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APPLYING THE THEORY OF PLANNED BEHAVIOR (TPB) TO EXPLAIN THE ADOPTION OF GREEN BUILDING

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ABSTRACT

Green building is defined as efficiently using water, materials, and energy and the impact on the environment and human health. Therefore, this study aims at identifying the factors affecting the implementation of green buildings in Malaysia. The method used in this study is quantitative and uses a "positivism" approach. The questionnaire was prepared using the five-point Likert scale. The questionnaire was sent to 384 respondents in Malaysia, and 330 valid responses were received in return. This research was analyzed using IBM SPSS Version 23.0. The results of the Pearson Correlation test have shown that there is a significant relationship between five selected determinants, namely cost (r =0.717, p = 0.000), attitude (r =0.765, p = 0.000), information, knowledge, and awareness (r =0.751, p = 0.000), management and government (r =0.823, p = 0.000), and technology and training (r =0.773, p = 0.000) towards intention in adopting green building technology. Next, the most dominant factor was management and government (β = 0.487, p= 0.000). This study is expected to motivate the use of green buildings based on selected determinants. Discussions were also made concerning aspects of the implications and recommendations of the study.

Keywords: *Adoption of green building, Theory of planned behavior,*

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determinant of green building

INTRODUCTION

Environmental problems such as pollution, climate change, and natural resource shortage are worrying worldwide issues (Liang & Yang, 2019). Harmful practices and attitudes from humans themselves have led to environmental pollution (Ajibade et al., 2021). Adverse effects on the environment can lead to global warming since the occurrence of high temperatures has increased compared to the average temperature (United Nations, 2022). Global warming causes an increase in the sea level, rising temperatures, and melting ice at the South Pole. The average temperature of the world in a period of five years, from 2015 to 2019, is estimated to be 1.1 degrees Celsius warmer than the pre-industrial era, which is in years 1850 to 1900, and 0.2 degrees Celsius warmer than the period 2011 to 2015 (United Nations, 2022). Therefore, green practices must be implemented widely and continue to control carbon dioxide emissions (CO2). However, many people in the world still need to learn the importance of implementing green practices (Muhammad, Long, & Salman, 2020). Society is unaware of environmental issues and is not taking lessons from events and frequent natural disasters. The COVID-19 pandemic that hit the world showed the need to practice green practices. For instance, the Bashir et al. (2020) study has indicated that environmental pollutants negatively correlate with the COVID-19 epidemic. Lockdown due to COVID-19 has reduced transport activities, resulting in less energy consumption and lower oil demand.

In response to the environmental issue, scholars agree that green building offers promising solutions (Abdullah Halim et al., 2022). Green building (also known as green construction or sustainable building) refers to the structure and the application of environmentally responsible and resource-efficient processes throughout the building's life cycle: from planning to design, construction, operation, maintenance, renovation, and demolition. This requires collaboration with contractors, architects, engineers, and clients at all project stages (Azis, 2021; Ong, Yusof, & Osmadi, 2021). Green building practices through the integration of various green envelope components have been empirically proven to promote efficient use of energy, water, and other resources, protect the occupants'

