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Do green features increase housing value in Malaysia?

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Abstract

Purpose – The purpose of this paper is to identify the perception of valuers towards the contribution of green features in residential property valuation. The concept of green housing was designed to reduce the negative impacts on the environment and humans. The cost of green housing is higher than the conventional building and is reflected in the selling price, which is further enhanced by the increasing demand for green buildings in the housing market. Such a scenario could be a challenge to the valuers when they carry out a valuation on housing with green features, as there is a lack of information to guide valuers.

Design/methodology/approach – This study used a quantitative research method. A comprehensive review of the international green rating tools was carried out to ascertain the relative green features in residential buildings. There are 14 green features identified and grouped into four main categories. A total of 147 valid responses were collected by an online platform and face-to-face distribution among licensed valuers in Malaysia.

Findings – The result confirmed that the 14 green features are contributing to the residential property valuation with a reasonable range of adjustment from 2.0% to 6.5%.

Originality/value – The understanding of the range of adjustment for each green feature may provide a guide to the valuer in determining the range of adjustment based on green features associated with residential property in Malaysia. The findings contribute ideas and options to the future development of residential projects by taking into consideration the specific green features that potentially lead to environmental sustainability and building value.

Keywords Residential property, Green features, Range of adjustment, Comparison approach, Valuation

Paper type Research paper

1. Introduction

The construction industry is playing a significant role in the economy of every country because the growth of the construction industry may enhance a nation's economic performance, especially for developing countries (Dakhil, 2013). Although the building and construction industry generates social and economic benefits for the public, it also causes negative impacts on the environment (Shafii and Othman, 2007). With the increase in public awareness of protecting the natural environment, the development of green buildings has become a primary concept in construction activities in recent years (Ding *et al.*, 2018). Several pieces of evidence support the growth of green buildings; for example, green buildings in China have increased from 10 units to 1,092 units between 2008 and 2014 (Zhang *et al.*, 2017), the USA' green-certified projects increased significantly from 2 to 5,557

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between 2000 and 2013 (Sue-Dong *et al.*, 2014), the UK has registered a total of 24,607 buildings for building research establishment environmental assessment method (BREEAM) since 1990 (BREEAM, 2014) in addition to many green developments in other countries.

In Malaysia, the construction of green residential property is recently emerging. Among the few green residential properties are Avantas Residences in Kuala Lumpur, Tropez Residences in Johor Bahru and the Light Point in Pulau Pinang; these and many other green residential projects have proved that the green concept is growing and well accepted by the public. Based on the statistics provided by the green building index (GBI) council, a total of 333 residential new construction projects in Malaysia have registered under GBI before 30 September 2020 (GBI, 2020).

As the residents have begun to consider the benefits of green building and are willing to purchase at a higher price (Hu *et al.*, 2014), the developers are active in proposing the green building development as a competitive advantage in the market and increasing their profit margins (Padgett and Moura-Leite, 2012). According to RICS (2011), professional valuers should continue to improve their knowledge to perceive any new development that may influence the value of the property. Previous studies have emphasised that valuation professionals should incorporate sustainability in the valuation process (Michl *et al.*, 2016; Warren-Myers, 2012). With the increasing market share of green residential property, valuers should consider green features in the valuation process (RICS, 2011).

Pitts and Jackson (2008) mentioned that the comparison approach is the most suitable approach to value property with green features. However, issues arise when applying the comparison approach because it is difficult to find the appropriate comparable properties, and some green features might not be recognised by the official green certificate in the country (Wan Ismail and Abdul Majid, 2015). This can be a challenge for a valuer to deal with the property associated with green features in the valuation process (Geissler and Groß, 2010). Lambourne (2020) has conducted a study to investigate the impact of sustainability features on the residential and commercial property valuation in Abu Dhabi and Dubai. The results of a questionnaire survey reported that the majority (70%) of respondents, which consists of registered valuers and surveyors, perceived that reliable market data is among the challenges for real estate professionals as they are reluctant to add value for green features without evidence. This is consistent with the finding by Michl *et al.* (2016) where data availability was found to be one of the key barriers to integrating sustainability into property valuation. Warren-Myers (2012) highlighted that the issues of limited empirical evidence and limited knowledge among valuers could lead to their incorrect interpretations of strategic research and inappropriate adjustments or comparisons in valuing real estate with sustainability features. Meanwhile, for green buildings that are still in their infancy, the lack of both transactional data and knowledge among valuers were found to be the two major issues associated with green building valuation; as a result, valuers will apply the adjustments that they think to be realistic when valuing green building (Nurick *et al.*, 2015). Hence, the research question that arises in the current context is as follows: What is the percentage of adjustment for residential property valuation with green features in Malaysia when using a comparison approach?

