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The empirical study of green buildings (residential) implementation: perspective of house developers

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Abstract

This paper presents a study of green buildings implementation from the perspective of housing developers. The agenda of green buildings is to preserve all natures from the destruction by human activities. However, not many of house owners know that their houses are degraded and produced CO_2, roughly 10 to 30 tonnes annually. This means that our houses are one of the causes of the global warming and environmental pollution. Therefore, the green building concept for green residential is an alternative effort to decrease the effects of CO_2. Green residential means applying the houses with a minimum energy, water and natural resources that provide good air quality and reduce wastes. This qualitative study aims to explore the perceptions of housing developers towards green residential development. Presently, the demand for green residential is very low because buyers hesitate to pay 30% more costs for a green residential than a conventional house. The data collections for the study area are throughout face-to-face semi-structured interviews, photo collections, and some observations with housing developers. There are twenty-two respondents involved during the data collection period from two home and property exhibitions. The study finds that 77% of respondents are aware of the green residential concept. The other 23% of respondents realize about the green residential concept and the perceived benefits but indistinguishable. Government roles are significantly crucial for flourishing the development of green building and technologies into the housing projects.

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1. Introduction

Excessive development has led to main changes in world civilization, including the economic, social, and natural environment[1]. The negative impacts of human unlimited activities like extreme energy production (*e.g.,* oil and gas industry) and overload transportations become problems to the world's financial, economic, social, and environment. According to a report in United State of America, residential, commercial, and industrial buildings produce Carbon Dioxide (CO_2) emissions more than 38% as compared to 10% of world's CO_2 emissions[2]. Therefore, the air pollution becomes a tremendous impact to all of us, especially our health, environment and property damage. As examples, an environmental degradation and extreme release of CO^2 worldwide significantly impact human quality of life. In the U.S. alone the average output rate by using coal-fired electricity generation is about 954 grams of CO_2 per kilowatt-hour. And recently, the petroleum consumption to produce electricity, as much as 119 billion kilowatt hours of the nation, has produced 106 million of metric tons of CO_2 emissions. This indicates that the nation becomes the second biggest polluter at 863 grams of CO_2 per kilowatt hour. Thus, green development becomes the world new agenda to ensure that the human standard of living can be sustained. At the same time, the surrounding nature must be preserved from any damages caused by the pursuit of economic growth through the heavy development. Green development now has been developed by various countries in the world such as European countries, America, and Australia. Besides, Asian countries such as Singapore, China and Japan also have applied it appropriately to the needs and development of their society. Green development is not only important to the extent to advanced countries, but also important to developing countries such as Malaysia and Thailand. As one of the major industries in Malaysia, the construction industry certainly can effectively achieve human living standard by developing the green residential. One of green residential criteria is that the house can achieve long lasting, sustainable through the efficiency of energy use. It can be achieved through green technology applications like photovoltaic systems, rain water collection, and recycled materials.

1.1. The study background

As a developing country, Malaysia also adopts the green programs (green buildings and green technologies). The government has implemented the green programs as stated in the government agendas since 2010. Several implementations included are improvement of living standards, promoting sustainable development system, preserving and conserving the environment, and green supply management. The entire agenda is based on the implementation of Agenda 21, Sustainable Development Program United Nations (UN). Throughout the agenda, Malaysia was interested to follow the footsteps of developed countries in developing foresight in-line with the consensus with other countries as included in the World Summit on Sustainable Development (WSSD) on the planning and direction of green development in the new millennium. For example, the European countries have used many of energy efficiency systems and green buildings such as the British Research Establishment Environmental Assessment Method (BREEAM) and the German Green Building Association (GGBA). As consequences, Malaysia has launched its green building program by introducing the Green Building Index (GBI) developed by PAM (Malaysian Institute of Architects) and ACEM (Association of Consulting Engineers Malaysia), in order to promote and to flourish the construction industry with green building technologies. GBI is the first green building program where the environmental rating system becomes one of its standards and also the first comprehensive system in Malaysia to evaluate the environmental design and building performance[3].

