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A MULTIDIMENSIONAL ASSESSMENT FRAMEWORK FOR HOUSE BUYERS' REQUIREMENTS OF GREEN HOMES

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ABSTRACT

Developers are one of the construction industry players that looking into occupants' needs during the housing development processes. The growing awareness on the need of sustainable or green construction practice become a cornerstone to built better environment which fulfill the occupants' needs in the modern era without sacrificing the environmental protection, preservation and conservation. This paper aims to develop a multidimensional assessment framework for house buyers' requirements of green homes in the Malaysia housing development. The framework could answer a multitude of problems in developing green homes in Malaysian housing industry. Sample of the study is defined as house buyers who attended property fairs in six states and one federal territory in Malaysia, namely, Kedah, Penang, Kelantan, Melaka, Johor, Sabah and Kuala Lumpur. The respondents were selected through the convenience sample technique. Out of 2600 questionnaires distributed, 1642 were answered and returned with a response rate of 63 per cent. The data was analyzed by utilizing descriptive statistic, factor analysis, correlation, and multiple regression analysis. This study found that green homes consist of six main elements, namely community design and planning, efficient usage of resources, use of alternative resources, natural system, protection and safety, and reusing and recycling approach. The result shows that better requirements of green homes among house buyers in Malaysia towards higher implementation of green home principles. The multiple regression analysis shows that all the variables could significantly foresee the house buyers' requirements of green homes of house buyers in Malaysia.

Keywords: green homes, framework, buyer's requirement.

INTRODUCTION

The government has put high priority in providing better houses that meet all requirements and visions of current and future generations in Malaysia along with sustainability objectives. Therefore, developers who are responsible in housing provision need to firmly understand on the green homes concept and development rather than blindly embark on this kind of development.

The green home concept is part of a sustainable development; the concept focuses on costs and energy saving, preserving natural resources, and providing comfort to the occupants. A part of the concept, recycling has been implemented for many years ago, but not by every household. According to Oktay (2002), housing industry should satisfy both; the need for a shelter and the need for sustainability. Therefore, most developing countries do not just face a similar problem in building environmentally friendly premises; they also have a mutual problem in meeting the prerequisite needs of house buyers. All aspects in site and building designs should be critically considered.

Many researchers had discussed the problems plaguing the housing industry and green-related technology issues. Essa, *et al*. (2007) assert that the efforts face the challenges posed by the housing industry should be unified and consolidated in order to meet the sustainability objectives of the industry. Lowrey (1995) argues that research on both green marketing and green consumers suggest that most green concepts are notoriously difficult to apply. Furthermore, Al-Temeemi and Harris (2004) observe that the two most pressing problems are the energy crisis and the world's increasing demands for sustainable houses.

Thomark (2002) points out that the main focus of construction industry is building houses or buildings in general that are environmentally friendly. This suggests that Malaysian housing developers should apply the sustainability concept to ensure a harmonious life for everyone in the country.

This paper attempts to develop a framework or model that will enable a massive development of green homes in Malaysia. It focuses on the green home aspects that suit the Malaysian environments. Dangelico and Pujari (2010a) argue that environmental policies and documentation of green standards are needed as guidelines for housing developers to ensure that green products actually meet the requirements to be environmental friendly. Similarly, in the developed countries, architects, developers, contractors and owners are given proper guidelines so that they can easily build up sustainable houses.

This study attempts to develop a multidimensional assessment framework/model for house buyers' requirements of green homes in the Malaysia housing development. This research has been based on a premise that current frameworks or models of green homes have not been implemented in whole Malaysia. Hence, both sides of the existing market will be studied: the providers (consist of property developers, contractor and construction consultants) and the house buyers.

SUSTAINABLE DEVELOPMENT

A sustainable development is a "development which meets the needs of the present without compromising the ability of future generations to meet their own needs" if referred to Brundland Report (Vouvaki and Anastasios, 2008). Walsh, *et al*. (2006) believe that the meaning of sustainability is the word 'sustainability' implies limits; the use of resources by urban residents must be related in some way to the constraints imposed by nature, society, or the functioning of the planet.

