction projects. This simulation model would serve as a predictive tool to assess potential SHRs associated with various green construction practices. By simulating different scenarios and construction methodologies, stakeholders can identify and mitigate potential hazards before they occur on-site. The model would incorporate data on materials, construction techniques, and environmental conditions to provide a comprehensive risk assessment. This proactive approach not only enhances the safety and health outcomes but also aligns with the principles of ethical governance by ensuring that all potential risks are thoroughly evaluated and addressed. The integration of such a simulation model into the governance framework would support more informed decision-making, foster greater accountability, and ultimately lead to safer and more sustainable construction practices.

In conclusion, sustainable building practices in general have a good impact on both public health and safety; nonetheless, it is imperative to examine and handle any potential dangers that may arise properly. Green construction can help create healthier and safer buildings by using non-toxic building materials, improving indoor air quality, and facilitating access to natural light and outdoor spaces. To guarantee that a safe working environment is maintained in the construction industry, it is essential to ensure that workers receive the required training and to identify and minimize any new hazards associated with alternative materials and technology. Integrating a simulation model into the governance framework of green construction projects further ensures that all potential risks are evaluated and mitigated, supporting the ethical implementation of sustainable practices.

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## AUTHORS CONTRIBUTION

Muhamad Nabil Bin Zamani (Conceptualization; Methodology; Project administration; Writing–original draft; Investigation)

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Fadzida Ismail (Conceptualization; Supervision; Writing – review & editing; Project administration)

## AVAILABILITY OF DATA AND MATERIALS

The data supporting this study’s findings are available on request from the corresponding author.

## ETHICAL STATEMENT

Not applicable.

## CONFLICT OF INTEREST

The author(s), as noted, certify that they have NO affiliations with or involvement in any organisation or agency with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, jobs, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, expertise or beliefs) in the subject matter or materials addressed in this manuscript.

## REFERENCES

Abdelaal, F., & Guo, B. H. W. (2021). Knowledge, attitude and practice of green building design and assessment: New Zealand case. *Building and Environment*, *201*, 107960.

Abu Bakar, N. A., Mohamad, F., & Ab Rahman, A. (2023). An optimized virtual model of vaccination centre operations in malaysia using hybrid agent-based and discrete event simulation. *Proceedings of International Conference on Research in Education and Science*, *9*(1), 1727–1744.

Abu Bakar, N. A., Zakaria, S. A., & Aminuddin, A. (2023). An enhanced simulation model using integrated agent-based simulation and social force theory for modelling human evacuation in close building: Implementation and development. *Proceedings of International Conference on Research in Education and Science*, *9*(1), 1695–1711.

Adam, K., Bakar, N. A. A., Fakhreldin, M. A. I., & Majid, M. A. (2018). Big data and learning analytics: A big potential to improve e-learning. *Advanced Science Letters*, *24*(10), 7838-7843.

Bakar, N. A. A., Ab Fauzan, A. I., Majid, M. A., Allegra, M., & Fakhreldin, M. (2018). The simulation models for human pedestrian movement of a departure process in an airport. In *2018 International Conference on Innovation and Intelligence for Informatics, Computing, and Technologies* (3ICT) (pp. 1-6). IEEE.

Rahman, A. A., Kahar, M. N. M., & Din, W. I. S. W. (2020). Fuzzy-logic-RSSI based approach for cluster heads selection in wireless sensor networks. *Indonesian Journal of Electrical Engineering and Computer Science*, *18*(3), 1424-1431.

Chileshe, N., Rameezdeen, R., Hosseini, M. R., Martek, I., Li, H. X., & Panjehbashi-Aghdam, P. (2018). Factors driving the implementation of reverse logistics: A quantified model for the construction industry. *Waste management*, *79*, 48-57.

Ha, C. Y., Khoo, T. J., & Koo, Z. Y. (2023). Current status of green building development in Malaysia. *Progress in Energy and Environment*, 1-9.

Fernandez, S. V., Majid, M. A., Bakar, N. A. A., & Fakhreldin, M. (2021, August). Enhanced colour scheme assessment tool (COSAT 2.0) for improving webpage Colour selection. In *2021 International Conference on Software Engineering & Computer Systems and 4th International Conference on Computational Science and Information Management (ICSECS-ICOCSIM)* (pp. 459-464). IEEE.

Golovina, O., Teizer, J., & Pradhananga, N. (2016). Heat map generation for predictive safety planning: Preventing struck-by and near miss interactions between workers-on-foot and construction equipment. *Automation in Construction*, *71*, 99–115.

Hair, J. F., Risher, J. J., Sarstedt, M., & Ringle, C. M. (2019). When to use and how to report the results of PLS-SEM. *European business review*, *31*(1), 2-24.

Hwang, B., Lee, J. H., & Bang, D. (2018). Single-cell RNA sequencing technologies and bioinformatics pipelines. *Experimental & Molecular Medicine*, *50*, 96.