health and increase the workers' productivity and reduce waste, pollution, and environmental destruction (Olubunmi, Xia, & Skitmore, 2016; Ohueri, Enegbuma, & Kenley, 2018). The Malaysian Ministry of Economic Affairs also has reviewed the Twelfth Malaysia Plan (12MP) from 2021 to 2025 by promoting green buildings as one of the national plans. Cooperating with the Construction Industry Development Board (CIDB) and the Ministry of Works, the government has developed the Malaysian Carbon Reduction and Environmental Sustainability Tool (MyCREST) to guide, assist, measure, and reduce the built environment's impact in reducing carbon emissions and environmental impact, considering a more holistic view of the life cycle. It also aims to integrate socioeconomic considerations related to the built environment and urban development. In Malaysia, a recognition system that considers the climate, social, infrastructure, and economic development is used to evaluate the performance of green buildings. This system is called the Green Building Index (GBI). GBI was built by the Association of Architects Malaysia and the Association of Consulting Engineers Malaysia (ACEM). GBI evaluates and recognizes green buildings based on six criteria: 1) efficiency of use of energy resources, 2) water use efficiency, 3) the quality of the indoor environment, 4) site planning and management, 5) materials and resources, and 6) innovation. Leisure 1Farm Resort Central Spine di Iskandar Malaysia, Johor, Eco Majestic di Semenyih, Selangor, Bandar Gamuda Gardens di Kuang, and Selangor Marvelane Homes by The Lake di Subang Jaya, Selangor are some examples of green building in Malaysia. However, Malaysia is still behind in implementing green buildings compared to other Asian countries such as Japan, Australia, and Singapore due to problems such as the apathetic attitude of engineers in the building industry due to the lack of prospects, unconvinced buyers and customers, and the propagation of low expertise (Nabilla, 2018; Roslee, Abdul Tharim, & Jaffar, 2022).

Therefore, this study aims to identify the factors affecting the implementation of green buildings in Malaysia. The second is to examine the most substantial factor influencing the adoption of green building technology among the Malaysian public. Previous studies have discovered five factors influencing the desire to adopt green building technology: economic issues, attitudes, information, knowledge and awareness, management, and government, as well as technology and training (Kumar & Tawalare, 2021; Raouf & Al-Ghamdi, 2020). By examining these determinants of green

building technology adoption rather than specifying the design features of green building technology, this study provides meaningful insights into how the identified enablers or factors can be harnessed for the sustainable development of green buildings in Malaysia. This study is one of few studies on the behavioral aspects of green building in a developing country (i.e., Malaysia) context.

LITERATURE REVIEW

The present study applies the theory of planned behavior (TPB) to investigate the determinants that predict intentions to adopt and purchase athe green- building. The TPB is a theoretical framework for predicting intention behavior, which a substantial amount of research across multiple behavioral domains has supported.

Ajzen's Theory of Planned Behaviour for Framing the Intention to Adopt Green Building Technology

Based on the advancement of the theory of reasoned action (TRA), Ajzen (1991) further developed the theory of planned behavior (TPB) to provide a comprehensive model to determine antecedents of individual intention and behavior. The theory idea believes that an individual is said to have a strong desire to perform when showing a real possibility of the desired action. In this situation, the level of individual desire is determined by three primary forms of belief, which are: behavioral, normative, and control, that exist in the relationship between attitudes, subjective norm, and perceived behavioral control. The three events that drive the level of desire are the main elements in the model. Attitudes and subjective norms are very desirable factors. At the same time, perceived behavioral control represents the possibility of presenting a form of behavior and is further related to the perception of situational efficiency or self-efficacy (Azjen, 1991).

Attitude is an essential element that affects a person's intention to perform a specific behavior. Attitude is an individual assessment of the effect of implementing a behavior (Ajzen, 2005). An individual's evaluation of behavior performance will produce two forms of belief, favorable or unfavorable if a person performs the behavior. For example, if the

individual believes adopting green building technology will lead to several positive consequences. Thus, the inclination to adopt green buildings is higher. The next element in this theory is the subjective norm (subjective norm), referring to the individual's perception of other individuals who are considered essential to him/her regarding a specific behavior (Ajzen, 2005). Subjective norms become a construct directly related to a person's behavioral intention. This is because a person's behavior is dependent on other people's perceptions of his behavior. For example, suppose the perception of other individuals (e.g., close friends and family members) towards green building technology is positive. In that case, it will motivate a person to adopt the technology.