1.2. The problem statement

House as a part of human life should be planned with a balance between physical buildings, environment, and people as the residents. As basic knowledge, the conventional house produces 10 to 30 tons of CO_2 a year and it directly becomes one of the major factors to contribute in the global warming catastrophes. Therefore, a green development agenda becomes a new impetus in the arena of construction industry in Malaysia. The introduction of GBI can be a motivation for a green benchmarking in the Malaysian construction industry. Since the agenda is novel, it has created a lot of misperceptions and problems, not only for potential buyers, but also for the construction industry players such as developers, architects, engineers, town planners, and contractors. According to the Ministry

of Energy, Green Technology and Water[4], the construction industry faces troubles in order to extend the green building technologies in Malaysia as follows:

i. A very low demand towards green's products and services as well as expensive costs;
ii. A very tough challenge to get cooperation from construction industry players in the application of the green technology;
iii. A lack of local expertise in green technology;
iv. A lack of R&D activities, transfer technology and knowledge in green technology fields, and
v. A lack of awareness, understanding and acceptance of green technology among the construction industry players and citizen as the whole.

Presently, construction players have been aware that the costs of green building technology implementation will be 30% higher than conventional buildings. So, it will cause a chain reaction from all parties involved in the construction industry in Malaysia, particularly the housing developers that need to reconsider to 'go green' or not to implement it[5]. Meanwhile, housing developers assume that the green building business is too risky and at this moment, Malaysia is lacking of expertise in green building[7]. In this study, the level of awareness and perceived obstacles delaying the housing developers in implementing the green technologies into residential building construction projects are explored.

2. Literature reviews

Green (building) technology refers to the development and application of products, equipment and systems to protect the environment and the natural environment, and to minimize or to alleviate the negative effects of human activities[6]. Generally green building is a crucial area where cities can implement sustainability objectives and design to reduce some negative impact on the environment via application of technologies into building development. As a part of that, this study focuses on the green building specifically the green residential where the human being lives. It is also referred to house's applications of green technology with energy efficiency that provide human with comfort, safety and healthy living environment. Green residential mostly are operated by using sustainable resources that simply can be found around us such as wooden (trees harvested and replanted), solar energy, hydroelectric power and wind power. As significant impact, the green building has an important function to achieve the objectives of sustainable development, such as; (i) energy efficiencies and renewable energy, (ii) conservation and reuse of materials and resources, and (iii) improve human health and indoor environmental quality[8].

2.1. Green buildings

There is a lot of green building system or also known as a sustainable rating system for buildings and groups of buildings that have been developed and rated such as in the United Kingdom, it has a green building program likes BREEAM, Green MARK (Singapore), Green STAR (Australia) and Leadership in Energy and Environmental Design (LEED) in the United States of America. According to U.S. Green Building Council[9], the green building can be defined as "a type of structure that utilizes and demonstrates environmental stewardship and resource conservation throughout its entire lifespan, from construction, operations, maintenance, and renovation to demolition". On the other hand, the Green Building Index (GBI)[10] defines green building as "a green building focuses on increasing the efficiency of resource use – energy, water, and materials – while reducing building impact on human health and the environment during the building's lifecycle, through better siting, design, construction, operation, maintenance, and removal. Green buildings should be designed to reduce the overall impact of the built environment on its surroundings". Buildings with green technology in Malaysia are considered new. However, the efforts to develop a comprehensive green technology for buildings, including residential are ongoing, to ensure a better quality, comfortable and affordable to a wide range of social groups. Currently, the government is aware that green technology can be an alternative for residents to keep healthy, afford for energies like electricity and water, as well as sustainable building materials. In other places, green technology in building construction has been accepted

and widely popular in some developed countries such as United States, United Kingdom, and Germany. The phenomenon of climate change, which has impacts on nature, such as floods, hurricanes, ice liquidity in the north and south, rising sea levels and temperatures, and the destruction of flora and fauna, makes the agenda to assimilate innovative green technology in every aspect of life essential. Thus, the method of applying green technology that can be incorporated in the construction of a building is necessary to make greenhouses environment occupied more environmentally friendly, energy and costs saving. Meanwhile, the green residential energy becomes efficient because the conventional homeowners use large number of power source as to be the main cause of global warming due to the production of 10 to 30 tons of CO_2 per annum. About 1.8 billion tons of CO_2 or more of these values can be saved by using green building improvement (Steiner, 2007). In Malaysia alone, a production of electricity in 2005 has produced 160.24 million tons of CO_2 emissions from the consumption and flaring of fossil fuels. Electricity generators in Malaysia produce around 60 million of CO_2 each year. In 2012, Malaysia burnt about 56,000 tons of coal daily or almost 1.7 million tons a month and that coal comes from international countries like Australia (60%), Indonesia (30%), China (5%) and South Africa (5%). According to news reports[11] 94% of the electricity consumption in Malaysia is powered by burning fossil fuels and the demand of it will be increased dramatically at least at a rate of 3% annually and maybe double in the year 2020.