According to Chen, *et al*. (2005), to ensure a sustainable future for the world, one important challenge for developing countries is to amend the old vision of development models and adopt more environmental awareness. A housing development involves some criteria of sustainability requirement and encompasses the use of materials, energy, and water (Walsh, *et al.*, 2006). Therefore, Simula, *et al.* (2009) mention that to create solutions in terms of demands, housing developers should pay more attention on green perspectives since the early design and technology-selection phase. Financial incentives should be given to developers and the benefits to customers must be explained. The current literature demonstrates that awareness is the key to sustainable developments in developing countries.

GREEN HOMES

Currently, green home in Malaysia become a main agenda in the provision of housing to the public which aims to meet environmental requirements and create a comfortable zone for occupants. Green home aspect also helps developers conserve the environments and use their resources efficiently. Ismail (2012) define green homes as completed homes that fulfilled current occupant needs without compromising the future generation requirements.

GREEN HOMES CRITERIA

In this study, the criteria of green homes become the main reference in identifying the house buyers' requirements. This is in line with recommendation put forward by Ding (2008) which states that environmental building assessment methods will be useful as a design tool if it was introduced as early as possible in the development process to allow for early collaboration between the design and assessment teams. The findings of the study will serve as a guideline in elaborating the requirements of Malaysian house buyers for green homes. The following section discusses the green homes criteria; community design and planning, efficient usage of resources, use of alternative resources, natural system, protection and safety, and reusing and recycling approach.

COMMUNITY DESIGN AND PLANNING

This aspect has been represented by 4 categories, namely public infrastructure, community design, design for safety, and adaptable building.

Public infrastructures

According to Walsh, *et al*. (2006) there is a desire for transportation among house buyers to help them overcome the distance that separates their homes from places where they work, shop, seek medical attention, go to school, do business, or visit friends and relatives. In site selection, the infrastructures that already exist will influence the environment, the economy and social activities in new developments area. As a consequence, providing sustainable housing cannot be accomplished without providing an adequate transportation system. In this regard, Walsh, *et al*. (2006) and Omer (2007), claims that building and urban design patterns will influence the requirements of energy for transportation activities. The recent study shows the importance of infrastructures in green homes or sustainable housing areas. The completion of infrastructures in the sustainable community area will save a lot of energy and conserve the environment through efficient planning and design.

Community design

Sanoff (2000) has defined community design as involvement of local people in the social and physical developments of the environment they are living in. According to Toker (2007) sustainability is one of the major characteristics of community design. Human and organizational needs have to be too understood because the benefits of green home demand a broader perspective that links building design, organizational performance, and human factors research (Omer, 2008). According to Wedding and Crawford-Brown (2007), sustainability is one of the key elements that could bring more meaningful to our life with healthy, harmony, and quality of life.

Design for safety

There are multiple procedures of crime prevention have been implemented to ensure safety and security of public in the housing community. Natural surveillance has been practiced in Crime Prevention through Environmental Design (CPTED), Secured by Design (SBD) and Defensible Space (DS). Cozens (2002) defines natural surveillance as a crucial dimension since criminals do not generally wish to be observed and apprehended. The configuration of physical features, activities and people, in ways that maximize opportunities for surveillance can act to discourage crime. Desyllas *et al*. (2003) also define natural surveillance as the overlooking of public spaces by members of the public in the course of their day-to-day lives.

Adaptable building design

Adaptable building design in the green homes criteria consist three main features that are generality, flexibility and elasticity. Arge (2005) and Moffat (2001) elaborate these three features as follows:

a) Generality: ability of a building to meet changing functional users' or owners' needs without

changing its properties. The most important measures giving high generality in office buildings are:

- Building width - allowing different work place designs or solution;
- Floor to floor height net - allowing different work place designs or solutions, for example, work stations across the whole floor; and
- Technical grid - allowing different work place designs or solutions.

b) Flexibility: ability of a building to meet changing functional users' or owners' needs by changing its properties easily. The most important measures giving high flexibility in office buildings are:

- Modularity - the most commonly used flexibility measures in buildings;
- Plug and play building elements - allowing fast changes of layouts or technical service parts; and
- Flat and soundproof suspended ceiling - contributing to rapid and easy moving of internal walls.

c) Elasticity: ability of a building to be extended horizontally or vertically. The most important measures giving high elasticity in office building are:

- Building form or organisation of space - allowing parts of the building to be used by different organisations or user groups;
- Functional organisation - separating function with different functional performances, allowing for the building to be used by different organisations or user groups;
- Fire sprinkling - allowing the largest continuous space unit; and
- EIB/ Lon Works - easing changes in the configuration of spaces to be rented or sold.

EFFICIENT USAGE OF RESOURCES

This element is aim to conserve the environment, prudent use of resources and reduce the financial cost on development. The resources that are always addressed in the green construction practice are water, energy and materials.

Water efficiency

Water is very important to human daily lives. Water scarcity may impact society in different ways: for example, it can limit both population and economic growth, endanger wildlife and reduce the domestic gardening for home-grown food (Ryan, *et al*., 2009). The growing scarcity and rising cost of water have led to the awareness that water has to be allocated and used in efficient ways (Grimble, 1999).

Energy efficiency

Malaysia has various energy policies including the National energy policy (1979), National Depletion policy (1980) and Fuel Diversification Policy (1981, 1999). The National Energy Policy has three primary objectives; supply, utilization and environmental. The first primary objective is to ensure the provision of adequate, secure and cost-effective energy supply by developing indigenous energy resources (both non-renewable and renewable) using least costly options and to diversify supply sources (both from within and outside the country). The second objective is to promote an efficient utilization of energy and discourage wasteful and non-productive patterns of energy consumption within the socio-cultural and economic parameters. The final objective is to ensure that the factors pertaining to environmental protection are not neglected in the pursuit of the supply and utilization objectives (Mohamed and Lee, 2006). This could assurance that the energy is used efficiently and the environments would be protected.

Material efficiency

The external walls, roof and floors of a building are the main building areas that contribute to the heat gained and loss inside the building. Therefore, Omer (2007) points out a suggestion to lessen heat gained and loss by adapting appropriate insulation system in the building like roof insulation, cavity fill, double-glazing, internal wall lining and exterior wall cladding can be used.

USE OF ALTERNATIVE RESOURCES

Similar to the above discussion, water, energy and material will be elaborated, but in a way of how to harness from the alternative resources.

Water

Water was obtainable directly from rainfall, wells, streams, tube wells (bored into aquifers), or diversion of surface flows. Grimble (1999) stated that the water supply is mainly for local people and small scale of it supplied to the industries and other fields to enable economic growth. Al-Jayyousi (2003), Misra and Sivongxay (2009) define greywater as the wastewater collected separately from cloth washers, bathtubs, showers and sinks. However, it does not include wastewater from kitchen sinks, dishwashers, or toilets. Dish, shower, sink, and laundry water comprise 50-80% of residential wastewater (Al-Jayyousi, 2003).

Energy

Energy is essential in the modern life since it provides services that underpin economic activities and enables residents to meet basic needs such as food, shelters, health, education, and mobility (Walsh, *et al*., 2006). Looming scarcities and the associations of social, economy, and ecological impacts with conventional sources of modern energy like fossil fuel or nuclear reactors are again pushing the developments of renewable energy sources, namely biomass, hydro, wind, and geothermal (Buchholz, *et al*., 2007). According to Omer (2008), the adoption of green or sustainable approaches to the way in which the society runs is seen as an important

strategy in finding a solution for energy problems. The key factors in reducing and controlling CO_2, which is the major contributor to global warming are the use of alternative approaches to generate energy and the exploration of how these alternatives are used today and may be used in the future as green energy sources.