On the other hand, a negative social perception will inhibit a person's tendency to do so. The final element in this theory is perceived behavioral control. It is related to the individual's perception of whether it is easy or difficult for him to perform a specific behavior. It depends on the individual's internal and external factors, such as experience, skills, resources, and opportunities (Ajzen, 1991). If the individual does not control these factors, his intention to do something will be weak. According to our study, building contractors and government support, for example, plays a vital role in promoting green development, for instance, promoting rebate for constructing green building houses. Employing TPB, we proposed that Cost, Attitude, Information, Knowledge and Awareness, Management and Government, and Technology and Training could significantly influence the motivation of the Malaysian public to adopt green building technology (see Figure 1).

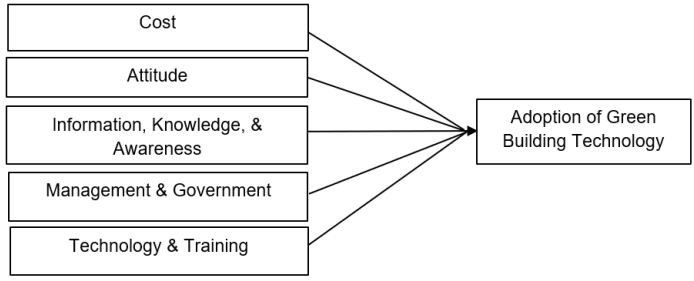

Figure 1. Conceptual Model

(Source: Author)

Cost and Intention in Adopting Green Building Technology

Several obstacles hinder the achievement of green buildings in Malaysia, where many organizations consider green building construction challenging and costly. Green development requires higher expenses than conventional structures (Roslee, Abdul Tharim, & Jaffar, 2022). This statement is supported by Dwaikat et al. (2018), where the first concern in green development is considerable expense compared to conventional structures. The cost gap between these two structures is due to green technology, and capable elements affect the price. This refers to the situation where contractors and developers must get materials from foreign countries because Malaysia does not have environmentally friendly products, which is enough. Most green building construction materials are expensive because they are made from materials that have a low heat absorption rate. Therefore, computer technology is used by architects to help the process of arbitrating decisions related to the selection of material types and costs. Most computer technology in the construction field focuses on modules that help the construction of buildings digitally or virtually. However, finding suitable green building materials for green building design and, at the same time controlling the construction cost is a time-consuming task. This is because the architect will use the "trial and error" method or simulation technique, which is time-consuming. Thus, this study proposed the following hypothesis:

H1: There is a significant relationship between cost and the intention to adopt green building technology

Attitude and Intention in Adopting Green Building Technology

The concept of green development is new, leading to developers' policies, business owners, and the community facing difficulties in implementing green development (Guribie et al., 2021). For example, developers who have ideas about green development may not be able to implement them because the community is opting for more conventional development due to a lack of understanding of goodness derived from the concept of green development. Market characteristics are essential factors for green innovation adoption and diffusion. Accordingly, a market with a larger population, higher incomes, and education might require greater

demand for green innovation in residential buildings. Customers' attitudes, lifestyles, behavior, and culture likely play a key role in developing the green building market (Zhang & Tu, 2021). Customers' buoyant demand for green buildings will motivate the construction industry to meet more green standards, boosting green building adoption (Zhang et al., 2018). Thus, this study proposed the following hypothesis:

H2: There is a significant relationship between attitude towards the intention of adopting green building technology

Information, Knowledge, and Awareness and Intention in Adopting Green Building Technology

According to the statistical report of the Department of Statistics Malaysia, the number of people in Malaysia is expected to increase by about 20 million people in 2040 from 2010 (Bashir et al., 2020). An increase in the population of humans will result in more energy will be needed at the same time leading to environmental problems. This is because the increase in human population will increase demand in the construction sector. A construction process that cannot be efficiently managed will harm the environment. Hence, the knowledge and awareness of the green technology concept need to be promoted to the public and among the construction industry players. Mahat et al. (2019) study in the Malaysian context, for instance, found that most respondents (53.85%) indicated that their knowledge of green building is at the average level, and only 35.38% of the respondent have a good understanding of green building technology. Adopting green building development also requires designers to have a wide range of knowledge dimensions such as social environment, cultural concepts, aesthetic standards, and engineering design knowledge (Murtagh, Roberts, & Hind, 2016). Potbhare, Syal, and Korkmaz (2009) pointed out that green building guidelines are necessary to enhance the awareness and knowledge of developers, contractors, and other participants about green buildings. Thus, this study proposed the following hypothesis:

