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Green Building Implementation Challenge for Housing from Developer Perspective in Indonesia

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Abstract
The purpose of this study is to examine the challenges of implementing green building concepts for residential buildings from the developer's point of view. Nowadays, housing provision in Indonesia highly depends on the property developer. Hence, the role of property developers in implementing green building concepts in residential buildings is incredibly significant. Data collection was conducted by sending questionnaires to various developers in Indonesia. The result shows that the main challenges in executing the green building concept are the lack of forceful regulations followed by a lack of market technology and training. In addition, during the implementation process, it was discovered that all developers had applied certain green building strategies, such as green area provision, site selection close to public facilities, natural lighting design, and ventilation design.

Keywords*: developer perspective; green building; green building strategies; housing; implementation challenges; Indonesia*.

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1. INTRODUCTION

The global population now exceeds 7.8 billion people, with an annual growth rate of approximately 1.1 percent (United Nations, 2021). Indonesia is currently the fourth-largest country in the world, behind China, India, and the United States, with a population of over 270 million that is expected to increase gradually each year. This increase in population will result in the need to provide more housing in the future.

The building and construction industry accounts for 36% of global final energy consumption and 39% of the global carbon footprint (IEA, 2017), mostly from residential buildings (IEA, 2019). Approximately 42% of on-grid electricity is consumed by households in Indonesia, which is higher than industrial (33%), commercial (25%), and is expected to grow due to population growth (Secretariat General of the National Energy Council, 2019). The high residential energy consumption in Indonesia' is affected by household lifestyles such as appliance ownership, income, occupation, family pattern, and residential location (Sukarno et al., 2017).

Green buildings may significantly contribute to the realization of global sustainability. In the context of Sustainable Development Goals, green building has higher integration with SDG6, SDG7, SDG9, and SDG17 (Goubran & Cucuzzella, 2019). It has also been demonstrated that green building strategies play

a crucial role in achieving UN Sustainable Development Goals, such as water and energy efficiency (Alawneh et al., 2018, 2019), and building materials (Omer & Noguchi, 2020).

Nowadays, housing provision in Indonesia highly depends on the property developer. As a result of the convenience of getting financing support from banks, buying a ready-to-move-in house or apartment is more desirable than building a customized house. Therefore, property developers play a crucial role in implementing green building concepts in residential buildings.

The concept of green building is intended to create a liveable building that meets the minimum standards for safety, health, and adequate space. Green buildings, according to the Green Building Council Indonesia (GBCI), have several criteria that aim to create environmentally friendly living behaviour for its occupants, including Site Development, Energy, Water, Material, Indoor Health and Comfort, and Management (GBCI, 2014).

Currently, the assessment of residential buildings under GREENSHIP certification may be conducted using the GREENSHIP New Building or GREENSHIP Existing Building for a multistorey apartment building, GREENSHIP Homes for a single house and GREENSHIP Neighbourhood for a housing area. Despite the green building certification is not required for every residential building in Indonesia, this research focuses on the implementation of the green building concept and not the certification itself.

Research on green building concept implementation focusing on residential buildings or housing is still limited, especially in developing countries like Indonesia. The current study uses mid to high-rise buildings as the case of green building concept application and assesses only one criterion, especially energy efficiency (Ghaffarianhoseini et al., 2013). Moreover, residential property research uses a mix of case studies with other building functions, only focuses on cost and barrier to adoption in terms of green technologies (Zhang et al., 2011).

In addition, studies related to green building implementation in Indonesia have been explored only on the stakeholders' knowledge of the green building rating system (Berawi et al., 2019), policy (Wiryomartono, 2015), the role of stakeholders (Sahid et al., 2020), implementation plan (Hatmoko et al., 2017) and barrier from building occupants perspective (Wimala et al., 2016). However, no study ever explored in detail the barrier faced by the developer in the green building implementation process, despite the fact that previous research has indicated that developers play the most significant role in green building implementation (Sahid et al., 2020). Hence, this research focuses on exploring green building implementation challenges, especially for housing from the developer's perspective.

