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Barriers of Green Building Technology Adoption in Malaysia: Contractors' Perspective

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Abstract
Green building technology, sometimes referred to as eco-friendly building materials are used in building constructions with minimal negative influence on the surrounding natural environment such as using renewable resources rather than relying on depletable fossil fuels. The problem statement of this research is the high cost of the green building material; lack of awareness of adopting green building practices among construction players; and lack of availability of technology. The aim of the research is to identify the factors contributing to the lack of adoption of green building technology among contractors and find a way to increase its use in the future. Therefore, this research has set the objectives of determining the factors contributing to low adoption of green building technology and recommending ways to increase the adoption of green building technology. This research adopts a quantitative method by using a questionnaire survey. A total of 341 Grade 7 contractors registered with Construction Industry Development Board (CIDB) were selected as the respondents of this study. According to the findings, the majority of respondents identified a high initial investment and long payback period as significant barriers to implementing green building technology in construction. Besides, lack of awareness and financial resources were also found to be major contributors to the low implementation.
Keywords: Green Building Technology, Contractor Perspective, Malaysia

Research Background

Construction industry plays a very important role in driving economic and social development while at the same time maintaining good environmental sustainability. This will improve the quality of life of the community and will provide an excellent built environment for future growth and development. Mahat et al (2019) stated in their study that government agencies, private organizations, and the public have collaborated with the construction industry to promote wider use of green building technology to the public, energy efficient buildings, and unimpeded access in the built environment. However, the use of green

technology in Malaysia is still in the introduction phase because many parties are not interested in applying the use of green technology in building construction (Lim et al., 2018).

Green technology is one of the most discussed trends, especially among industry players in Malaysia. In the construction industry, this technology has many benefits for the building structure itself. Green technology can not only be applied in new facilities but also in existing structures. Buildings are becoming increasingly renewable and energy-efficient, which reduces their environmental impact and carbon footprint. A building or structure is developed and built using a sustainable and environmentally friendly method throughout the entire process, with a focus on durability, economics, usefulness, and comfort.

Even though there are an abundance of green building technology implementation highlighted, there are still issues regarding the low acceptance of it by the industry. Mahat (2019) mentioned that using modern technologies such as the application of green building material is considered costly due to the need for technical capacity, lack of competition, and is mostly manufactured abroad. The level of awareness and knowledge on the development of green technology is still very low. Lim et al (2018) noted in their study that a lack of public understanding is one of the most significant barriers to the development of green buildings in Malaysia, according to a survey done in the country. The low level of awareness and knowledge is an obstacle that must be overcome in order to create a local construction sector that is capable of being more environmentally friendly and user friendly. The other factor contributing to the lack of adoption of green building technology in the Malaysian construction industry is the availability of the technology (Yee et al., 2020).

Besides, the construction industry sector contributes to much of the pollutions that occur in our society, and it may cause the health of occupants and consumers to be affected. There are many ways to overcome this problem so that pollution in this sector can be controlled and, at the same time, it can be decreased to make the environment cleaner and healthier. Adopting green building materials to new proposed buildings and old, used buildings is an effective way to make construction industry environmentally friendly.

This suggestion can be realised by exposing industry players to the benefits of using green building technology. Thus, the aim of this study is to identify the factors that hinder the green building technology implementation in Malaysia and highlight the recommendations to overcome the problems. Hopefully, this study will contribute and allow for exceptional environmental preservation in the construction industry.

Literature Review

A "green building" is a type of sustainable construction that priorities durability, economy, utility, and comfort. It is a method for designing and constructing a building or structure while taking a sustainable and ecologically friendly approach at every step. The fundamental objective to be achieved in this constantly expanding sector comprises the sustainability of economic progress.

Since many scientific studies on green technology show that greenhouse gases are causing global warming and climate change, the public is increasingly pushing for environmentally friendly mechanisms to help reduce the impact of fossil fuel consumption, landfill, and industrial sector wastes. The most effective way to leverage green technology is to use it to achieve higher energy efficiency in the construction sector. Green building construction is an integral part of the design and construction process for any new projects.

Therefore, sustainable and energy-efficient materials and technologies are utilised in every area of the building's construction, from the design of the structure to the systems that

run and maintain operations. Although many studies have stated that green technology has many benefits to development, especially in the construction industry, many industry stakeholders still do not understand. They are not exposed to the importance of its use to the environment and the project itself. This is because the introduction to green technology in Malaysia is still in a prelude phase.

The capital cost for the material and installation itself is excessively expensive compared to traditional materials and methods. Hence, many developers are not interested in employing green technology materials in their projects. The cost of development may be increased by using this new technology. Still, looking into the future, it will be more profitable because the building life span may be longer due to the sustainable materials used. Green buildings are valued more than conventional buildings. They can even obtain greater rents, which deliver not only economic benefits but also offer social and environmental advantages that have no tangible gain.