Material

Obata, *et al*. (2005) says that the concept of "sustainable development" has been applied seriously on resources, energy, and environments which are essential commodities for continuous development of human society. It is quite changeling to use the resources without damaging the environment. Natural minerals such as metals, oils and gases are important resources to the engineering and power generation industries. The increasing number of world population will lead to the shortage of natural minerals. Therefore, the development of new substitutable resources for industrial materials is required in order to conserve and preserve the natural minerals as much as possible to protect the interests of future generations.

NATURAL SYSTEM

According to Oktay (2002), the consideration of local climate should address both positive and negative aspects of the site. For example, the building orientation will take advantage of free energy from the sun in terms of both heat and light if appropriately designed. Urban shade trees offer significant benefits in reducing air-conditioning demand and improving urban air quality by reducing smog. In addition to their aesthetic values, urban trees are able to change the climate of the city and improve urban thermal comfort in hot climates. Individually, urban trees also act as shading and wind-shielding elements that supply ambient conditions around individual buildings. The elements are explained by Akbari, 2002):

a) Shading

Shading plays an important role when properly placed and scaled around a building. In the summer, trees can block unwanted solar radiation from striking the buildings and reduce its cooling-energy use. Shading can increase the heating-energy in the winter while blocking it during the summer. The shades cast by trees also reduce glare and block the diffusing light reflected from the sky and the surrounding surfaces, thereby altering the heat exchange between the building and its surroundings. During the day, tree shading also reduces heat gain in buildings by reducing the surface temperatures of the surroundings. At night, trees block the heat flow from the building to the cooler sky and surroundings

b) Wind shielding (shelterbelts)

Trees act as windbreaks that lower the ambient wind speeds, which may lower or raise a building's cooling energy use depending on its physical characteristics. In certain climates, tree shelterbelts are used to block hot and dust-laden winds. In addition to energy-saving, this will improve the outdoor conditions of the city. Through wind shielding, trees affect a building's energy balance in three ways:

- Lower wind speed on a building shell slows the dissipation of heat from sunlit surfaces. This detrimental phenomenon (during the summer) is significant only for un-insulated building.
- Lower wind speed results in lower air infiltration into buildings.
- Lower wind speed reduces the effectiveness of open windows during the summer, resulting in increased reliance on mechanical cooling.

PROTECTION AND SAFETY

Gomez-Munoz and Porta-Gandara (2003) highlights important issue of energy saving in the construction industry by using solar passive techniques that allow the reduction of the thermal gains and electrical loads of air-conditioned systems. In the context of Malaysia, Sufian and Rahman (2008) indicates that the recognition of quality materials is depending on official recognition certified by IRIM Berhad. SIRIM Berhad is a government-owned company under the Ministry of Finance appointed by the Department of Standard Malaysia to develop a Malaysian Standard (MS). SIRIM is responsible for developing standards for critical products, systems and services. The approval of a standard as MS is governed by the Standards Malaysia. Paul and Taylor (2008) assert that to ensure green buildings to be more comfortable and satisfying compare to conventional building, there must be some features that are unique, or at least more common, to their designs that could contribute to a better indoor environmental quality.

REUSING AND RECYCLING APPROACH

Recycling is regarded as an emerging trend, beginning with the greening of society during 1970s, and actually coming into force during the early 1990s (Anderson and Brodin, 2005). Rocha and Sattler (2009) demonstrates that the reusing of building components is an alternative for reduction of construction and demolition waste (CDW) when renovating and demolishing buildings. Building deconstruction enables the recovery of building parts such as bricks, windows, and tiles, from traditional demolitions in which parts are transformed into amorphous materials. Pappu, *et al*. (2007) mention that the use of some of the industrial wastes such as cementation/raw material or additives could be realised in manufacturing blended cements, concrete, bricks and aggregates.

Huang, *et al.* (2007) demonstrates that the use of secondary (recycled), instead of primary (virgin), materials could ease landfill pressures and reduce the demand for extraction. This is one way of getting the road construction industry on track towards sustainable construction practices. Current research and practices tend to concentrate on the use of waste materials in the lower courses (base, sub-base, etc.) of the road as they could

absorb materials in larger quantities than they do in the upper courses.

