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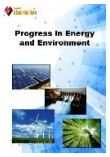

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Original Article

Current status of green building development in Malaysia

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Abstract

Terrible environmental conditions on Earth have warned us over the past decade. To avoid the current situation going further, many countries started to implement sustainable green building development. Sustainable green building development tends to preserve and conserve the environment by using sustainable green material, decrease of negative impact from construction industry and improve on the building life cost cycle. Although the number of green buildings increased compared to last century, but adoption of sustainable green building in the Malaysian construction industry is considered slow. Besides, sustainable green building development also concerns social and economic aspects. This study will analyze the current status of green building development in Malaysia. The study has reviewed articles pertinent to green building development from reputable science databases. The result obtained showed the current status of green building development is decreasing due to the impact of Pandemic COVID-19. Furthermore, the results also showed the number of green buildings in Malaysia is comparatively low. This study provided a benchmark for policy makers and construction key stakeholders about the current status of green building development in Malaysia which can be utilized as a guideline in promoting green building development.

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1 Introduction

Recently, the change of extreme climate, increase of carbon dioxide emission happened in the world and this has cause greenhouse effect and result in global warming, discharge of non-recycle and non-disposable waste are occupying space on the land and the sea. Activities such as massive deforestation, excessive plunder of natural resources, emission of greenhouse gases and use of unrenewable material have brought devastating impact to the environment. According to Hohensee [1], construction industry has caused over 2 trillion dollars of negative impacts towards social and environment annually. The environmental issues have getting more serious, especially in the developing countries such as Malaysia due to the low awareness level towards green building implementation in the construction industry [2].

These phenomena have drawn the attention from the world and started to implement the sustainable development as one of the remedy actions to protect the environment [3,4]. In 21st century, green building has been developed often around the world. Green and sustainability has linked to the meaning of environment friendly [5]. A sustainable green building development is a kind of strategy to improve energy efficiency and reduce the overall impacts to the environment. Besides, sustainable green building development also emphasizing the social and economic aspects [6]. However, the number of

green buildings in Malaysia is comparatively low compared to the total buildings in Malaysia. The trend and status of green buildings in Malaysia should be identified to obtain a benchmark for green building development in Malaysia. This could aid the policy makers in benchmarking the current status of green building development. Therefore, this research is intended to identify the current status of sustainable green building development in Malaysia.

2 Literature review

2.1 Green building development

Green building is developed to comply the needs of the current and avoid the negative impact to the future generations while fulfilling their needs [7]. Green building is defined as the building which is designed, constructed, and maintained in order to reduce water, energy consumption and construction costs by improving the efficiency and sustainability of the building systems and reduce the negative impact of buildings to the environment [8]. There are three pillars in sustainable green building concept which act as the objectives to achieve sustainability. The green building concept is not only concerning on environment aspect, but also considering economic and social aspects [9].

2.1.1 Environmental aspect

In the construction industry, raw materials such as water are extracted from nature. Hence, green building is considered as one of the methods to reduce the use of natural resources especially non-renewable resources such as plastic, wood, metal etc. According to Wuni et al. [10], green building is able to reduce the effect from the construction industry to the environment. The construction activities have led to the amount of construction waste which showing an increasing trend [11,12]. According to Taha [13], there are eight million tons of construction wastes which have been produced from the construction activities every year. This has led to serious environmental issues in Malaysia [12]. Therefore, the green building concept should be implemented in the construction industry to provide a good environment in Malaysia. By implement the green building concept in the construction industry, it can reduce the building operation costs such as reducing the building maintenance fee and improving energy efficiency in the building operation stage [14].

2.1.2 Social aspect

Green building development aims to achieve quality of life and well-being of occupants. To provide a healthy, comfort and satisfaction environment through building design, which can reduce occupants' heath issues in order to improve occupants' productivity and provide a comfort area to the occupants [14]. Mateus and Bragança [15] mentioned that accessibility of public facilities should be included in social performance of green building assessment such as nearer to public transportation to the building, garden or park near to the building, workout facilities, game facilities and more facilities which allow relaxation for occupants. These appropriate relaxation activities able to reduce the anxiety and stress level of occupants [16].