This study aims to investigate the challenges in implementing green building concepts for housing from the developer's point of view. The study's results will show the level of challenges faced by developers and the green building strategies commonly implemented by them. As a result, various stakeholders can play their respective roles in promoting the implementation of green building concepts for housing.

In order to determine the most effective method of data collection through structured questionnaires, a preliminary literature study was conducted to collect information about general barriers in green building design and strategies commonly applied. This would serve as a comparison for future analyses, besides current studies have been conducted on various building types or climate conditions.

2.1 Green Building Challenges Attributes

The development phases for green buildings can be divided into four groups, (1) site selection, (2) planning and design, (3) construction, and (4) operation and maintenance (Zhang et al., 2011). The implementation of green building concepts faces numerous challenges at all stages of development.

Previous research about green building implementation uses various sources and case studies. Following are some literature discussions about the application of green building in (1) Study on residential building

cases, (2) Study on literatures and (3) Study on green building expert opinion.

Study on Residential building cases. Through a questionnaire given to construction players, Zainordin, Nur, & Mohd (2017) classified the barriers into three categories, e.g., time, cost, and knowledge. It suggests that awareness of environmental issues should be increased among stakeholders. Similarly, Zhang et al. (2011) discovered through content analysis on residential buildings that green building properties may face a number of challenges, including higher cost, insufficient policy, technical difficulties, the risk involved, planning and approval process, lack of knowledge and awareness of the green technologies, lack of efficiency of regulation, unfamiliarity with green technologies, and conflict of interest between stakeholders. Additionally, Zhang also made a point about regulation.

Study on Literatures. The regulation issue is also supported by Häkkinen & Belloni (2011), who stated that in addition to the regulation and building code, other aspects that become challenges for green building implementation include the availability of tools, process, economics, awareness of the client, lack of client understanding, designer's competence, slow development of a new concept and lack of knowledge. Additionally, Darko & Chan (2017) studied green building adoption barriers based on literatures and summarized several key factors, including lack of information, cost, incentives, interest and demand, and green building codes and regulations as the most reported barriers.

Study on green building expert's opinion. Chan, Darko, Ameyaw, & Owusu-Manu (2017) concluded that green building experts have identified five categories of general barriers, including technological risk and difficulties, stakeholders' attitudes, knowledge limitation, market limitations and higher cost and information.

From the previous study, the barriers to implementing the concept of green building can be classified into four categories, including (1) regulation, (2) time, (3) cost and risk, (4) knowledge and technology (see Table 1). Under current conditions, these barriers are appropriate due to the lack of local or national regulations. The emergence of new technologies in green buildings also affects the time, cost and risk of the project. In addition, the lack of public understanding of green building concepts leads to lower awareness and conflict of interest among stakeholders.

Table 1. Type of Challenge in Green Building Implementation based on Previous Studies

Category	Green Building Implementation Challenge	Previous Study
Regulation	Planning and approval process	(Zhang et al., 2011)
	Regulation and building code	(Darko & Chan, 2017; Häkkinen & Belloni, 2011; Zhang et al., 2011)
Time	Available product supply and tools	(Häkkinen & Belloni, 2011; Zainordin, Nur, et al., 2017)
	Extra time in the process	(Häkkinen & Belloni, 2011; Zainordin, Nur, et al., 2017)
	Extra time to gain knowledge	(Zainordin, Nur, et al., 2017)
Cost and Risk	High cost	(Chan et al., 2017; Darko & Chan, 2017; Häkkinen & Belloni, 2011; Zainordin, Nur, et al., 2017)
	Low demand for green building	(Chan et al., 2017; Darko & Chan, 2017; Häkkinen & Belloni, 2011; Zainordin, Nur, et al., 2017)
	Lack of incentives/ financing scheme	(Chan et al., 2017; Darko & Chan, 2017; Zainordin, Nur, et al., 2017)
	Risk and uncertainties	(Chan et al., 2017; Zhang et al., 2011)
Knowledge and Technology	Resistance of stakeholders	(Chan et al., 2017; Häkkinen & Belloni, 2011)
	Lack of expertise/ competence	(Chan et al., 2017; Häkkinen & Belloni, 2011; Zainordin, Nur, et al., 2017)
	Lack of knowledge	(Chan et al., 2017; Häkkinen & Belloni, 2011; Zainordin, Nur, et al., 2017; Zhang et al., 2011)
	Unfamiliar with green building technology	(Chan et al., 2017; Darko & Chan, 2017; Häkkinen & Belloni, 2011; Zainordin, Nur, et al., 2017; Zhang et al., 2011)