H3: There is a significant relationship between the information, knowledge, and awareness towards the intention of adopting green building technology

Management and Government and Intention in Adopting Green Building Technology

Government acts as an essential enabler in promoting green building development since they must show and promote environmentally friendly action to create public trust in this matter (Sharif, Kamaruzzaman, & Pitt, 2017). The government also can vigorously motivate critical stakeholders, such as investors, to invest in green buildings. The government could ratify policies on energy conservation to optimize the economy, society, and environment. For instance, the Malaysian government recognizes MyHIJAU Mark to acknowledge products, equipment, systems, and service providers certified by GreenTech Malaysia that meet local and international environmental standards. Based on the criteria, several groups of products and services have been selected. These include ICT equipment, paint, cement, energy-efficient indoor lighting, furniture, and building facility management services (Ministry of Energy, Green Technology, and Water, KETTHA, 2018). The government stimulates developers and consumers to enter the green building market by implementing subsidy policies (He & Chen, 2021). If society does not will this approach positively affect them, they may not be interested in supporting this sustainable development concept (Soon et al., 2017). Thus, this study proposed the following hypotheses:

H4: There is a significant relationship between management and government regarding the intention of adopting green building technology

Technology and Training and Intention in Adopting Green Building Technology

From an organizational point of view, internal obstacles can prevent decisions for green development. These include a lack of financial resources, a lack of green expertise in the firm, a lack of leadership ability, and a lack of time to implement green practices (Roslee, Abdul Tharim, & Jaffar, 2022; Yee, Ismail, & Jing, 2020). There are also difficulties in managing and maintaining green buildings. The management should ensure that operations and maintenance staff carry out their duties and maintain the designed greengreen design criteria. Green building maintenance requires high expertise in management in the use of available resources to ensure it

is environmentally friendly (Sharif, Kamaruzzaman, & Pitt, 2017). Thus, this study proposed the following hypothesis:

H5: There is a significant relationship between technology and training toward the intention of adopting green building technology

METHODOLOGY

A quantitative study was conducted, and the data was collected using a questionnaire. Green (1991) recommends a calculation formula $N \geq 50 + 8$ m for the regression analysis, where m is the number of predictor variables in determining the appropriate sample size. Based on the formula, this study's minimum sample size is (50 + 8X5) = 80 respondents. In addition, based on the Krejcie and Morgan Table of 1970, 384 Malaysian public respondents were defined. Usable questionnaires were received from 330 respondents, representing a response rate of 85.9%. From the data, male respondents were 160 (48.5%), and female respondents were 170 (51.5%). Regarding the age bracket, most respondents were 20-29 years of age (n=167, 50.6%). An examination of the highest level of education showed that most respondents received tertiary qualifications (undergraduate and postgraduate) (n=248, 75.2%).

In this research, the questions were adapted from 26 items developed by Chan et al. (2017). The questionnaire used in this study had two main sections: Section A was about respondents' demographic background, and Section B collected data on the study variables. Questions in Section B were designed on a five-point Likert scale ranging from strongly disagree (1) to neutral (3) and strongly agree (5). Data from the field were analyzed using IBM Statistical Packages for Social Sciences (SPSS) version 23.0 software. To test the normality of the data, the researchers depend on the value of skewness and kurtosis, where these two items are referred to as the shape of the data distribution. According to Kline (2005), the skewness value should fall within the range of -3 to +3, while for kurtosis, the range of -10 to +10 needs to be assumed. Then, the reliability of the instruments was measured based on Cronbach's Alpha, where when the Cronbach Alpha value is between 0.6 to 1, it shows that all items have high reliability (Sekaran & Bougie, 2016). To test the hypothesis, the Pearson correlation

has been used to determine the relationship between the dependent and independent variables. The relationship is significant if the p-value is less than 0.05 (one-tailed). Finally, multiple regression is run to determine the primary determinant influencing green building adoption.