2.1.3 Economic aspect

Many researchers emphasize this aspect and believe green buildings can provide direct and indirect economic benefits. The cost benefits can be reflected from the building operating cost such as costs of water, maintenance fee, repair, and energy consumption. Lower operating cost of a green building to achieve cost efficiency over the building lifetime. This is significant during the inflation of currency and the increase of energy cost [17]. The design of the building and green technology implemented in the building can reduce energy consumption and water usage by using rainwater harvesting system or generating own energy and filtration of used water, reduce maintenance cost by using specific materials and technology that can reduce the frequency of maintenance process. For example, a better natural ventilation design could be implemented to increase the life span and reduce the maintenance of air conditioning systems.

2.2 Green building assessment tool in Malaysia

According to Atsusaka and LeVan [18] and Samari et al. [3], government as a moderator in promoting the green development will be more effective compared to waiting the developers to aware of the

importance of the green development. By having the intervene of government, rules and regulations will be executed to enforce the Malaysian property developers in implementing green development [3].

Therefore, Malaysia government has promoted green building assessment tools to encourage the green building development. To achieve sustainable green building concept, various kind of assessment tools are implemented to different countries [19]. In 2009, Green Building Index (GBI) has been launched in Malaysia to assist National Association of Homebuilders (NAHB) in promoting sustainable development by using Green Building Guidelines for Residential Structures [2]. The objectives of GBI are to enhance and promote the sustainable built environment as well as to increase the awareness of every party involved with buildings about the issues in environments and sustainability for the future generations [20]. There six rating criteria in GBI rating system which are Energy Efficiency (EE), Indoor Environment Quality (EQ), Sustainable Site Planning & Management (SM), Materials & Resources (MR), Water Efficiency (WE) and Innovation (IN) [21]. Fig. 1 shows the Green Building Index assessment criteria [21].

Besides, Malaysia Green Building Council also known as Malaysia Green Building Confederation (MGBC) was formed in 2007 to initiate a non-profit making organization and promote sustainable green building. The Malaysia Green Building Council was supported by two of the professional organizations which is Association of Consulting Engineers Malaysia (ACEM) and Pertubuhan Akitek Malaysia (PAM) in year 2008. Moreover, Malaysia Green Building Council aims to lead the local construction industry toward sustainable green building development [22]. Therefore, a green building assessment tool which is known as GBI was established in year 2009.

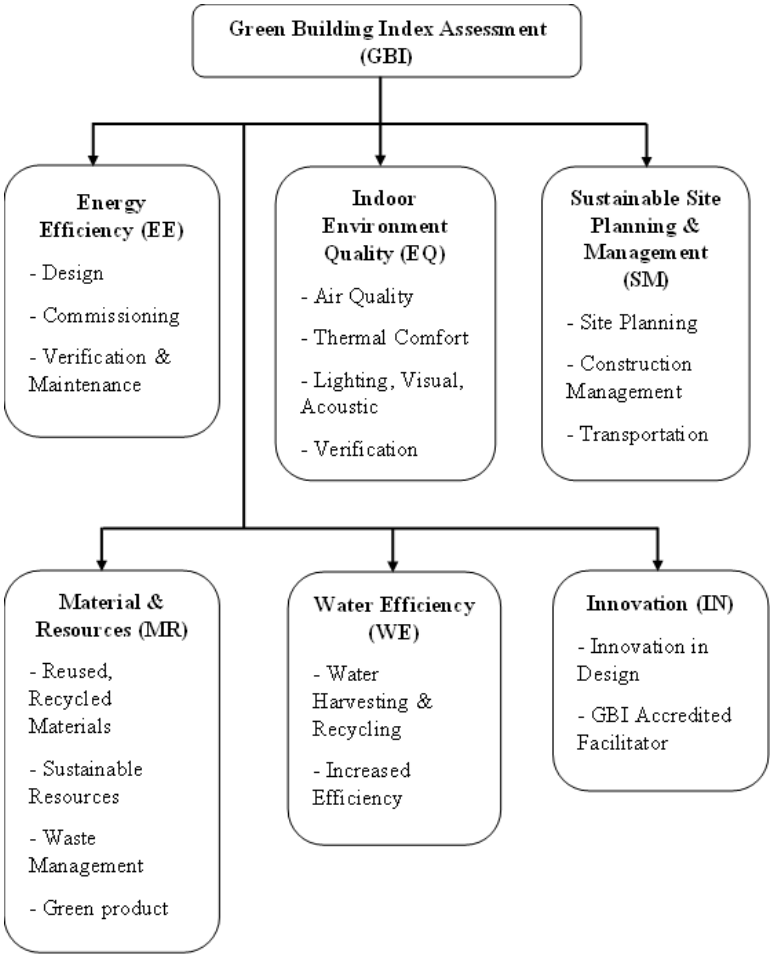

Fig. 1 Criteria and Sub-Criteria of Green Building Index Malaysia [21].