2.1 Green Building Challenges Attributes

As green building strategy implementation is related to the local climate, hence the acceptable strategies that can be implemented are various. Insulating glass blind technology, double windows, radiant floor heating, solar hot water technology, water reuse, water-saving appliances, floor insulation, and smart home systems are some examples of green building technologies used in residential properties in China (Zhang et al., 2011). In semi-arid climate, the strategies focus on indoor illuminating system, which includes glazing and the use of LED, control system, energy and water conservation system, renewable energy system, energy and water recovery system, air quality system, and a system for maintaining comfort zone temperature (Ahmad et al., 2016).

From the previous research strategies, energy efficiency and conservation have become the focus of green building implementation, followed by water conservation and indoor health and comfort. Common key criteria of green building rating tools include site, energy, water, indoor environment quality, material, waste, pollution, and management (Illankoon et al., 2017).

2. METHODS

Data collection was conducted using a structured questionnaire sent to the developers which were surveyed. Developers who are eligible as respondents must have at least one residential project. The questionnaires were distributed using an online platform from June to August 2020.

The questionnaire was divided into two sections, e.g., green building implementation challenge and green building strategies. The green building implementation challenge is divided into four topics, including (1) regulation, (2) time, (3) cost and risk, and (4) knowledge and technology, which is assessed on a Likert scale (agree-disagree) to investigate the level of difficulties of the challenge (see Table 2). In addition, the implementation of green building strategies was divided into six categories based on the GREENSHIP certification criteria, e.g., (1) site development, (2) energy efficiency, (3) water conservation, (4) material resources, (5) health and comfort, and (6) environmental management, to be answered with "yes", "no" or "do not know" to see the implementation of each green building strategy in practice (see Table 3).

The number of questionnaires returned by developers is 70, with 50 valid responses. Most of the developers surveyed are based in Java, but have projects around Indonesia. Majority of the surveyed developers have both apartment and housing projects (51%), housing-only projects (35%) and 12% have other residential projects such as SOHO and condominiums. The questionnaire's finding included the developers' challenges and the strategies they have been implemented.

Table 2. Green Building Implementation Challenge Attributes

	Green Building Implementation Challenge Attributes
Regulation	R1 - Lack of forceful regulations for implementing green buildings
	R2 - Lack of government support for green building implementation
	R3 - Inadequate green building certification system
Time	T1 - More complex design
	T2 - Extra time for the design process
	T3 - Extra time for the construction process
Cost & Risk	CR1 - High cost of green building
	CR2 - Low market/buyer interest in green building concept housing
	CR3 - Lack of financial support specifically for green buildings
Knowledge & Technology	KT1 - Lack of interest from stakeholders in the green building concept
	KT2 - Resistance to change towards green building
	KT3 - Lack of information and experience with green building concepts
	KT4 - Lack of training related to green buildings
	KT5 - Lack of technology in the market that supports green buildings

Table 3. Green Building Strategy Attributes

	Green Building Strategy Attributes
Site Development	SD1 - Green Area Provision
	SD2 - Site selection close to public facilities
	SD3 - Site selection near public transportation
	SD4 - Stormwater management
Energy Efficiency	EE1 - Electrical sub-metering installation
	EE2 - Natural lighting design
	EE3 - Ventilation design
	EE4 - Renewable energy (e.g. installation of water heaters with solar energy)
Water Conservation	WC1 - Water metering installation
	WC2 - Low-flow sanitary and water fixtures
	WC3 - Rainwater harvesting
	WC4 - Wastewater management system
Material Resources	MR1 - Material reuse
	MR2 - Environmentally friendly material
	MR3 - Prefab material
	MR4 - Local material
Health and Comfort	HC1 - Visual comfort
	HC2 - Thermal comfort
	HC3 - Minimise pollutant
	HC4 - Noise control
Environment Management	EM1 - Environmentally friendly construction activity
	EM2 - Support green activity
	EM3 - Waste management