FINDINGS AND DISCUSSION

The normality test of the data distribution was measured through the criteria of skewness and slope (kurtosis), and the analysis results found that the questionnaire's skewness and kurtosis values were normally distributed (see Table 1). The reliability test results found that the instrument reached a reasonable and acceptable level of reliability which exceeded 0.60 (Sekaran & Bougie, 2016).

Table 1. Normality & Reliability Results

Variables	Skewness	Kurtosis	Cronbach's Alpha	No. of Items
Cost	-0.624	-0.175	0.862	4
Attitude	-0.614	0.097	0.912	7
Information, knowledge, and awareness	-0.655		0.912	5
Management and government	-0.559	-0.297	0.884	5
Technology and training	-0.417	-0.649	0.902	5
The intention of adopting green building technology	-0.534	-0.536	0.922	5

(Source: Author)

Table 2. Pearson Correlation Results

		The intention of adopting green building technology
Cost	Pearson Correlation Sig. (1-tailed)	0.717** 0.000
Attitude	Pearson Correlation Sig. (1-tailed)	0.765** 0.000
Information, knowledge, and awareness	Pearson Correlation Sig. (1-tailed)	0.751** 0.000
Management and government	Pearson Correlation Sig. (1-tailed)	0.823** 0.000
Technology and training	Pearson Correlation Sig. (1-tailed)	0.773** 0.000

(Source: Author)

Correlation analysis first discovered that there is a significant relationship between cost (r =0.717, p = 0.000), attitude (r =0.765, p = 0.000), information, knowledge, and awareness (r =0.751, p = 0.000), management and government (r =0.823, p = 0.000), and technology and training (r =0.773, p = 0.000) towards intention in adopting green building technology. Therefore, all hypotheses were accepted.

Table 3. Regression Results

Variables	Beta (β)	Sig. (p)	Tolerance	VIF
Cost	0.096	0.074	0.317	3.155
Attitude	0.121	0.084	0.187	5.335
Information, knowledge, and awareness	0.005	0.945	0.186	5.382
Management and government	0.487	0.000	0.174	5.741
Technology and training	0.179	0.008	0.207	4.831
R2 Adjusted R2 F Change Sig.	0.704 0.699 153.925 0.000			

(Source: Author)

Based on Table 3 shows that the adjusted R^2 is 0.699, where 69.9% of all independent variables influence the dependent variable. The beta value for the cost is β = 0.096, p= 0.074, followed by attitude (β = 0.121, p= 0.084), information, knowledge, and awareness (β = 0.005, p= 0.945), management and government (β = 0.487, p= 0.000) and technology and training (β = 0.179, p=0.008). Therefore, it shows that management and government is the most substantial independent variable influencing the intention to adopt green building technology compared to other independent variables.

Consistent with previous studies, this study confirms the significant association between determinant factors and the intention to adopt green buildings. First, previous studies highlighted that green development requires higher expenses than conventional structures (Dwaikat & Ali, 2018). Many building materials that make the house more durable and resistant to heat and cold are costly. More complicated or sophisticated systems that reduce energy dependencies - such as photovoltaics and solar panels can be costly. Thus, this study recommends that the government or stakeholders help support green building development. For instance, some banks have started their initiatives in preferential financing for recognized

properties to promote the popularity and interest in green buildings. One is Commerce International Merchant Berhad (CIMB), which offers preferential rates and lower financing for those recognized by GBI, GreenRe, LEED, or BCA Green Mark. Second, supporting studies such as Guribie et al. (2021) and Zhang et al. (2018) also confirmed attitude and market influence intention in adopting green building technology. The house developers may not be able to implement green buildings if the community is opting for conventional development. To achieve the objectives of green development, every citizen in Malaysia must make green practices a living culture. Parents have a significant role in educating their children to practice green culture. An effective way to foster awareness about green practices is through educational institutions. This matter needs to be nurtured as early as possible because it will be a determining factor in practicing an environmentally friendly way of life.