The problem of achieving long-term development will be confronted by the company that lacks financial assets. The development of green building technology is crucial because it requires the acceptance of all stakeholders for efficient execution, including the government, proprietors, consultants, and contractors.

The main cause for concern is that most developers and designers prefer using conventional construction techniques rather than using green technologies, despite the recent government support for the construction of more green buildings and widespread public awareness of environmental issues on a global scale. Green building firms must also contend with a scarcity of manufacturer incentives. When the government or private sector acts as a catalyst, the construction industry can embrace green technologies in its projects.

It has been found that green building technology includes a wide variety of activities, techniques, and skills to minimise the negative impacts of construction on both the environment and human well-being (Samer, 2013). The main objective of using green building technology in construction is to minimise the total impact of the built environment on human health and the natural environment through sustainable building goals.

Adopting this technology can create a clean and healthy environment for the society and occupants of the building. Meanwhile, the life span of the building can also be extended with the utilisation of the green building materials in the development phase. The energy usage and environmental effect of buildings are enormous. Almost 40% of primary energy and 70% of electricity in the United States is consumed by commercial and residential structures (Vatalis et al., 2013). To cut down on energy use, consider optimizing the orientation of the building, minimising solar heat gain through the building's exterior envelope, and utilising natural lighting.

Also, consider implementing best practises for building services, such as using renewable energy and conducting thorough testing, commissioning, and maintenance. The amount of energy consumed by the construction industry continues to rise, largely due to the country's rapid expansion, which results in excessive energy usage. The research found that commercial building power usage quadrupled between 1980 and 2000 and is predicted to rise another 50% by 2025, according to report by (Shukla and Sharma, 2018). Energy efficient (EE) buildings use less energy, cost less to operate, and improve comfort, saving money for homeowners and businesses.

Conserving water will be a major component of the green building during the next few years. UN data shows that buildings use 20 percent of the world's available freshwater and that freshwater resources are becoming increasingly limited every year (Al-Qawasmi, 2019).

Meanwhile, water efficiency (WE) refers to utilising newer technology and methods that use less water whilst providing the same level of service.

Drinking water systems can use less water yet provide the same or better customer service while saving money. WE improvements save operational expenses (such as pumping and treatment) and minimise the demand for additional water sources and water infrastructure expansion. As a result, less freshwater is consumed, which frees up more for current and future demands whilst also enhancing water quality and aquatic habitat.

Materials efficiency (ME) is one of the green building components that encourages the use of eco-friendly products derived from renewable resources and recycling. Effective construction waste management techniques, such as storing, collecting, and reusing recyclables and building formwork and trash, should be utilised. The used materials help reduce the environmental impact of extraction and processing of virgin resources by using goods and pre- or post-consumer recycled content materials.

Construction waste management is critical in preventing construction sites from disposing of rubbish or junk that has accumulated on their premises. Responsibilities for reusable materials are assigned to specific locations, while recyclable materials are directed to manufacturing facilities. Certified wood-based goods should be acquired to show that the materials used are not unlawful since this may contribute to the development of ecologically responsible forestry (Algburi et al., 2016).

Construction and demolition waste management have emerged as one of the most significant environmental issues in a number of developed nations. There are two types of building construction trash: structural waste and finishing waste. Structure waste is the garbage generated during the construction of the building. According to Yeheyis (2013), the construction and demolition waste produced by the Canadian construction industry makes up 27% of all municipal solid waste disposed

of in landfills. However, it is apparent that over 75% of the waste generated by the construction sector has residual value and so may be recovered, salvaged, and/or repurposed. There is widespread recognition of the necessity for comprehensive and integrated waste management processes, technologies, rating systems, and regulations.

Building environmental conditions are influenced by a variety of physical variables such as air temperature, relative humidity, air movement, ventilation, lighting, and noise. Clearly, these variables can also significantly affect the symptoms of individuals who are suffering from building-related illnesses, such as asthma and allergies. There is an emphasis on social sustainability and environmental quality as part of the current green certification process, which supports the idea that people who use built environments should feel confident and satisfied in the space they occupy.

In order to be considered green, a building must not only be energy-efficient, emission-reduced, or land-saving, but it must also serve as a major component in providing a pleasant workplace or residential environment for the occupant's activities (Li et al., 2014). In terms of the implementation barriers of green building technology, a few factors are highlighted in this study which includes high initial investment, lack of awareness, lack of financial resources and lack of end-user support. Compared to standard equipment, energy-efficient and renewable energy technologies such as energy-efficient air conditioners and photovoltaic devices demand a greater initial investment. Implementation of green construction may be more expensive than conventional construction. According to Wang et al (2016), a large initial expenditure is one of the main reasons for the reluctance to implement energy-efficient lighting systems in commercial buildings.

The lack of awareness and expertise is a barrier that must be overcome in order to develop a local construction industry that is competent and sustainable. Bohari et al (2016) found that a frequent obstacle to adoption is due to lack of understanding among practitioners themselves, particularly among design teams, financial advisers, and contract advisors. It is supported by AlSanad (2015) who mentioned in his study that the most important barriers highlighted were lack of awareness.