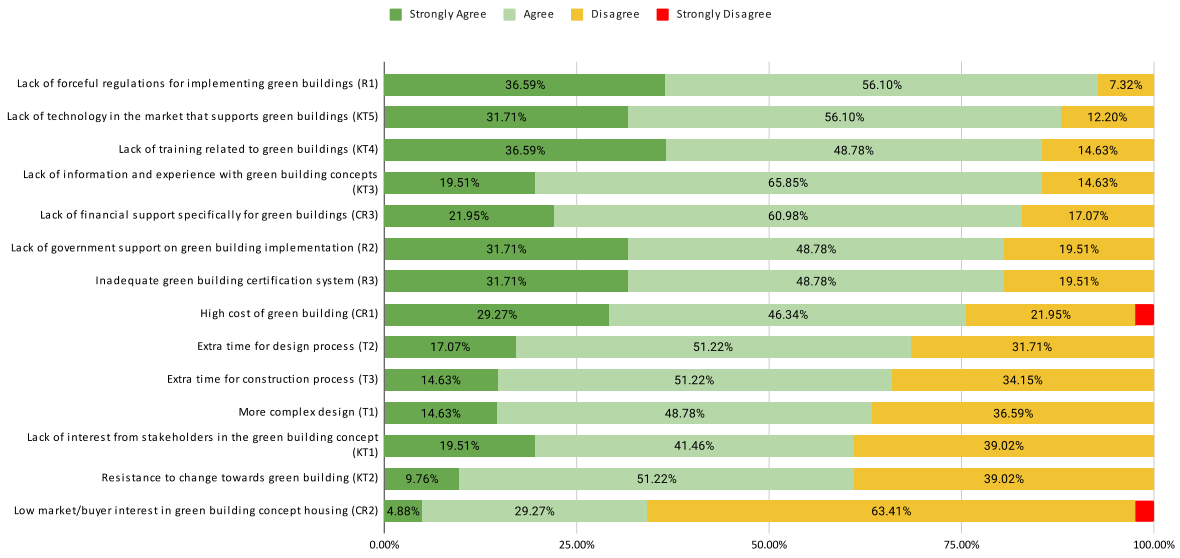

Figure 1. General opinions on green building implementation challenges from a developer perspective (n = 50 developers)

3. RESULT

According to the collected developer opinions, the lack of forceful regulation for implementing green buildings is considered as the biggest challenge by 92.7% (agree or strongly agree), followed by the lack of technology in the market and lack of training by 87.8% and 85.4% developers, respectively (see Figure 1). Low market interest, on the other hand, is the least common challenge in green building implementation, with 34.2% (agree or strongly agree), followed by resistance to change towards green building and lack of interest from stakeholders for 61.0% for both (see Figure 1).

In addition, the most implemented green building strategies (implemented by all respondents) are green area provision, public facilities accessibility, natural lighting design

and ventilation design (see Figure 2). Other commonly implemented strategies (implemented by more than 75% of respondents) include in the site development category (incorporating public transport accessibility and stormwater management), water conservation category (water metering installation), material resources category (local material), health and comfort category (visual comfort, thermal comfort, minimize pollutant, noise control), and environment management category (supporting green activity, and waste management) (see Figure 2). However, less than half of respondents employed material reuse, renewable energy, rainwater harvesting and the use of low-flow sanitary and water fixtures.

4. DISCUSSION

4.1 Challenges faced by the developer in Indonesia

Developers play a significant role in the provision of green buildings. Investigating the challenges that developers face when implementing green concepts could assist various stakeholders in taking their respective roles to overcome the challenges.