This study aims to identify the perception of valuers towards the contribution of green features in Malaysia's residential property valuation. The scope of this research is limited to the licensed valuers, who are registered with the board of valuers, appraisers, estate agents and property managers (BOVAEP) in Malaysia. The remainder of this paper is organised as follows. Firstly, a brief review of the literature on international green rating tools is given in Section 2, and categories of green features for residential property in Malaysia is given in Section 3. An explanation of the research methodology is given in Section 4. The results and findings are given in Section 5. Section 6 and 7 present the discussion, conclusion and recommendations.

2. International green rating tools

Countries worldwide have established their own standards for the green building assessment because countries have been unable to reach an agreement about the performance target of green building (Dwaikat and Ali, 2018). The World Green Building Council defines green building rating tools as "certification that is used to assess and recognize buildings which meet certain green requirements or standards". Green rating tools cover the evaluation of green building performance based on certain criteria and different building types, including residential and commercial. To identify the green features that are commonly acknowledged in residential property, international and national green rating tools were reviewed. Among them are leadership in energy and environmental design (LEED) adopted in the USA, BREEAM adopted in the UK, green star adopted in Australia, green mark adopted in Singapore and green building index (GBI) adopted in Malaysia.

2.1 Leadership in energy and environmental design

LEED is the green building standard that has been applied most widely around the world (Ding *et al.*, 2018). LEED was established in 1998 and developed by the United States Green Building Council. LEED, as third-party certification, has been accepted by the public to prove the building is designed and built using materials and resources (MR) that reduce negative impacts on humans and the environment (Khashe *et al.*, 2015). According to LEED (2019), more than 94,000 projects in over 165 countries worldwide have used LEED as green building standards and rating tools to evaluate the performance of buildings.

LEED is comprising nine green building assessment criteria for residential property that are integrative process (IP), location and transportation (LT), sustainable sites (SS), water efficiency (WE), energy and atmosphere (EA), material and resources (MR), indoor environmental quality (IEQ), innovation (IN) and regional priority (RP). IP provides an opportunity for the project team to implement the appropriate green strategies during the building construction period to save development costs. LT mainly focuses on the benefits such as amenities for residents and neighbourhood developments during the site selection. The purpose of SS is to reduce the pollution and negative impacts on the environment from the construction activities. Water is one of the vital resources in building operation; thus, WE was included to monitor the water usage and reduce water consumption. EA was applied in a green building to improve the overall energy performance and reduce greenhouse gas (GHG) emissions. MR includes eco-friendly materials used for the building to enhance the building's durability and performance. The adoption of IEQ may improve the occupant's health by reducing indoor air pollutants, providing thermal comfort and enhancing ventilation performance. IN provides an opportunity for the design team to encourage the new design concept in green building. The main purpose of RP is to solve the geographical and environmental issues of a building.

2.2 Building research establishment environmental assessment method

BREEAM, the world's most common method to evaluate green building performance (Ding *et al.*, 2018), has served to encourage the sustainability concept in new projects and existing buildings since it was launched in 1990 (BREEAM, 2014). This assessment method, which was established in the UK and applied widely in European countries such as Spain, Germany, The Netherlands and other countries, is acknowledged as one of the most comprehensive methods to evaluate the green performance of a property (Ding *et al.*, 2018).

According to Doan *et al.* (2017), there are a total of 561,600 buildings certified under BREEAM in 77 countries.

There are 10 sections to be considered in BREEAM assessment of the green building, which includes management, health and well-being, energy, transport, water, materials, waste, land use and ecology, pollution and IN. Management was implemented to ensure the sustainability concept from the building construction to operation. The quality for health and well-being improved occupant's satisfaction from the aspect of health and safety. Also, the adoption of energy-efficient design for residential buildings may reduce negative impacts such as carbon emission and save operation costs over the lifetime of the building. The transport section focused on the improvement of accessibility and local amenities for occupants to encourage the reduction of car usage. The water section aims to minimise the water demand and reduce the water consumption over the building's lifetime. In addition, the material and resources used for the construction should be considered in terms of the impacts on the building's lifecycle and environment. Waste in the BREEAM is to encourage the reduction of waste from the construction activities and waste management for occupants. The land use and ecology for BREEAM are focused on sustainable environment issues in the development site and surrounding areas over the long term. Pollution in BREEAM was applied to control the building's impacts on the environment and to avoid pollution. The innovation part encourages all relevant parties to provide the new green concept to enhance the building's performance.