2.2. Green Building Index-Residential New Construction (GBI-RNC)

Green Building Index – Residential New Construction (GBI-RNC) is an environmental rating system for buildings developed by PAM (Malaysian Institute of Architects) and ACEM (Association of Consulting Engineers Malaysia). It is designed to evaluate a house in Malaysia tropical weather conditions. GBI is the first comprehensive system in Malaysia to evaluate the environmental design and building performance based on six (6) main criteria, namely; (i) Energy Efficiency (EE), (ii) Indoor Environment Quality (EQ), (iii) Management and Sustainable Planning Area (SM), (iv) Material Resources (MR), (v) Water Efficiency (WE), and (vi) Innovation (IN). At the moment, Malaysia has a population of approximately 28 million and the country is considered as a high energy user. In terms of electricity consumption, each Malaysian used an average of 3667kWh (kilowatt hours) in 2008. A peek at the consumption pattern in the developed countries shows that Malaysia could easily double its demand for electricity as it continues to climb the ladder of prosperity in the next seven years. For example, Hong Kong's per capita consumption is 5899kWh, Germany 7184kWh, Switzerland 8163kWh, Japan 8474kWh and Singapore 8513kWh. According to KeTTHA, the electricity consumption is expected to rise at an average rate of 3% to 4% annually until 2020[12]. Studies on the use of energy by households conducted by the Centre for Environment, Technology and Development (CETDEM), led by Ir. Gurmit Singh in collaboration with the Petaling Jaya City Council (PJCC) find the average ratio of electricity consumption for a house in Malaysia as shown in Table 1.

Table. 1: Ratio of Consumption Electric Usage in a House

A House Electric Consumption	%	A House Electric Consumption	%
Cooling – Air Conditioning	45	Cooking	5
Refrigerator & Freezer	22	Entertainment	4
Heating - Iron, Kettle, etc.	11	Washing Machine & Dryer	2
Lighting	7	Others	4

2.3. Green building implementation factors

According to a study conducted by McGraw-Hill construction company in 2005[13], rank one and two of the most cited perception factors on why green buildings must be implemented are; (i) energy efficiency and increase of productivity (73%) and (ii) being good reputation for the company to protect the environmental values (72%). While some other factors are also important, presented in Figure 1. Housing developers also hope that if they adopt green technologies into their housing projects, an expansion of business can be reached into new clients in near future. They are also interested in investing more on green technologies if they can have credits from local authorities and government agencies.