METHODOLOGY

Producing a multi-dimensional assessment framework or model that measures the criteria of green homes in Malaysia is the main purpose of this research. According to Al-Temeemi and Harris (2004) in order to assess public attitudes and the acceptability of a study in construction industry, a survey in the form of questionnaire can be designed.

This study involves collecting data on the perceptions of potential house buyers using a set of questionnaires given in a natural non-contrived setting without controlling and manipulating the variables. Distributing surveys that contain questionnaires is a common technique used in research to gather data quickly from large groups of people (Al-Temeemi and Harris, 2004; and Zikmund, 2000). The surveys are distributed to obtain the research data and then will be analyzed to test the hypothesis that predicts the relationship between the green home criteria and house buyers' requirements in Malaysia.

Correlational study has been used to investigate the relationship between the implementation of green home elements and the criteria of green homes among potential house buyers in Malaysia. The research samples consist of house buyers who attending property fairs in six states and one federal territory in Malaysia namely, Kedah, Penang, Kelantan, Melaka, Johor, Sabah and Kuala Lumpur. The respondents have been selected through the convenience sampling technique. Out of 2600 questionnaires distributed, 1642 answered questionnaires have been returned, a response rate of 63 per cent. The unit of analysis for this study is the potential house buyer in Malaysia.

CONCEPTUAL FRAMEWORK OF GREEN HOMES REQUIREMENTS

According to Sekaran (2000) developing a conceptual framework helps researchers propose and test certain relationships that can improve their understandings on the dynamics of the situation. A conceptual framework was developed following the current literature on green theories and concepts were reviewed. The criteria of green development in developed countries and empirical research on sustainable developments are the main focuses for the framework.

After literature reviews are prepared, the criteria of green homes have been examined, identified, selected, and synthesized. The criteria are represented by these variables: (1) community design and planning, (2) efficient usage of resources, (3) use of alternative resources, (4) natural system, (5) protection and safety, and (6) reusing and recycling approach. The dependent variable is the requirements of green homes.

Figure-1 illustrates the theoretical relationships between the independent and dependent variables in this study. This Figure demonstrates that there are six direct relationships between the six independent variables and the dependent variable.

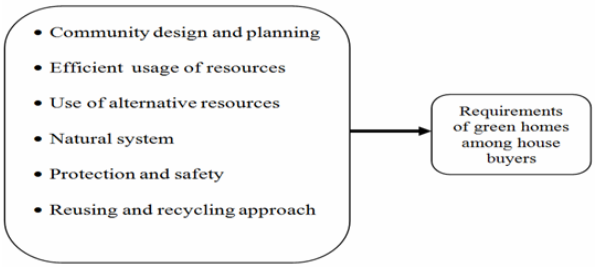

Figure-1. Conceptual frameworks of green homes requirements.

The implementation of sustainability aspects and green homes criteria is predicted to be important for the mass developments of green homes in Malaysia. In this study, six direct relationships such as the following have been conceptualized:

The relationship between community design and planning, and requirements of green homes among house buyers

Community design and planning aspect plays an important role in housing developments to ensure the criteria of green homes are met. This aspect should be the priority in housing developments to encourage good social interactions, protect occupants, and increase economic activities. The community design and planning variable has four dimensions: 1) public infrastructure, 2) community design, 3) design for safety and 4) adaptable building.

In this study, the relationship between community design and planning and the requirements for green homes among house buyers in Malaysia is hypothesized as such:

H_A 1(1): There is a positive relationship between community design and planning, and the requirements for green homes among house buyers.

The relationship between efficient usage of resources and requirements of green homes among house buyers

Efficient usage of resources aspect plays an important role in housing developments. To build green houses, resources have to be used efficiently to avoid wasteful usage. Efficient usage is one of the criteria of green homes implemented in developed countries. Figure-1 illustrates the conceptual relationship between efficient usage of resources and the requirements of green homes among house buyers in Malaysia. In this study, the conceptual efficient usage of resources aspect has three dimensions: 1) water, 2) material and 3) energy. The conceptual relationship between efficient usage of resources and the requirements of green homes among house buyers in Malaysia is hypothesized as such:

H_A 1(2): There is a positive relationship between efficient usage of resources and the requirements of green homes among house buyers.