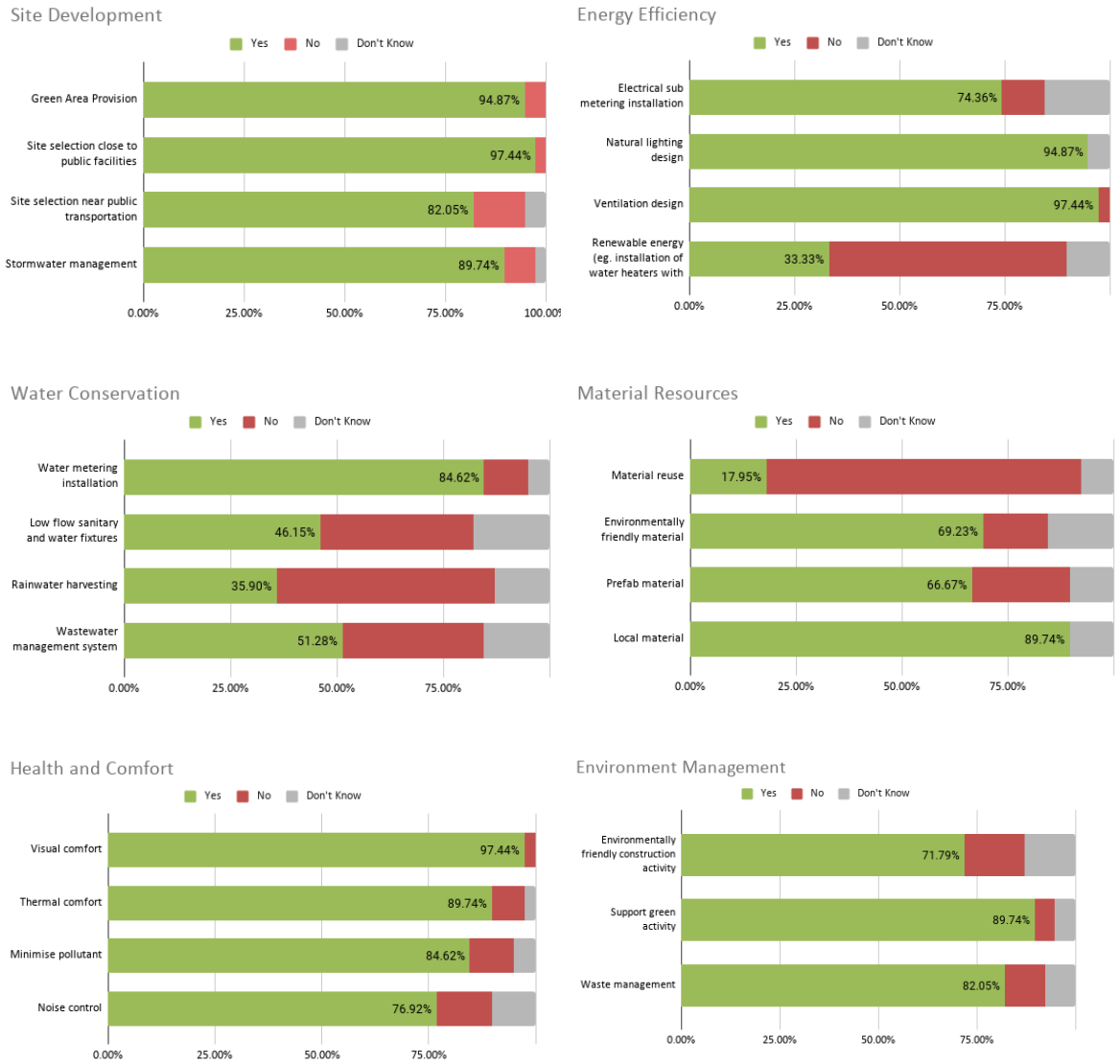

Figure 2. Green building strategies have been implemented by the developers (n = 50 developers)

Forced regulation needs. In this study, the lack of forceful regulation for implementing green buildings is considered the biggest challenge. The government always has a key role in supporting green building implementation, one of them is by issuing regulations. Government-related barriers have been identified as a factor in the implementation of green building technology, especially in a developing country (Chan et al., 2018).