2.3 Green star

The Green Building Council of Australia (GBCA) is a not-for-profit organisation that was established in 2002 to encourage the development of green concepts and design in construction activities (Morris *et al.*, 2018). In 2003, the green star was launched by GBCA as a standard of measurement to evaluate the green building performance in Australia. This rating tool was also designed to promote a common concept, minimise building's lifecycle negative impacts and increase the awareness of sustainability in the construction industry (Morris *et al.*, 2018). Green star has also been implemented as a green building rating tool in New Zealand and South Africa (Illankoon *et al.*, 2017).

Green star assesses and rates a building based on nine categories, which include management, IEQ, energy, transport, water, materials, land use and ecology, emission and IN. The effectiveness of building management with the implementation of green concepts such as reduction of energy use, environment management and others may enhance the building's performance. High indoor environment quality focused on the improvement of productivity and health for occupants with the appropriate designs. To reduce the energy consumption of a building, the adoption of the energy category may monitor and reduce energy usage and minimise GHG emissions. The transport category in green star encouraged the occupants to use alternative transportation and reduce carbon emissions. The purpose of monitoring water usage may reduce the water demand and encourage the use of non-potable water sources such as rainwater or greywater. The sustainable materials used for the building should be considered during the initial phase and the appropriate strategies applied to handle the waste issues. Land use and ecology are focused on the minimisation of impacts from development sites and protecting the environment through policies and management practices. In addition, emissions due to construction activities were to be controlled. Finally, innovation was a step to provide better ideas or concepts that may contribute to the sustainability of the building.

2.4 Green mark

The Building and Construction Authority (BCA) launched a green building rating tool called green mark scheme in Singapore in January 2005. The design of green mark scheme is based on the tropical climate in Singapore (Liu *et al.*, 2017). It was adopted to encourage eco-friendly construction activities and reduce the energy consumption of a building (Fesselmeyer, 2018). According to BCA (2019), this will support the development of green buildings in Singapore, as environmental awareness is increased among developers, architects and other relevant parties when they begin construction activities.

The criteria of green mark were restructured into five sections, which include climatic responsive design, building energy performance, resource stewardship, smart and healthy building and advanced green efforts. The climatic responsive design mainly focuses on minimizing the building impacts of climate change and protecting the natural environment through management practice. The building energy performance section was intended to improve energy efficiency and reduce consumption through the green design concept. Resource stewardship aims to achieve efficiency with the resources used along with the building's lifecycle. The smart and healthy building provides a better indoor quality environment to enhance human health and well-being. Advancing green efforts in a green mark may help the relevant parties such as architects and developers implement the new green design in the building to enhance the overall building performance.

2.5 Green building index

In Malaysia, the GBI was developed by the Malaysian Institute of Architects and the Association of Consulting Engineers Malaysia in 2009 due to weather conditions, environmental issues and cultural and social needs (Shafiei *et al.*, 2017). The objective of GBI is to promote sustainability in the built environment and improve awareness among the stakeholders of environmental issues; hence, contributing to a sustainable future for the next generations.

GBI assesses a residential building based on six criteria which include energy efficiency (EE), IEQ, MR, sustainable site planning and management (SM), WE and IN. EE as a criterion adopts a suitable design or strategy to enhance the energy conservation performance through the building lifecycle. IEQ provides a comfortable environment for occupants by maintaining the indoor quality of buildings. MR encourages the use of eco-friendly construction materials for the building and promotes a management system to solve waste issues. Good planning under the SM category may improve the convenience of the occupants and reduce the negative impacts on the environment during the building construction and operation. Because water is one of the resources for building operation, the WE concept was mentioned in GBI to minimise water consumption and water demand. Also, IN will encourage the new concept that meets the GBI's objectives to enhance the building's performance.

3. Green features for residential property

Green features that are integrated into the building will be able to enhance the building's overall value. Based on the review of international green rating tools and the GBI in Malaysia, this study has compiled four categories of green features for residential property, which include EE, IEQ, WE, innovation and others (IO).