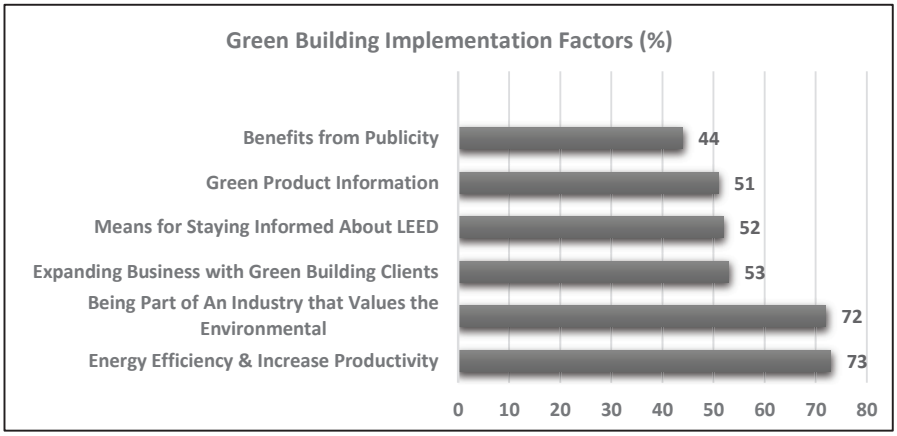

Fig.. 1. Green Building Implementation Factors

3. Methodology

There are two main phases in the data acquisition of the study. The first phase is the accumulation of raw data through intensive reading and references about green building, residential, and technology, including the GBI's homepage and research journals and conference proceedings papers. The second phase of the study involves the researchers with fieldworks which are interviews and observations. This study is conducted through the qualitative approach in which the technique of data interpretation is created to explain the real meaning of the study. Face-to-face and semi-structured interviews become the main method, while the secondary method is more on observations of the housing construction sites. The series of interviews were conducted with twenty-two (22) respondents (all of them are housing developers). All interviews were conducted at two home and property exhibitions at Mid Valley Exhibition Centre, Kuala Lumpur and Melaka International Trade Centre, between October to December 2012. The interview process was guided with an interview guide. The interview guide was constructed based on previous research, mainly comes from Turner Construction report[14] and McGraw Hill construction report 2005[13]. The preliminary interview guide was validated by three (3) experienced persons in green building areas; (i) a professor of climate, energy and environmental, (ii) an officer (green technology) from KeTTHA, and (iii) an officer (green building and technology) from PKNS (Perbadanan Kemajuan Negeri Selangor). Each interview was taken approximately 45 to 60 minutes and it was digitally recorded. During that time, researchers also collected some pictures of the house under construction as well as new construction projects that were displayed in the exhibitions. Some of the data collected are in the forms of video and computer's drawings and illustrations. Researchers also went to the construction sites at three different locations; Putrajaya, Batu Berendam, and Bukit Katil, Melaka. This paper seeks to address the following questions:

(i) What is the level of awareness of green building (residential) among housing developments in Malaysia?
(ii) What are perceived obstacles faced by housing developers in implementing green building (residential)?

4. Findings

All the data gathered are processed according to Creswell[15] by using the data analysis spiral (*see* Fig. 2). By applying the method, there are four (4) steps to be followed. The details of the steps are described as below:

(i) Data organization – this study collects data in terms of interviews transcriptions, pictures, illustrations and observations of house construction projects. All recording interviews were transcripted within 24-hour and emailed to respondents in order to verify the information. No amendments were required;

(ii) Perusing the entire data set several times – to get the sense of what it contains as a whole;
(iii) Identifying general categories or themes – subcategories or subthemes and see the pattern;
(iv) Integrating and summarizing the data – by using charts, shapes, tables, figures or diagrams.

The results of the findings are presented in Figure 3 and 4 as well as some other issues are deliberated in the next section.

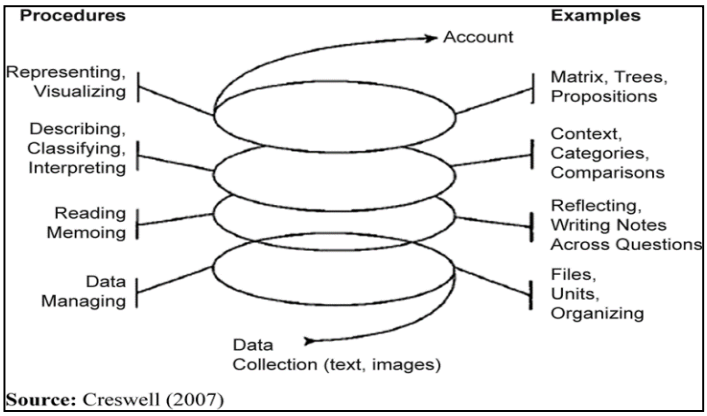

Fig. 2. Data Analysis Spiral

5. Discussions

The objective of the study is to explore the level of awareness and the perceived obstacles from the housing developers towards adoption of green technologies into house building (residential). The study managed to get twenty-two (22) respondents and all interviews were conducted within three days (28 to 30 December 2012). The data were collected via (i) face-to-face semi-structured interviews, (ii) pictures, illustrations and videos, and (iii) observation of the construction site. Each interview was digitally recorded and transcribed within 48-hour. Then the transcription was emailed to the respondents for validation purposes. On the other hand, this section discusses other important findings from the data analysis that are presented as follows:

5.1. Housing developers

There are twenty-two (22) respondents that were selected randomly from two (2) home and property exhibitions. All respondents come from the housing developer companies and they are involved via semi-structured face-to-face interviews. On average, all of them are involved in the mainstream of housing and building construction businesses between 15 to 25 years. When they were asked about awareness of green buildings in Malaysia, most of them were aware and realized (17 out of 22 respondents or 77%) that green building technologies application should be adapted into the housing construction presently, and the adaptation will bring a lot of green benefits for future generations. The concern about values of environmental is also encouraged since they are now guided by numerous of government's Green Technology (GT) programs. Some of them (12 out of 22 respondents or 55%) have involved in AFFIRM framework (Awareness, Faculty, Finance, Infrastructures, Research & Marketing) as it was established in the 10th Malaysia Plan. Construction companies are encouraged to take part in GT programs such as to develop Putrajaya and Cyberjaya as the pioneer of GT townships. The government also provides tax exemption equivalent to