In Indonesia, The Ministry of Environment Regulation No. 08 Year 2010 on Criteria and Certification of Environmentally Friendly Building and The Ministry of Public Works and Public Housing Regulation No. 02/PRT/M/2015 on Green Building are the only national regulations supporting green building implementation. However, in Indonesia, there is no legal consequence for disregarding or not implementing these regulations (Virgayanti, 2017).

The regulation of green building concept implementation for housing in Indonesia based on The Minister of Public Works and Public Housing Regulation No. 02/PRT/M/2015 on Green Building is mandatory for mid-rise to high-rise residential mix-used buildings and recommended for non-simple housing or residential property. Additionally, the certification made by Green Building Council Indonesia (GBCI) is not mandatory and could only encourage building owners or developers to apply green building concepts by obtaining certified labels. Therefore, there are no regulations that enforce the implementation of the green building concept nationally covering all residential building types.

The Governor of DKI Jakarta Regulation No. 38/2012 on Green Building is the only local government regulation that can force buildings in Jakarta by certain criteria to apply the green building standard. Local government plays a vital role in green building implementation, especially because of its responsibility in granting the building permit. However, more powerful national regulations are needed to interfere with the implementation of green building nationwide. Other studies have found that putting the government in charge of promoting green building technology while construction stakeholders adapt to it is the most reliable strategy for implementing it (Chen et al., 2020).

High demand for green buildings. Low market demand was identified as the less common challenge in green building implementation from a developer perspective. In contrast, the findings of this study show that market demand for green building products is not an impediment to developers selling green building products. Recently, a green lifestyle has gained popularity, and people are willing to pay more for a greener product. Understanding green buildings as the better living choice may affect this perspective. Higher homebuyers' knowledge of green building was found to increase their willingness to accept the additional cost of green buildings (Ofek & Portnov, 2020). Developers benefited from green building labels to gain market interest.

In research focusing on energy performance, the big challenge of implementing a green building strategy is the cost due to the application of technologies and renewable energy (Ghaffarianhoseini et al., 2013). In fact, investing in new technology for green buildings, such as energy-efficient appliances and materials, still incurs substantial capital expenses. Despite claims of significant operational cost savings, consumers have yet to accept this. With reliable data, informing consumers or potential buyers of the risks, uncertainties, and benefits of using green technology solutions could increase the concept's acceptability (Häkkinen & Belloni, 2011).

Lack of knowledge, high interest in green building. Other than regulation, knowledge & technology becomes the strongest barrier to implementing the green building concept. Lack of green building training, information, and experience become the main barriers that need to be overcome by the developer. Moreover, the lack of available green technologies in the market becomes an obstacle too from the developer's perspective.

While most of the studies argued that the lack of knowledge and understanding about green building concepts and technology always become a barrier to green building acceptance (Liu et al., 2018), implementation (Darko & Chan, 2017), and resistance from the

stakeholders to change from the use of traditional technologies to newer technologies (Chan et al., 2017). However, based on this study, stakeholders' resistance to implementing the green building concept is not significant, and the interest in implementing green building from the developer perspective is actually quite high. The interest in implementing the green building concept is still quite high although their lack of green building knowledge and skills.

A basic conceptual understanding is essential for implementing green building strategies to drive the attitude toward green building. A study of students in university institutions about understanding green building concepts found that the students lack the real picture of implementation strategies (Zainordin, Wahi, et al., 2017). This condition shows that the educational institutions do not yet promote sufficient understanding of sustainable concepts for the students as future development actors.

Willingness to implement, less financial and government support. From the developer's perspective, the complexity of the design, and extra time in the designing process and construction process are not strong barriers to implementing green building concepts. Achieving a design with good performance and minimum environmental impact is a huge challenge. The need for good collaboration from various actors with different expertise and knowledge is important in the initial stages of the projects (Häkkinen & Belloni, 2011). A close interaction between various stakeholders, including the supplier, professional, and user, is also important to implement integrated information technology in speeding up the working process. However, the additional project cost is very common in a green building project.