The relationship between use of alternative resources and requirements of green homes among house buyers

The literature reviews show that there is a obvious relationship between the use of alternative resources aspects and the requirements of green homes among house buyers. Conceptually, the use of alternative resources aspect has three dimensions namely: 1) renewable water, 2) renewable material and 3) renewable energy. The conceptual relationship between the use of alternative resources and the requirements of green homes among house buyers in Malaysia is hypothesized such as the following:

H_A 1(3): There is a positive relationship between the use of alternative resources and requirements of green homes among house buyers.

The relationship between natural system and requirements of green homes among house buyers

Natural system aspect plays an important role in building green houses. This aspect encourages the creation of a good environmental circulation in housing developments. The conceptual relationship between natural system aspect and the requirements of green homes among house buyers in Malaysia is hypothesized such as the following:

H_A 1(4): There is a positive relationship between natural system and requirements of green homes among house buyers.

The relationship between protection and safety, and requirements of green homes among house buyers

The literature reviews show clearly that there is a relationship between protection and safety aspect and the requirements of green homes among house buyers. It plays an important role when housing designs and zones are developed. The protection and safety aspect has three dimensions; 1) design, 2) material and 3) product. The conceptual relationship between protection and safety aspect and the requirements of green homes among house buyers in Malaysia is hypothesized as the following:

H_A 1(5): There is a positive relationship between protection and safety, and requirements of green homes among house buyers.

The relationship between reusing and recycling approach, and requirements of green homes

Reusing and recycling approach aspect plays an important role in building houses that meet the requirements of green homes. Finally in this study, the relationship between reusing and recycling approach and the requirements of green homes among house buyers in Malaysia is hypothesized such as the following:

H_A 1(6): There is a positive relationship between the implementation of reusing and recycling, and requirements of green homes among house buyers.

RESULT AND DISCUSSIONS

Hypothesis

The study has managed to determine the relationships between the independent and dependent variables that is implementation of the green homes aspects (community design and planning, efficiency usage of resources, use of alternative resources, natural system, protection and safety, and reusing and recycling approach) and the requirements of green homes among house buyers in Malaysia. The results demonstrate that all independent variables have positive relationships with the requirements of green homes. This suggests that in order to meet the requirements of green homes set by house buyers in Malaysia, there will be more implementation of the green home aspects.

Table-1 presents the summary of the test results on the relationships between the green homes aspects and the requirements of green homes among house buyers. These results propose that there will be higher levels of implementation of green homes aspects in building houses. The results also indicate that there is an increase in the preferable perceptions of requirements of green homes among house buyers. The strongest relationship is the natural system with the r-value of 0.721. This is followed by the use of alternative resources with the r-value of 0.706. The results propose that the implementation of the green homes aspects in building houses need to be done so that the houses that meet the green home requirements of the house buyers would be more available.

Table-1. Summary of Test Results - Relationship between the implementation of Green Homes aspects and requirements of Green Homes.

Alternative hypothesis	r	p	Results
H_A 2(1): There is a positive relationship between the implementation of community design and planning aspects and the requirements of green homes among the house buyers	0.539	p<0.01	Significant
H_A 2(2): There is a positive relationship between the implementation of efficiency usage of resources aspects and the requirements of green home among the house buyers	0.627	P<0.01	Significant
H_A 2(3): There is a positive relationship between the implementation of alternative resources and requirements of green home among the house buyers	0.706	P<0.01	Significant
H_A 2(4): There is a positive relationship between the implementation of natural system aspects and the requirements of green homes among the house buyers	0.721	P<0.01	Significant
H_A 2(5): There is a positive relationship between the implementation of protection and safety aspects and the requirements of green homes among the house buyers	0.601	P<0.01	Significant
H_A 2(6): There is a positive relationship between the implementation of reusing and recycling approach aspects and the requirements of green homes among the house buyers	0.666	P<0.01	Significant

Descriptive analysis for modelling of House Buyers requirements of Green Homes in Malaysia

Descriptive analysis has been used in this study. Frequency distribution techniques have been used to figure out the maximum and minimum scores as well as the mean and standard deviation. They are crucial in describing the responses on major factor.