3 Methodology

This study is reviewing pertinent journal articles about green building development in Malaysia from the aspect of three pillars which are environment aspect, but also considering economic and social aspects the from various articles. The contributions of these pertinent articles were used to determine the current status of green building development in Malaysia which can be used as a benchmark for the policy makers. To scope and evaluate the current status of green building development in Malaysia, this study has reviewed the literature concerned with green building development in Malaysia such as the application of green building, registration of green building and certified green building. This study frames the discussion with specific focus on analyzing the current status of green building in Malaysia to propose a benchmark of current green building status to the policy makers. Fig. 2 shows the research procedure where this study started with the searching of keywords which related to green building development in Malaysia in several reputable science databases such as Google Scholar, Emerald Insight and Science Direct. The results of the search were filtered through several inclusion and exclusion criteria to ensure the selected articles are pertinent to the green building development. Next, the GBI yearly summary was obtained from the GBI official website to be made as the fundamental information of Table 1. The details of GBI summary are presented clearly in Table 1 where this study can compare the value and summarize the results of green building numbers in Malaysia. Further elaboration was shown in the next section.

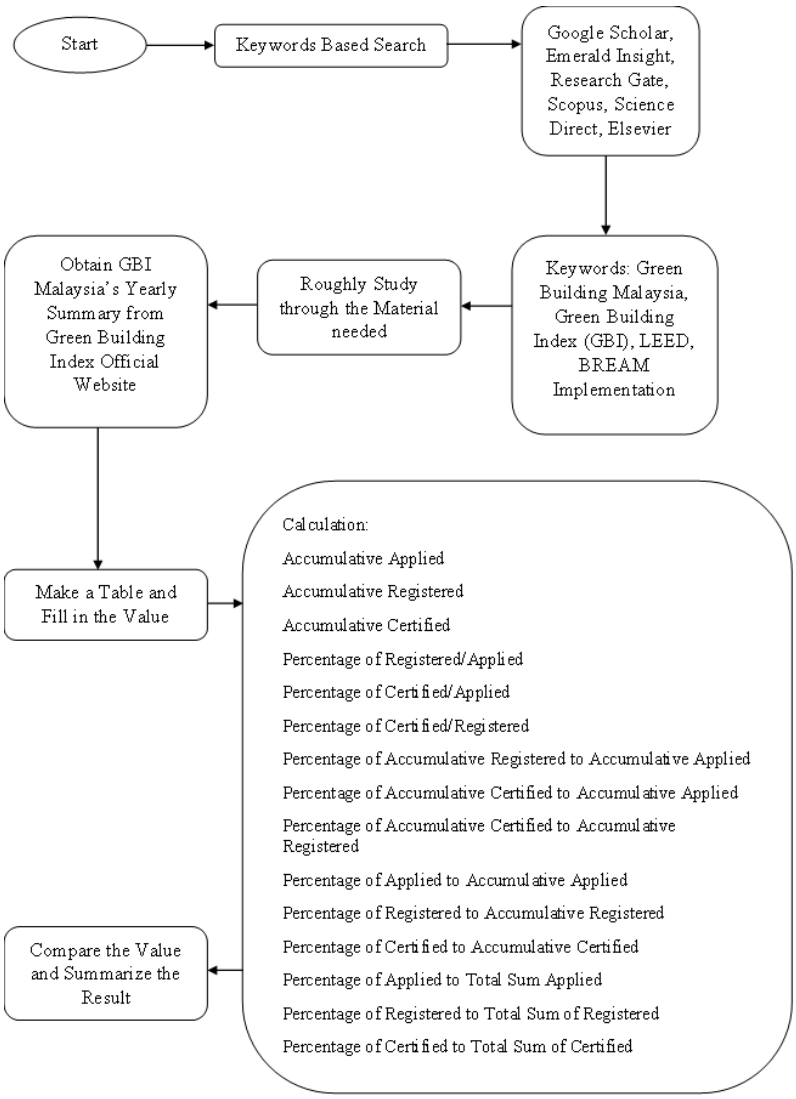

Fig. 2 Research Procedure.