In green building practices, end-user is defined as someone who purchases or rents green the building property or, in other words, as a stakeholder who will contribute to the expansion of the market. In a construction project, stakeholders are significantly impacted by the organization's operations and who inhabit the finished building during the post-occupancy period (Mwero & Aduda, 2019). The issue may arise because most of the consumers are still unaware of the benefits of the implementation.

The increased costs associated with green initiatives may demotivate the developers, clients or end-users, that discouraging them from participating. In practice, according to Williams and Dair (2007), supplying green features and developments is considerably more expensive than conventional features and advancements. Customers also are still not prepared to pay the additional expenses involved, which may serve as a demotivator for clients and make them hesitate to undertake green initiatives for future projects.

Research Methodology

In this study, a quantitative data approach was used in which the primary research data and instruments were gathered from a questionnaire survey. Prior to utilising SPSS version 28 to analyse the data from the respondent's questionnaire, the process involved numerical data. Specifically, the variables were analysed using descriptive statistics and presented using graphical analysis. Furthermore, a comparison can than be made during the study process. As a result, the questionnaire is created with a consistent format based on a certain subject to provide useful data.

The respondent is given the option to use the five-item Likert scale when filling out the questionnaire. With the Likert scale, respondents can select from 1 for “strongly disagree” to 5 for “strongly agree”. Based on Grade 7 contractors registered with Selangor's Construction Industry Development Board (CIDB), the general population was selected. According to Krejcie & Morgan (1970), 341 respondents make up the sample size for a population of 3034. The survey obtained a response rate of 48% as a result.

Analysis and Discussion

Table 1
Respondents' Demographic profile

	Category	Frequency	Percentage
Work experience	1-5 years	66	40.5
	6-10 years	58	35.6
	>10 years	39	23.9
Years ventured in green building projects	1-5 years	24	14.7
	6-10 years	13	8.0
	>10 years	5	3.1
	Not involved	121	74.2
Total green building projects	1-5 years	20	12.3
	6-10 years	13	8
	>10 years	9	5.5
	Not involved	121	74.2

Table 1 shows the demographics of the respondents who participated in the study. From the 163 respondents, 40% (Frequency = 66) have 1–5 years of work experience, 35.6% (Frequency = 58) have 6–10 years of work experience, and only 23.9% (Frequency = 39) have more than 10 years of work experience.

This survey also revealed that only 25.8% (Frequency = 42) of respondents have collaborated on green building projects, with 1–5 years of experience contributing to 14.7% (Frequency = 24), 6–10 years of experience contributing to 8% (Frequency = 13), and more than 10 years of experience contributing to 3.1% (Frequency = 5), respectively. Surprisingly, the findings show that 74.2% of the respondents are not involved in any joint ventures or main green building projects.

In addition, only 12.3% (Frequency = 20) of the respondents have 1–5 years of experience in any green building projects. Then, followed by 8% (Frequency = 13) of the respondents have 6–10 years of experience and 5.5% (Frequency = 9) of the respondents have more than 10 years of experience in green building projects.

Table 2
Barriers to Green Building Material Adoption

Variable	Mean Score	Rank
High initial investment, long payback period	4.59	1
Lack of awareness of adopting green building practices	4.48	2
Lack of financial resources	4.39	3
Lack of end-user support	4.33	4

Table 2 illustrates the significant barriers to green building material adoption in Malaysian construction industry. There were high initial investment, long payback period (4.59), lack of awareness of adopting green building practices (4.48), lack of financial resources (4.39) and lack of end-user support (4.33).

According to Mwero and Aduda (2019), the initial cost was a significant factor because the cost incurred when purchasing more efficient technologies involved higher initial costs, which many consumers did not want to spend on and which low-income consumers may not be able to afford because they have limited capital.

Besides, lack of public awareness is a top obstacle in many developing green markets country and even in established markets country (Mwero & Aduda, 2019). Morover, Alohan and Oyetunji (2021) mentioned that supplying green features and developments is considerably more expensive than conventional features and advancements.

Lastly, it is very essential for end users to demonstrate their dedication and collaboration to appropriately using their green buildings. Failing to do so renders the green building ineffective, which defeats the objective of the green building (Bohari et al., 2016).

Conclusion

The study has explored the implementation barriers of green building technology from the contractors' perspective. The result of the survey show that the most significant factors contributing to the low level of adoption of green building construction technologies are the high initial investment and the long return period. Lack of awareness of the implementation and lack of financial resources were also found as the major reason of the low adoption of green building technology. In order to overcome this issue, it is recommended that the government give good incentives to green building technology implementation. Besides, educational and training courses also are needed to increase the awareness and interest of the green building technology. In conclusion, developers and government should work together to find the best strategy to boost the implementation of green building technology towards more sustainable development.

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