Table-2 presents the mean scores that range from 3.2098 to 4.3835. The highest mean score is represented by concern of the health and environments with the score of 4.3835. This Table also presents that all variables have high mean scores. This indicates that house buyers in Malaysia have high expectations on green homes. The results also show that the standard deviation ranges from 0.44603 to 1.31739 in this study.

Table-2. Descriptive statistics of the variables (n=1642).

Variables		Minimum	Maximum	Mean	Std. Deviation
CDP1	Design and planning	2.50	5.00	4.0996	0.47754
CDP2	Safety and comfort zone	2.75	5.00	4.1579	0.51730
EUR1	Intention	3.00	5.00	4.3448	0.45098
EUR2	Concern	1.00	5.00	3.2098	1.31739
UAR1	Efficiency	2.00	5.00	3.7212	0.61958
UAR2	Strength	2.00	5.00	3.8368	0.63022
UAR3	Conservation of environment	2.67	5.00	4.2152	0.55503
NS1	Integrate of design and environment	3.00	5.00	4.2504	0.44985
NS2	Comfort and stimulated of environment	2.75	5.00	4.1565	0.54958
PS1	Concern of the health and environment	3.00	5.00	4.3835	0.44603
PS2	Design	2.20	5.00	3.9538	0.55313
RRA1	Conservation and cost saving	2.14	5.00	3.8459	0.53397
HBRGH1	Green homes aspects	2.50	5.00	4.0906	0.45720

The proposed theoretical model

The factor analysis outcomes present that the community design and planning aspects variable has been reformed from having four dimensions into merely having two dimensions- 1) design and planning, and 2) safety and comfort zone. The second variable, efficiency usage of resources aspect variable has been reformed from having three dimensions to having two dimensions- 1) intention,

and 2) concern. The third variables, use of alternative resources aspects variable has only three dimensions- 1) efficiency, 2) strength, and 3) conservation of environments after the factory analysis. Then, the fourth variable, natural system aspect variable has only two dimensions- 1) integrate of design and environment, and 2) beautification and comfort after the factory analysis. This is followed by the fifth variable, protection and safety variable which has been changed from having three dimensions to two dimensions- 1) concern of the health and environment, and 2) design. The sixth variable, reusing and recycling approach variable only has two dimensions- 1) conservation and cost saving after the factor analysis. Lastly, the seventh variable, the house buyers' requirements of green homes components has one factor namely green home aspects. In Figure-2 presents the proposed theoretical model.

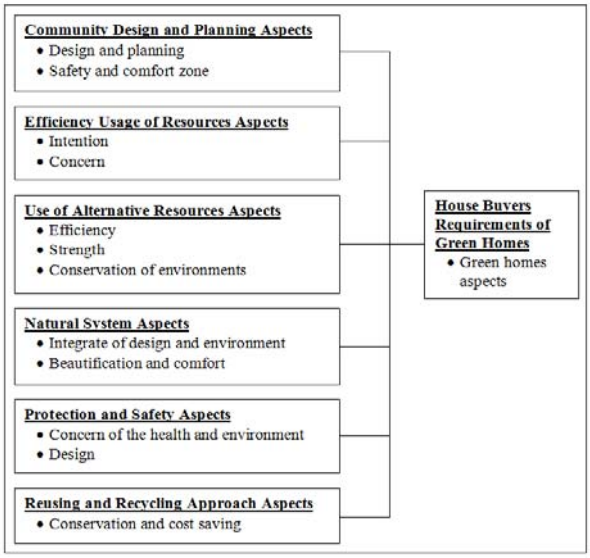

Figure-2. The proposed theoretical model.