3.1 Energy efficiency

According to Wang *et al.* (2012), the term "energy efficiency" can be defined as "using less energy without compromising the performance of the building". This means that the building will provide the same level of energy performance with the reduction of energy consumption at the same time. EE is an essential element to achieve an optimum building operating cost. The main purpose of EE is to reduce the energy consumption for a building and lead to a decrease in its overall GHG emissions. Six green features were considered in this category are as follows:

- solar photovoltaic;
- solar shading devices;
- wall insulation materials;
- high-performance glazing;
- green roof; and
- lighting with motion sensor.

3.1.1 Solar photovoltaic. The functionality of solar photovoltaic to generate renewable energy was recognised by LEED, BREEAM, green star, green mark and GBI. According to Singh (2013), solar power is a renewable energy source that absorbs and converts sunlight into electricity directly by using photovoltaic. Solar photovoltaic is a highly recommended system used to generate renewable electricity for residential buildings in Malaysia. Although public awareness of solar photovoltaic is limited, it should become one of the major renewable energy generation sources in the future (Muhammad-Sukki *et al.*, 2011). Some of the housing developers in Malaysia have included solar photovoltaic in their new housing projects for greater competitiveness.

3.1.2 Solar shading devices. A solar shading device is a green feature mentioned by LEED, BREEAM, green star, green mark and GBI. The function of solar shading devices is to block out the direct hot sunlight through the glazing to decrease the overall thermal transfer value of buildings (GBI, 2014). A well-designed solar shading device can minimise the solar heat gain and provide a cooling space to improve the satisfaction and productivity of occupants, particularly for buildings in tropical climates such as Malaysia, Singapore, Thailand and Indonesia. At the same time, it also provides better visual comfort and thermal comfort to the building occupants (Prowler, 2008).

3.1.3 Wall insulation materials. Wall insulation is one of the green designs recognised by LEED, BREEAM, green star, green mark and GBI. Wall insulation is commonly used to enhance the indoor thermal comfort of buildings in countries with tropical climates. According to Meng *et al.* (2018), wall insulation will help reduce energy consumption as lower indoor temperatures will reduce the need for indoor air conditioning. According to GBI (2014), the wall insulation can be improved by using autoclaved lightweight concrete, composite insulated walls, double brick walls and many other options.

3.1.4 High-performance glazing. High-performance glazing is a green feature recognised by LEED, BREEAM, green star, green mark and GBI. Normally, high-performance glazing is used to improve building EE and thermal comfort (Ander, 2016). Some commonly used building glazing in residential properties are tinted windows, low-emissivity glass and other designs.

3.1.5 Green roof. Green roof is one of the green features mentioned by LEED, BREEAM, green star, green mark and GBI. The roof is the main component of the building envelope and important to evaluate the thermal performance of buildings due to the direct solar heat gains from the roof (Ran and Tang, 2018). Empirical evidence from research done by the Malaysian Institute of Architects in 2008 shows that the total solar heat gains from the roof are between 27% and 86%, depending on the different types of housing and different locations. Therefore, green roofs play a significant role in tropical climates such as Malaysia to reduce the cooling demand and improve the building's internal comfort level due to the hot climate (Jaffal *et al.*, 2012).

3.1.6 Lighting with motion sensor. Lighting with motion sensors was recognised by LEED, BREEAM, green star, green mark and GBI to reduce the energy consumption in a building. According to Kandasamy *et al.* (2018), artificial lighting contributes a large amount, which is 29%, to the total energy consumption of an office building. The lighting system with motion sensors can reduce energy consumption because the sensors will switch off the light when there is enough sunlight or when the building is unoccupied. Smart lighting systems may enhance the occupants' satisfaction with the personalised lighting level while harvesting daylight to reduce energy consumption at the same time (Kandasamy *et al.*, 2018).

3.2 Indoor environment quality

IEQ plays a key role in a building because people spend the majority of their time on indoor activities (IQI Global, 2017). A poor indoor environment affects the occupant's comfort and health. Several factors affect the indoor environment quality, such as amount and quality of light, air movement, noise level and other factors (Kamaruzzaman *et al.*, 2017). Thus, the present study includes low-toxicity finishes and furnishing, natural ventilation design, sufficient daylighting and sound insulation design into the IEQ category as part of the green features that contribute to residential property valuation.

3.2.1 Low toxicity finishes and furnishing. Based on LEED, BREEAM, green star, green mark and GBI, low-toxicity finishes and furnishing are some of the green features that are suggested to improve the green building's performance. Traditional housing normally uses more toxic building materials and furnishing materials that consist of volatile organic compounds (VOCs) (Wu, 2012). Empirical evidence of non-industrial building studies found that 60% of the VOCs indoors come from building materials and furnishings (Yang and Chen, 2001). Therefore, non-toxic materials that are produced from renewable or reusable resources are used in green building design (Guidry, 2004) to reduce the harmful impact on occupants' health.