Third, support from the previous study, such as Mahat et al. (2019) and Murtagh, Roberts, and Hind (2016), supported that information, knowledge, and awareness influence the intention to adopt green building technology. The concept of sustainability and green building is not only physical but to be applied to the community subtly in educating people to be more open to current technology while also contributing to the reduction in the use of materials that pollute the environment.

Finally, many studies also discovered that management and the government influence the intention to adopt green building technology (He & Chen, 2021; Soon et al., 2017). According to Ajzen (1991), perceived behavioral control directly affects behavioral intention in the TPB model. Notably, examination of the relative strengths of the associations between the independent variables noticeably indicates that management and government ($\beta = 0.487$, $p= 0.000$) can explain the variation in the intention to adopt green building technology. In other words, management and government are the best predictors relating to adopting green building technology. The management and government need to ensure that green buildings ensure occupants are comfortable and safe inside. Architecture, layout planning, lighting, and temperature comfort are essential in ensuring occupants get maximum comfort while contributing to the reduction of carbon dioxide gas. As for the management, green buildings also provide opportunities for companies that want to contribute to corporate social responsibility (CSR)

programs. It helps improve the company's image and reputation while giving the advantage of working in safer and more comfortable conditions.

Promoting green building development needs to be done continuously and effectively. Buildings worldwide use large amounts of energy and have caused waste of energy and pollution. The concept of green building is new to the construction industry because it requires management, maintenance, good use of materials, and energy management. This concept has just been introduced in Malaysia and is increasingly popularized in the industrial sector. It is one way to increase energy use efficiency, reduce pollution and waste, and preserve the environment. Green buildings are characterized by environmentally friendly construction technology, which is increasingly popular in most office and residential buildings. The study conducted by the Building and Construction Authority (BCA) and the National University of Singapore has found that buildings with Green Mark certification can retain PM2.5 particles and other fine particles, such as bacteria and fungi, due to having better filters. A survey also found that the residents were more satisfied with the building's temperature, humidity, light, air quality, and environment (Agensi, 2017).

CONCLUSION

This study aims to identify the influence of five selected determinants: cost, attitude, information, knowledge and awareness, management and government, and technology and training towards adopting green building technology. Second, this study aims to identify the most significant predictor of the intention to adopt green building technology. The results of the Pearson Correlation test have shown a significant relationship between five selected determinants towards intention to adopt green building technology, and the most dominant factor was management and government. The study makes significant theoretical contributions to the TPB and green development literature. First, using data from 330 respondents, the study further examines the empirical validity of TPB adoption. Secondly, this study provides the existing literature on green building adoption with reliable empirical evidence in a developing economy such as Malaysia—the context has not yet received much attention from scholars. However, several limitations have been identified. The first limitation of this study is the small sample

size, and future studies should use a larger sample size to retest the results in a similar context. Secondly, the generalization of the findings is limited due to the data collected in Malaysia only. Future research should expand the scope of the investigation to validate and generalize the current findings. Finally, this study only focuses on green building adoption intention from the five determinants perspective; it would also be worth carrying out future research by widening the current model more comprehensively.

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CONFLICT OF INTEREST

No conflicts of interest to declare.

AUTHOR CONTRIBUTIONS

All authors conceived the original idea. All authors discussed and agreed with this paper's focus and ideas. The data were collected and analysed by Noor Syazwani, A. and Nur Syairah, A. H. and the paper's main text were written and performed by Nurul Hidayana, M. N.

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