The development of House Buyers' requirements of Green Homes models

Regression analysis is used to achieve the main research objective. The main objective for this study is to develop a multi-dimensional assessment model for house buyers' requirements of green homes in the Malaysian housing industry. The following model is generated with a multiple regression analysis.

The model in this study has been constructed by determining the accumulated effects of the independent variables which are 1) community design and planning 2) efficiency usage of resources 3) use of alternative resources 4) natural system 5) protection and safety and 6) reusing and recycling approach on the overall perceived house buyers' requirements of green homes in Malaysia. In this, the hypothesis developed to test the model is:

H_A 3 (1): The implementation of green home aspects (community design and planning aspects, efficiency usage of resources aspects, use of alternative resources aspects, natural system aspects, protection and safety aspects, and reusing and recycling approach) is significantly related to the perceived house buyers' requirements of green homes among house buyers

Multiple regression analyses have been used to test this hypothesis. Based on the regression analysis, a regression model has been developed to determine the relationship of the variables in the study. Therefore, the model is as below:

REQUIRE = β + β1Community Design and Planning Aspects + β2Efficiency Usage of Resources Aspects + β3Use of Alternative Resources Aspects + β4Natural System Aspects + β5Protection and Safety Aspects + β3Reusing and Recycling Aspects + ε

Where,

REQUIRE = Overall House Buyers Requirements of Green Homes,
β = constant, and
ε = standard error.

Table-3 presents the summary of the model while Table-4 presents the independent variables which predict the overall house buyers' requirements of green homes.

Table-3. Multiple regression results for independent and dependent variables (Overall House Buyers requirements of Green Homes).

R	R^2	Adjusted R^2	Std. Error of the Estimate	F	Sig. F
0.836[a]	0.7699	0.698	0.24728	633.519	0.000[a]

Table-4. Multiple Regression Results for Independent (Overall House Buyers Requirements of Green Homes).

Model		Un-standardized coefficients		Standardized coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	0.116	0.071		1.634	0.102
	Community design and planning aspects	0.099	0.017	0.100	5.674	0.000
	Efficiency usage of resources aspects	0.114	0.016	0.120	7.193	0.000
	Use of alternative resources aspects	0.307	0.020	0.319	15.711	0.000
	Natural system aspects	0.274	0.025	0.258	11.011	0.000
	Protection and safety aspects	0.303	0.024	0.003	0.137	0.891
	Reusing and recycling aspects	0.195	0.016	0.232	12.399	0.000
a. Dependent variable: Requirement of Green Homes						

The outcomes from the regression analysis show that the regression coefficient, R=0.844 with R^2=0.7699, signifies that 77% of the variation in the house buyers' requirements of green homes have been statistically explained. The R^2 is statistically significant with F=633.519 at p<0.000. Thus, the general interpretation in the form of the regression equation can be stated as below: REQUIRE = 0.116 + 0.099 Community Design and Planning Aspects + 0.114 Efficiency Usage of Resources Aspects + 0.307 Use of Alternative Resources Aspects + 0.274 Natural System Aspects + 0.303 Protection and Safety Aspects + 0.195 Reusing and Recycling Aspects + 0.071

The results suggest that there is a strong and significant relationship to support the hypothesis. The results conclude that the independent variables 1) community design and planning, 2) efficiency usage of resources, 3) use of alternative resources, 4) natural system, 5) protection and safety, and 6) reusing and recycling approach can significantly explain the variation in the dependent variable which is the house buyers' requirements of green homes.

CONCLUSIONS

This study has been formulated and tested with seven hypotheses in order to examine the implementation of the green home aspects and house buyers' requirements of green homes among house buyers in Malaysia. The multiple regression analyses present that all independent variables could significantly predict the house buyers' requirements of green homes among the house buyers in Malaysia. The factor analysis results suggest that there are six variables of green home aspects namely community design and planning, efficiency usage of resources, use of alternative resources, natural system, protection and safety, and reusing and recycling approach. These variables are the pillars and essence of green homes. The house buyers' requirements of green homes are represented with one aspect namely the green home aspect. This study discovers that all variables are significantly correlated and has established relationship among each other.

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