3.2.2 Natural ventilation design. Natural ventilation design is a green design recognised by LEED, BREEAM, green star, green mark and GBI. Natural ventilation design can be defined as "natural forces (e.g. winds and thermal buoyancy force due to indoor and outdoor air density differences) that drive outdoor air through purpose-built, building envelope openings" (Chartier and Pessoa-Silva, 2009). Based on GBI (2014), two types of natural ventilation design are provided in more than 75% of total habitable rooms, which are cross ventilation and stack ventilation. Due to the increase in the awareness of protecting the natural environment, natural ventilation design has become an appropriate method to reduce energy consumption and provide a better quality of the indoor environment for the occupant rather than using a mechanical ventilation system (Walker, 2016).

3.2.3 Sufficient daylighting. Sufficient daylighting is one of the green designs mentioned by LEED, BREEAM, green star, green mark and GBI. Daylighting is an important aspect of green building design. It is "the controlled admission of natural light, direct sunlight and diffused-skylight into a building to reduce electric lighting and [save] energy" (Ander, 2016). The designs of daylight systems for a building include window, facade shading devices, roof lights and atrium spaces.

3.2.4 Sound insulation design. Sound insulation design was mentioned in LEED, BREEAM, green star, green mark and GBI to improve the occupants' comfort level. The consideration of low-frequency noise has become more important due to the increasing occurrence of sound sources such as construction and renovation activities, traffic volume and entertainment equipment in residences (Prato and Schiavi, 2015). According to GBI (2014), the purpose of sound insulation is to encourage and recognise building design with adequate noise attenuation properties to maintain good acoustic insulation, which is measured as a sound transmission class value of more than 45.

3.3 Water efficiency
According to UNWWAP (2018), the worldwide demand for water has increased by 1% every year due to the increase in population, economic growth and consumption style. On the other hand, the availability of water resources on earth showed a reduction due to rapid global development (Zhao *et al.*, 2013). Therefore, WE has become one of the criteria to encourage the water recycling concept and the smart use of water. With the criteria of WE, two green features were adopted in the present study for residential property valuation, which includes water-efficient fittings and rainwater harvesting system.

3.3.1 Water-efficient fittings. Water-efficient fitting is a green feature recognised by LEED, BREEAM, green star, green mark and GBI. Generally, water-efficient fittings will encourage a reduction in potable water consumption through the use of efficient devices. According to Cheng *et al.* (2016), a qualified green building can reduce water usage by approximately 37.6% compared to the conventional building baseline in Taiwan. Several water-efficient fittings are appropriate for residential properties, such as shower heads systems and hot water diverters, among others.

3.3.2 Rainwater harvesting system. Rainwater harvesting system was mentioned by LEED, BREEAM, green star, green mark and GBI for residential properties. Based on the Department of Statistics (2017), Malaysia is a tropical country with high annual rainfall ranging from 1,397.8 mm to 5,423.0 mm. Such a scenario provides support to rainwater harvesting system as a suitable green feature for residential properties in Malaysia. Rainwater harvesting system will lead to a reduction in potable water consumption (GBI, 2014). This system requires separate water storage tanks and additional pressure-boosting equipment to maximise rainwater collection from the rooftop. The use of rainwater harvesting system is an important part of sustainable development, as it can encourage the reuse of water and decrease the demand for public water supply (Li *et al.*, 2010). One of the examples in Malaysia is from Sunway Group, who has installed this system in their residential projects such as Sunway Serene, Sunway Mont Residences and other residential projects (Ch'ng, 2017).

3.4 Innovation and others
Innovation of building is a new concept and technology—designed to improve a building's performance from the aspect of reducing consumption as well as costs and improving green practices (Toole, 1998). Therefore, IO may encourage the development of new designs in a green building. In this study, building passive cooling design and other innovations were considered to be important green features for residential properties in Malaysia.

3.4.1 Building passive cooling design. Building passive cooling design is a green design recognised by LEED, BREEAM and green mark. According to Prieto *et al.* (2018), the passive cooling features are the first step for a building to reduce building energy consumption and ease the issue of increasing temperature worldwide. There are some building features that can be considered in building design to achieve passive cooling, such as an evaporative cooler, incorporating the natural ventilation design with night purge ventilation, internal solar heat control and other building features (Panchabikesan *et al.*, 2017; Prieto *et al.*, 2018).