100% of the additional capital expenditure to get the GBI certificate. Five out of 22 respondents (23%) have involved in Green Technology Financing Scheme (GTFS) which are worth of RM1.5 billion as a part of soft loan to produce GT materials for green building developers and owners. In making GT into construction of housing and building, all respondents have different opinions about perceived obstacles that they have encountered. There are ten (10) perceived obstacles have been found from the interviews and there are displayed in the Figure 3.

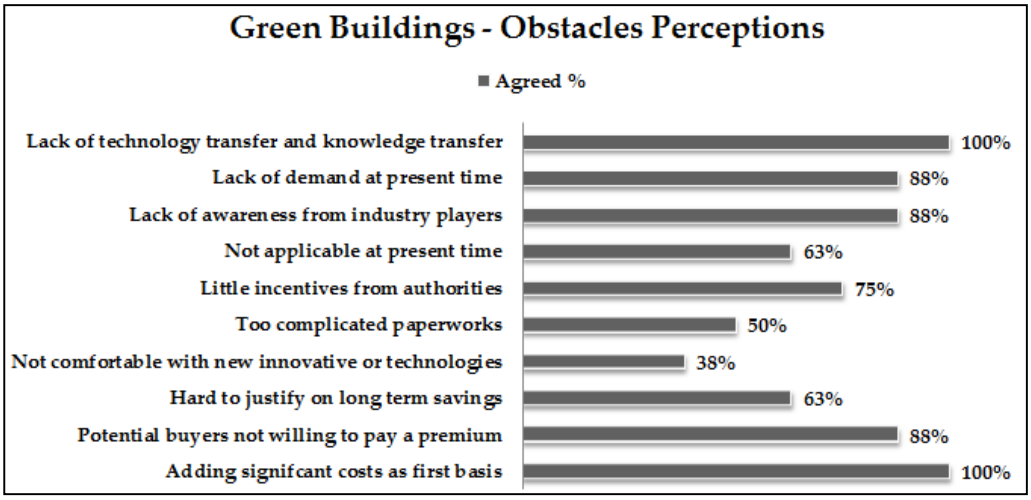

Fig. 3. Green Buildings Implementation – Perceived Obstacles

Firstly, all respondents were agreed that the leak of technology transfer and the knowledge of developing nations such as the United States of America and Australia have prevented the local housing developers to embrace green technology into their tasks. This is shown that there is not much collaboration between them in term of housing and building construction projects. Therefore, the impact of transferring technology and knowledge will limit to uprise the level of residential house with green technologies. Secondly, housing developers have faced a limitation of financial in order to upfront the green technology costs into the initial housing development. There are a few reasons for that; (i) presently there is too little exposure about green technologies embedded into house/residential from the perspective of buyers, housing developers and owner of the projects, (ii) buyers on the other hand, are not ready to purchase the house at a premium price because the present price by this time is expensive. For instance, at Kempas Height, Johor Bharu, a 2-storey semi-detached with 2500sq ft. is worth about RM950, 000 (US$296, 875), and in the meantime the average wage for a Malaysian is about RM5, 900 (US$1787) per month, and (iii) government should offer a bunch of incentives in terms of promotions and novel strategy, for example high exemption of taxes and less red-tape for bank loans. This is supported by a study of Samari et al.[8], the Malaysian government's approach and current strategy are not effective to encourage suppliers, developers and projects' owners to participate in green housing projects.

5.2. Housing developers – motivation factors

During the interviews, all respondents were asked to recommend some of X factors that will support to flourish the green buildings as well as green technology adoption for housing projects. Figure 4 shows the results from the respondents as they assume some of the X factors such as;

(i) A strong command from local government agencies such as Municipality, Construction Industry Development Board (CIDB), and KeTTHA as well as some private organizations like GBI, PAM and others,
(ii) A growing demand of potential house buyers to save some costs for long term period,
(iii) A growing number of potential house buyers via responsible spending to save the environment,

(iv) A growing number of people to do the greatest of future generations, and
(v) A growing investment of potential house buyers for the healthy condition (people suffer from disease such as asthma tend to pay more).