4 Status of green building development in Malaysia

A comparison of green building development in Malaysia from 2013 to 2022 has been made. Statistics provided show the flow and numbers of green buildings throughout the years. Table 1 shows the numbers of green building statistics provided by Greenbuildingindex Sdn Bhd [21]. From Table 1, it shows that the development of green building in Malaysia is decreasing. Table 2 shows the green buildings that developed in Malaysia. All types of buildings are considered in the green building categories, regardless it is high-rise nor landed properties. Although there are quite several green buildings that have been developed in Malaysia, it is still consider low percentage compared with the total buildings in Malaysia.

Table 1 Numbers of Green Building in Malaysia.

Numbers of Green Building Projects Applied Since Year 2013 To Year June 2022										
	Year									
Status	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Jun 2022**
Applied (A)	119	122	71	61	109	47	70	47	85	39
Registered (R)	110	119	69	53	98	44	66	45	81	38
Certified (C)	82	75	69	42	58	32	59	37	28	28
Accumulative Applied (AA)	514	636	707	768	877	924	994	1041	1126	1165
Accumulative Registered (AR)	476	595	664	717	815	859	925	970	1051	1089
Accumulative Certified (AC)	191	266	335	377	435	467	526	563	591	619
Percentage of Registered/Applied (D)%	92.44	97.54	97.18	86.89	89.91	93.62	94.29	95.74	95.29	97.44
Percentage of Certified/Applied (E)%	68.91	61.48	97.18	68.85	53.21	68.09	84.29	78.72	32.94	71.79
Percentage of Certified/Registered (F)%	74.55	63.03	100.00	79.25	59.18	72.73	89.39	82.22	34.57	73.68
Percentage of Accumulative Registered to Accumulative Applied (G)%	92.61	93.55	93.92	93.36	92.93	92.97	93.06	93.18	93.34	93.48
Percentage of Accumulative Certified to Accumulative Applied (H)%	37.16	41.82	47.38	49.09	49.60	50.54	52.92	54.08	52.49	53.13
Percentage of Accumulative Certified to Accumulative Registered (I)%	40.13	44.71	50.45	52.58	53.37	54.37	56.86	58.04	56.23	56.84
Percentage of Applied to Accumulative Applied (J)%	23.15	19.18	10.04	7.94	12.43	5.09	7.04	4.51	7.55	3.35
Percentage of Registered to Accumulative Registered (K)%	23.11	20.00	10.39	7.39	12.02	5.12	7.14	4.64	7.71	3.49
Percentage of Certified to Accumulative Certified (L)%	42.93	28.20	20.60	11.14	13.33	6.85	11.22	6.57	4.74	4.52
Percentage of Applied to Total Sum of Applied (M)%	10.21	10.47	6.09	5.24	9.36	4.03	6.01	4.03	7.30	3.35
Percentage of Registered to Total Sum of Registered (N)%	10.10	10.93	6.34	4.87	9.00	4.04	6.06	4.13	7.44	3.49
Percentage of Certified to Total Sum of Certified (O)%	13.25	12.12	11.15	6.79	9.37	5.17	9.53	5.98	4.52	4.52

Table 2 Green building development in Malaysia.

No.	Building	Location	Type of Building	Green Certification
1	Ponderosa Lake Side Luxury Apartments	Johor	Residential	Green Building Index (GBI), Malaysia
2	Molek Pine 4 Apartments	Johor	Residential	Green Building Index (GBI), Malaysia
3	Ken Rimba	Selangor	Residential	Green Building Index (GBI), Malaysia
4	S11 House	Selangor	Residential	Green Building Index (GBI), Malaysia
5	Setia Greens	Penang	Residential	Green Building Index (GBI), Malaysia
6	Setia Pinnacle	Penang	Residential	Green Building Index (GBI), Malaysia
7	The Light Collection 1	Penang	Residential	Green Building Index (GBI), Malaysia
8	The Light Collection 2	Penang	Residential	Green Building Index (GBI), Malaysia
9	Marinox Sky Villas	Penang	Residential	Green Building Index (GBI), Malaysia
10	Johor Authority Building	Johor	Commercial	Skim Penarafan Hijau JKR (PHJKR), Malaysia
11	Diamond Building	Selangor	Commercial	Green Building Index (GBI), Malaysia
12	Bangkok Bank Tower	Kuala Lumpur	Commercial	Green Mark, Singapore
13	Melawati Mall	Selangor	Commercial	Green Building Index (GBI), Malaysia
14	Setia City Mall	Selangor	Commercial	Green Building Index (GBI), Malaysia
15	I-Park Senai Airport	Johor	Industrial	Green Building Index (GBI), Malaysia
16	Setia Business Park, Laman Setia	Johor	Industrial	Green Building Index (GBI), Malaysia
17	Plot 56–69, I-park phase II Indahpura	Johor	Industrial	Green Building Index (GBI), Malaysia
18	Plot 1–3, District 6 @SILC	Johor	Industrial	Green Building Index (GBI), Malaysia