These building features provide a conducive thermal environment for occupants by reducing the cooling energy demand (Saffari *et al.*, 2017).

3.4.2 Other innovations. Other innovations constitute a new green design concept mentioned in LEED, BREEAM, green star, green mark and GBI. According to GreenRE (2017), other innovations include the aforementioned green features as well as innovating the building with a certain eco-friendly design that may extend the life cycle of the building and increase the building's efficiency in terms of reduction in the use of energy and water. There are several other innovations that can be considered for implementation in residential properties, such as the installation of energy-smart plugs, waterless urinals and other innovative designs to enhance the green residential building's performance.

4. Materials and methods

This study adopted a quantitative approach to assess the contribution of green features towards residential property valuation in Malaysia. Literature review of national and international green rating tools provides the fundamentals for identifying relevant green features in residential properties. A questionnaire survey was conducted among the valuers in Malaysia to solicit opinions about their consideration of green features in residential property values.

4.1 Measures

A questionnaire survey form was used as an instrument to gather the data required in this study. The questionnaire survey form consists of two parts. The first part, *Part A*, consisted of a list of questions on the demographic background of the respondents, including gender, working sector, years of working experience and other relevant details about the respondent. The second part of the questionnaire is to identify the contribution of green features in residential property valuation in the percentage of adjustment when using a comparison approach. There are a total of 14 green features included in this section. The respondent is required to state the range of adjustment in percentage for each green feature. Figure 1 shows the example question in the second part of the questionnaire.

Before proceeding to the distribution of the questionnaires, questionnaire pre-testing was carried out to gather feedback regarding the weakness of the questionnaire design (Kasunic, 2005). In this study, a total of 15 sets of questionnaires were distributed among the professionals in this field to ensure that they were able to understand the questions clearly, avoid grammatical errors and suggest any improvements for the questionnaire design if any seemed appropriate. Based on the pre-testing result, some grammatical errors were identified. The questionnaire has been revised accordingly and distributed as the final field survey among licensed valuers in Malaysia.

4.2 Procedures

The targeted respondents in this study are licensed valuers who are registered with the BOVAEP in Malaysia. Based on the valuer member listing obtained from the BOVAEP, a total of 967 valuers were registered in Malaysia as of 2019. Because all the licensed valuers

		Minimum (%)		Maximum (%)
	Category 1 : Energy Efficiency			
i	Solar Photovoltaic	____________	to	____________

Figure 1.
Example of question in questionnaire

in Malaysia were included as the targeted respondents, no sampling method has been applied in this study. The questionnaire survey forms were distributed to the respondents by two channels: online platform and face-to-face distribution. The online platform known as Survey Monkey was applied to distribute the questionnaire through email to the licensed valuers. A total of three reminders were sent out every two weeks after the questionnaire distribution to follow up regarding their responses. In addition, face-to-face distribution was conducted at a few valuation firms in the southern region. Multiple distribution channels were used to increase the response rate due to the widespread population of licensed valuers in Malaysia, covering the states of Selangor, Federal Territory of Kuala Lumpur, Penang, Terengganu, Perak, Kedah, Kelantan, Negeri Sembilan, Pahang, Melaka, Johor, Sabah and Sarawak.

When the targeted questionnaires were collected from the respondents, data was keyed into Microsoft Excel. Incomplete responses were recorded as void and excluded from the data analysis. The data includes the demographic background of valuers and the percentage of adjustment for each green feature when using a comparison approach for this residential property valuation exercise. The data gathered from the targeted respondents were summarised and analysed by frequency analysis.

5. Results and findings

A total number of 147 valid responses were gathered for data analysis. Frequency analysis is adopted to present the results of the demographic background of respondents. Table 1 shows the demographic profile of the respondents. The demographic information included their designation, gender, working sector, and their experiences in the valuation of residential properties with green features.