5.3. Recycled Materials

From house developers' point of views, there are 18 of the respondents who are not interested to make use of recycled materials for the house construction projects at this moment. However, another four respondents are interested in doing some studies on the cost-benefits in using the recycled materials. Among the things that can be reused are steels, aluminums, timbers, concrete, plastics, bricks and tiles.

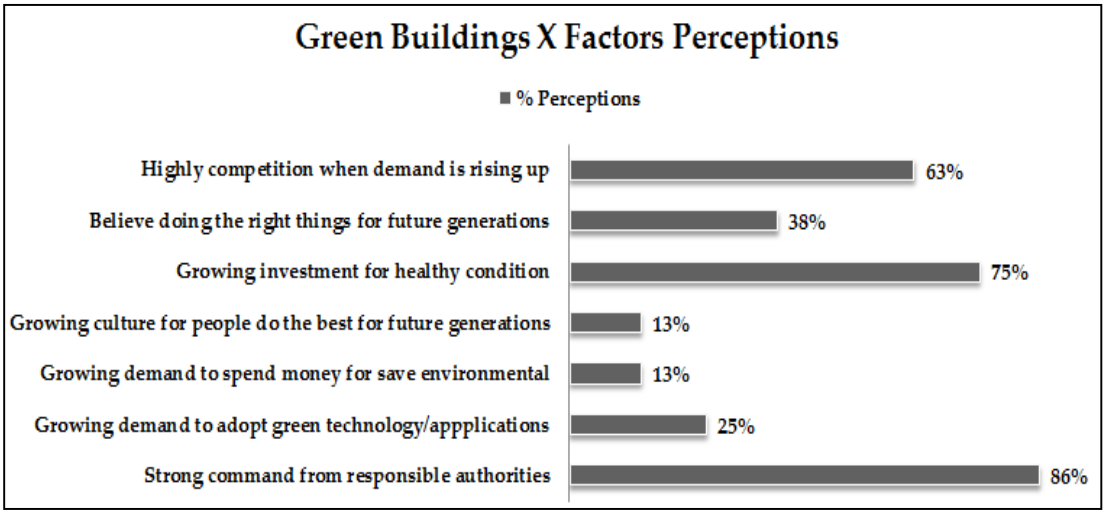

Fig 4. Green Buildings - X Factors Perceptions

5.4. Water Efficiency

The method of reuse waste water is still at an early stage for some housing project in Malaysia. At the moment, for housing developers to prepare the essential things for reuse waste water is quite awkward. On the other hand, there are a few developers shown a potential desire to use the rainwater harvesting for housing project in near future. This system will be applied in the water landscape and general cleaning purposes.

5.5. Government Intervention

The government provides two incentive schemes; (i) a series of tax incentives, and (ii) green technology finance scheme (RM1.5 billion). However, at this moment many of house developers are not in a position to grab the 'green' opportunities due to internal organizational problems (*e.g.,* stakeholders, financial and human resources). However, they believe that government has an important role to promote green technologies, especially the fact that the issue of global warming and renewable sources have emerged. These findings are supported by some previous studies [7].

5.6. Green Building Index

There are 15 of the respondents have mentioned about difficulty to achieve a standard or performance when it is driven by the context of development, the climate conditions and the location of the construction site. They did mention that the present standard of green building accreditation (GBI) may not entirely be appropriate for future implementation. On the other hand, if the standard of GBI becomes the benchmarks for housing developers, then a lot of potential threats may arise. It is in a view of fact that the reputation of the organization will be underestimated as the resale value is critical for future investors or potential buyers and the most importantly is the housing project needs to depend more and more on green accreditation awards. The GBI also will make the house prices increased dramatically as the impact of costs of designing, developing and maintaining.

6. Conclusions

This paper presents the results of twenty-two (22) respondents (housing development) through face-to-face semi-structured interviews towards perspective levels acceptance and green building awareness for residential projects. The study shows that 77% of respondents are aware about green buildings and technologies for residential and the others 23% realize about the green residential concept but indistinguishable. The study results can be summarized into two; (i) green buildings and technologies are still in novelty phase and need a robust awareness and collaboration between all players in the construction industry, and (ii) government's hands are needed intensely in providing more promotions and financial incentives for adopters of green buildings, green technologies, green materials producers, renewable energy and energy-efficient producers as an engine for green economic growth for future generations.

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