Kamis, A., Saibon, R. A., Yunus, F. A., & Rahim, M. B. (n.d.). *The SmartPLS Analyzes Approach in Validity and Reliability of Graduate Marketability Instrument*. https://www.researchgate.net/publication/348295457

Karakhan, A. A., & Gambatese, J. A. (2017). Integrating worker health and safety into sustainable design and construction: designer and constructor perspectives. *Journal of Construction Engineering and Management*, *143*(9), 04017069.

Kim, H., Sefcik, J. S., & Bradway, C. (2017). Characteristics of Qualitative Descriptive Studies: A Systematic Review. *Research in Nursing & Health*, *40*(1), 23.

Marjaba, G. E., & Chidiac, S. E. (2016). Sustainability and resiliency metrics for buildings – Critical review. *Building and Environment*, *101*, 116–125.

Nnedinma, U. (2016). Approaches, drivers and motivators of health and safety self-regulation in the Nigerian construction industry: a scoping study. *Architectural Engineering and Design Management*, *12*(6), 460–475.

Omidvar, M., Mazloumi, A., Work, I. M. F.-, & 2017, undefined. (n.d.). Development of a framework for resilience measurement: Suggestion of fuzzy Resilience Grade (RG) and fuzzy Resilience Early Warning Grade (REWG). *Content.Iospress.Com*. [Retrieved June 2, 2023], from https://content.iospress.com/articles/work/wor2512

Onubi, H. O., Yusof, N., & Hassan, A. S. (2020). Adopting green construction practices: Health and safety implications. *Journal of Engineering, Design and Technology*, *18*(3), 635–652.

Othman, I., Shafiq, N., & Nuruddin, M. F. (2017, December). Effective safety management in construction project. In *IOP Conference Series: Materials Science and Engineering* (vol. 291, no. 1, p. 012018). IOP Publishing.

Pan, M., & Pan, W. (2020). Knowledge, attitude and practice towards zero carbon buildings: Hong Kong case. *Journal of Cleaner Production*, *274*, 122819.

Roslee, N. N., Hamimi, A., Tharim, A., & Jaffar, N. (2022). Investigation on the barriers of green building development in Malaysia. *Malaysian Journal of Sustainable Environment*, *9*(2), 37–58.

Sarstedt, M., & Cheah, J. H. (2019). Partial least squares structural equation modeling using SmartPLS: A software review. In *Journal of Marketing Analytics* (vol. 7, issue 3, pp. 196–202). Palgrave Macmillan Ltd.

Shen, H., Shin, E. M., Lee, S., Mathavan, S., Koh, H., Osato, M., Choi, H., Tergaonkar, V., & Korzh, V. (2017). Ikk2 regulates cytokinesis during vertebrate development. *Scientific Reports*, *7*(1), 8094.

Waziri, B. Z., Hassan, A., & Kouhy, R. (2018). The effect of transitioning to renewable energy consumption on the Nigerian oil and gas exports: An ARDL approach. *International Journal of Energy Sector Management*, *12*(4), 507–524.

Yahaya, C. A. C., Firdaus, A., Zabidi, A., Bakar, N. A. B. A., Nawir, M. B., & Malek, P. N. A. A. (2023, August). Cloud of Word vs DroidKungfu: Performance evaluation in detecting root exploit malware with deep learning approach. In *2023 IEEE 8th International Conference On Software Engineering and Computer Systems (ICSECS)* (pp. 217-222). IEEE.

Yahaya, C. A. C., Firdaus, A., Ernawan, F., & Din, W. I. S. W. (2022). The relevance of bibliometric analysis to discover the area's research efforts: Root Exploit Evolution. *JOIV: International Journal on Informatics Visualization*, *6*(2-2), 489-497.

Yang, R. J., Zou, P. X., & Wang, J. (2016). Modelling stakeholder-associated risk networks in green building projects. *International Journal of Project Management*, *34*(1), 66-81.

Zhang, H., Zhang, J., Wei, P., Zhang, B., Gou, F., Feng, Z., ... & Zhu, J. K. (2014). The CRISPR/C as9 system produces specific and homozygous targeted gene editing in rice in one generation. *Plant Biotechnology Journal*, *12*(6), 797-807.

Zhang, X., & Mohandes, S. R. (2020). Occupational Health and Safety in green building construction projects: A holistic Z-numbers-based risk management framework. *Journal of Cleaner Production*, *275*, 122788.

Zhu, J., Bailly, A., Zwiewka, M., Sovero, V., Di Donato, M., Ge, P., Oehri, J., Aryal, B., Hao, P., Linnert, M., Burgardt, Zhu, J., Bailly, A., Zwiewka, M., Sovero, V., Di Donato, M., Ge, P., ... & Geisler, M. (2016). TWISTED DWARF1 mediates the action of auxin transport inhibitors on actin cytoskeleton dynamics. *The Plant Cell*, *28*(4), 930-948.