Based on Table 1, the designation of respondents may reflect the difference of respondents in working experience and level of knowledge. A total of 147 respondents are

Demographic background	N
Designation	
Licensed valuer	147
Gender	
Male	101
Female	46
Working sector	
Government sector	36
Private sector	111
Years of working experience	
Less than 5 years	4
5–10 years	30
11–15 years	60
More than 15 years	53
Years of working experience for residential property valuation with green features	
Less than one year	67
1–3 Years	41
4–6 Years	22
More Than 6 Years	17

Source: Questionnaire survey by researcher

Table 1. Demographic profile of respondents

licensed valuers who have experience in residential property valuation. Most respondents (111) come from the private sector, and the remaining 36 respondents are from the government sector. In addition, a total of 101 respondents are male, and 46 respondents are female. Regarding their year of working experience, the majority of the respondents, which is 97%, have more than five years of working experience in the residential valuation; 20% of the respondents had 5–10 years of working experience, 41% of respondents had 11–15 years of working experience and 36% of respondents had working experience of more than 15 years. To determine the reliability of responses, more than half of the respondents have experience in carrying out the residential property valuation with green features. The development of residential property incorporated with green features is still young in Malaysia. Accordingly, 28% of the respondents have one to three years of experience in valuation exercise for the residential property with green features, about 15% of the respondents have four to six years of experience, whereas only 12% of the licensed valuers have more than six years of relevant experience. Because almost all of the respondents (97%) have more than five years of experience in conducting valuation exercises for residential property in Malaysia, their opinion and insights in proposing a practical range of adjustment for the residential property with green features are valuable.

5.1 Contribution of green features in residential property valuation by using comparison approach

The perceptions towards the green features were gathered and analysed. Table 2 presents the result of the percentage of adjustment for these 15 green features when using a comparison approach to value residential property in Malaysia.

According to Tan (2012), the results of the study proved that the green features that affect property market value are focused on EE. The energy-efficient category of green features has recorded the highest range of percentage 2%–6.5%. Among the green features in the EE category, the licensed valuers in Malaysia are of the opinion that the range of adjustment for green roof features is 3%–6.5%. Other green features such as solar

	Green features	Range (%)
A	*Energy efficiency (EE)*	
	Solar photovoltaic	3.0–6.0
	Solar shading devices	2.0–6.0
	Wall insulation materials	3.0–6.0
	High-performance glazing	3.0–6.0
	Green roof	3.0–6.5
	Lighting with motion sensor	2.0–5.0
B	*Indoor environment quality (IEQ)*	
	Low-toxicity finishes and furnishing	2.0–5.5
	Natural ventilation design	2.5–5.5
	Sufficient daylighting	2.0–5.0
	Sound insulation design	2.0–5.0
C	*Water efficiency (WE)*	
	Water-efficient fittings	2.0–5.0
	Rainwater harvesting system	2.0–5.0
D	*Innovation and others (IO)*	
	Building passive cooling design	3.0–6.0
	Other innovations	2.0–5.0

Table 2.
Range of adjustment for each green feature

photovoltaic, wall insulation materials and high-performance glazing recorded a slightly lower range of adjustment from 3% to 6%. Besides, lighting with a motion sensor is the green feature that showed the lowest range of adjustment, which is 2.0%–5.0%.

For the IEQ, all the green features under this category showed a contribution to the residential property value with the range of adjustment from 2.0% to 5.5%. The features of sound insulation design and sufficient daylighting in the indoor environment were given consideration of 2.0%–5.0% adjustment. Among the four features categorised in the IEQ category, natural ventilation design has gained the highest range of adjustment of 2.5%–5.5%.

Compared to the EE category, the water-efficient category has shown less contribution to residential property value. The licensed valuers suggest that the range of adjustment for water-efficient-related features such as the water-efficient fittings and installation of the rainwater harvesting system may contribute to an adjustment of not more than 5%, whereas the range of adjustment for both green features is recorded at a range of 2.0%–5.0%. Building passive cooling design under the IO category has been assigned as one of the green features considered to have a higher contribution in residential property valuation, with the range of adjustment of 3.0%–6.0%.

6. Discussion

Currently, the green building concept is still at an emerging phase in Malaysia compared with other nations such as the UK, the USA and Australia. Because the development of green building has become a primary concept in construction activity (Ding *et al.*,2018), many green residential projects have been launched in different areas such as Johor Bahru, Pulau Pinang, Kuala Lumpur and other states in Malaysia, proving that residents have accepted the developments with green features. Hence, the valuers should consider the green features in deriving the property market value, which depends on the green features that are generally accepted by the real estate participants in the market (Runde and Thoyre, 2010).

Prior studies have noted the importance of green features in residential property value. For instance, a study conducted by Wan Ismail and Abdul Majid (2015) showed that a number of green features contribute to the property value in certain valuation approaches, which include an income approach, a comparison approach and an investment approach. A study conducted by Nurick *et al.* (2015) among the professional valuers in South Africa has recognised the need to incorporate green features in the valuation exercise of commercial property. These green features consist of the characteristics of reducing building maintenance and operation costs, improving human health and productivity and flexibility designs. The results of this study show a consistency with the previous study where all the green features identified are concluded with a specific range of adjustment. The respondents agreed that these green features should be associated with a certain amount of value increment.