Unfortunately, financial support for green building does not exist and government support for green building implementation is quite low. Financial support also becomes a barrier in many other countries. A study in Malaysia, among the professional construction industry, found that the lack of financial support and investment risk are two main barriers in developing green building (Samari et al., 2013). Based on national regulation, currently, incentives can be given for implementing green building in the form of relief from licensing/service fees, ease of licensing, additional building Floor Area Ratio (FAR), technical support/ advice from green building experts, awards and other incentives in the form of publications.

Ineffective certification. An inadequate green building certification system becomes a barrier too from the developer's perspective. Weak legal support for green building results in the low achievement of green building certification bodies in Indonesia (Virgayanti, 2017). At the same time, policy and market forces may play a vital role in shaping the decision of the real estate developer in the design and construction process (Hoffer, 2020).

Since currently, the green building certification is voluntary, legal support from the government green building certification is important to push forward the certification system. Lack of experience and rewards are found to be the biggest barrier for the building owner to take the green building certification (Berawi et al., 2019).

Result comparison with other studies. Compared to previous studies, the challenge faced in implementing the green building concept for a residential building in Indonesia is quite different. Indonesia is in the stage where strong regulation is needed first (see Table 4). Other countries mostly perceive the strongest challenge as the high cost of implementing green technology, the need for financial incentives, and the lack of demand, all of which are in the cost & risk category. The less awareness of green building additional cost while implementing green technology may not be felt by developers in Indonesia since they are not pressured to implement it.

Another challenge in the category of knowledge and regulation was similar to the challenges faced by developers in Malaysia. Increasing developers' understanding of the cost of green technology and the more difficult construction process will undoubtedly improve as their knowledge of green building grows.

4.2 Strategies implemented by the developers in Indonesia

Generally, developers of residential buildings in Indonesia have implemented the green building concept in its most basic form, but they are not yet familiar with advanced systems or technology. Some strategies have been implemented, including providing a green area and stormwater system on-site. Still, advanced water conservation strategies such as rainwater harvesting and low flow water fixture, are not commonly employed yet. Stormwater management is beneficial to prevent flooding and could help preserve the natural hydrological cycle (Huo et al., 2017).

Natural lighting and ventilation for cooling are examples of passive design strategies for energy efficiency that is commonly applied. However, the application of benefit technology, such as solar thermal for water heating, is still limited. The current state of implementing some passive design strategies has had a sufficient impact on health and comfort by taking visual comfort and thermal comfort into account in the building design. In hot-humid conditions, the naturally ventilated building is claimed to comply with indoor thermal quality (Huang et al., 2015).

Local materials are the most frequently used, followed by prefabricated materials and environmentally friendly materials, while material reuse is rare. Building materials have an impact on the entire life cycle of a building, as they contain the most embodied energy and have the potential to be a waste source in the future. As a result, it is critical to design a structure or component of a building that allows for disassembly and reuse (Hopkinson et al., 2018). The recycling of demolition waste (downcycling) has a higher environmental impact than reusing building material components or structures (Assefa & Ambler, 2017).

5. CONCLUSION

This study shows that the main challenge in implementing green building concepts in Indonesia is the lack of forceful regulations, followed by a lack of market technology and training. On the other hand, low market interest becomes the less common challenge in green building implementation. Some of the green building strategies have been commonly implemented by developers, including green area provision and site selection close to public facilities. Also, passive design strategies lead to energy efficiency, including natural lighting and ventilation design, which are more common than advanced strategies such as solar energy.

Table 4. Green Building Challenge Comparison with other Countries

Location	Type of building	Regulation	Time	Cost & Risk	Knowledge & Technology
Indonesia (from this study)	Residential	■	□	□	■
China (Zhang et al., 2011)	*Residential, hotel, office (green technology)	□	□	■	□
Malaysia (Zainordin, Nur, et al., 2017)	Residential	□	□	■	■
Malaysia (Elias & Lin, 2015)	Residential	□	□	■	■
Malaysia (Samari et al., 2013)	not identified	□	□	■	□
Ghana (Chan et al., 2018)	not identified	□	□	■	□

Note: ■ most common challenge, □ less common challenge

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