Overall, the results of this study show a reasonable range of adjustment for each green feature from 2.0% to 6.5%. For the EE category, the range of adjustment is slightly higher compared with the remaining category, which ranges from 2.0% to 6.5%. Each of the green features under this category account for up to 6% of adjustment except for the feature of lighting with motion sensor, which is accepted with a maximum of 5% adjustment in value considerably. Among these features, the green roof is the feature that allowed the highest percentage of adjustment, which is up to 6.5%. The rationale is that these two features require expensive costs of installation. Additionally, the advantage of potential energy cost reduction resulted in added value to the subject property. Also, since 1 January 2019, the Malaysian government has created certain policies designed to encourage residents to install solar photovoltaic panels (Carvalho *et al.*, 2018). Such a scenario will stimulate the growth of solar photovoltaic installation in Malaysia in the future. Other features such as solar photovoltaic, solar shading devices, wall insulation materials, high-performance glazing and building passive cooling design are the green features that gained up to a maximum of 6% adjustment. These green features improve the thermal comfort performance for occupants (Ander, 2016; Jaffal *et al.*, 2012; Zain *et al.*, 2007) by minimising energy consumption, hence contributing to a higher property value.

A slight conservative range of adjustment exists for the features of IEQ and WE compared with EE. The accepted range of adjustment for the features in relation to IEQ is from a minimum of 2% to a maximum adjustment of 5.5%. The design of indoor environment quality mainly focused on the social benefits rather than economic benefits, which are increasing values to environment quality and human productivity and health (WBDG, 2018). Although water-efficient green features can save costs and reduce water consumption for a building operation, it is considered to have less contribution to residential property value due to the cheaper water tariff in Malaysia (Chan, 2009). Therefore, the range of adjustment for water-efficient fittings and rainwater harvesting systems lies within a range of 2%–5% only. In fact, the installation of these features does not focus mainly on profitability or cost efficiency, but it provides an environment-friendly image to the building and property (Sousa *et al.*, 2019).

According to Bently *et al.* (2015), the valuation of property with green features should depend on the public perceptions and acceptance of these features. Among the 14 green features, 6 green features showed a higher contribution (6%–6.5%) in residential property value, which are solar photovoltaic, solar shading devices, wall insulation materials, high-performance glazing, green roof and building passive cooling design. Based on the valuers' perception, these green features can reduce thermal discomfort and minimise energy use and were considered well accepted by the public in Malaysia due to the hot climate condition. Referring to the Malaysia GBI assessment, these green features play a significant role with higher assessment points in green building evaluation. In addition, a study conducted by Shazmin *et al.* (2017) has confirmed that the green roof and solar photovoltaic are both green features that could increase the building value in Malaysia.

7. Conclusion

The study has proposed the green features contribution, which could be associated with adjustment consideration in the comparison approach of residential property valuations exercised in Malaysia. The economic and environmental benefits that potentially derive from the residential property with green features should be reflected in its market value. The added value by the green features can be translated into some percentage of adjustment in valuation exercise by comparison approach. Results from the questionnaire survey among the licensed valuers show important findings regarding their agreement that the identified green features contribute to the value of the residential property with a reasonable range of adjustment. Some of the professional valuers might encompass limited knowledge and skills on sustainability assessment. The proposed range of adjustments serves as a reference guide to the valuer in providing a reasonable rate of adjustment based on the green features, thus minimising the risk of making inappropriate adjustments. This study proposed the adjustment percentage in a range for the rationale that each type of green feature in the market exists with different specifications and is priced according to its technical specification. The valuers will allocate a specific percentage of adjustment based on its unique characteristics and available evidence.

A total of 14 green features relevant to the context of residential housing in Malaysia have been proposed with a range of adjustments from a minimum of 2% adjustment to a maximum of 6.5% adjustment for each feature. The findings of this study may serve as an important guideline for the valuers to carry out the residential property valuation with green features because they may lack knowledge and experience in the relevant aspects because the development of residential property with green features is still young in Malaysia. The relative range of adjustment for green features identified in the present study may be of assistance to the residential property valuation in Malaysia. A limitation of this study lies in the scope, which is limited to the residential properties in Malaysia only. The list of green features identified in this study can be extended in parallel to the development of green residential projects in the future.

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