From Fig. 3, the disparity between the number of registered (R) and Certified (C) is relatively increasing. Starting from 2015, Accumulative Certified (AC) to Accumulative Registered (AR) projects is higher than 50%. Most of the percentage of Applied (A) and Registered (R) remained higher than 90% but only two years which are 2016 and 2017 where the A and R's values are lower than 90%. Besides, the grey line from 2009 to 2016 rose higher than 2017 until 2021. The AC and AR value slowed down since 2017.

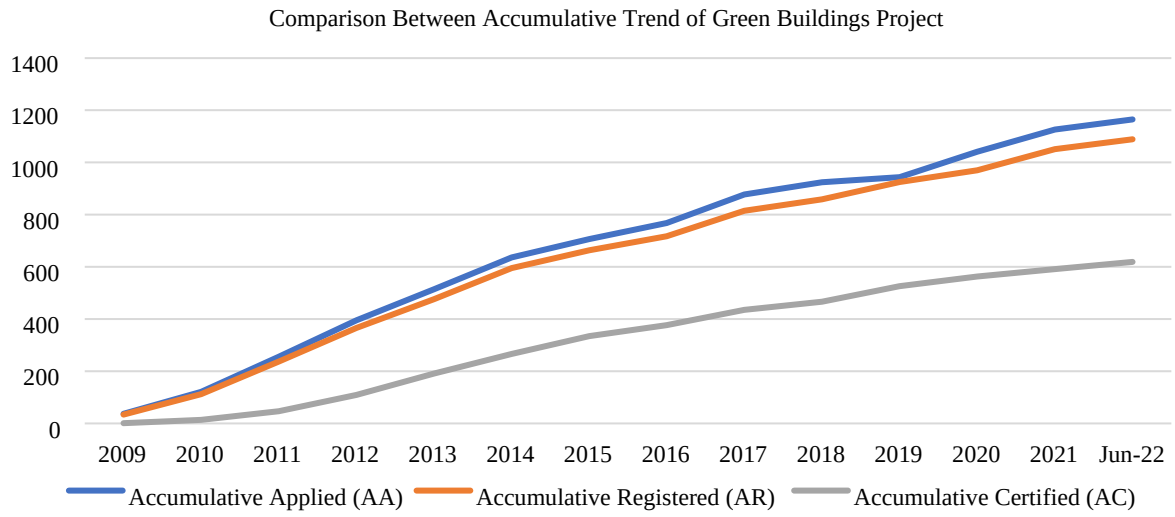

Fig. 3 Accumulative of Green Building Development in Malaysia from 2009 to 2022.

Fig. 4 shows the overall green building development is uncertain and showing a down trend since the peak in 2012. The highest applied and registered building is in 2012 where there were 139 applied applications and 129 registered buildings but only 62 projects were certified as green buildings. Besides, the highest successful registered buildings are in 2014 where there were 122 applied applications while only 119 were registered. The reason for the failure to register with GBI is due to lack of necessary information. Another reason for the failure of registration is due to the applicants not paying the registration fee successfully. On the other hand, 69 out of 69 registered projects are certified as green building in 2015 which is the highest numbers certified compared to the other years. In 2009, the first launch of GBI assessment tool, only one building is certified. This might be due to the knowledge of green building development to comply with the six criteria is still limited. The grey line indicated the level of knowledge of construction key stakeholders. When the grey line is nearer to the orange line, this means that the knowledge to comply with the GBI criteria is improved.

In 2021, Covid-19 brought a devastating impact to the economy around the worldwide. Movement Control Order (MCO) announced by the government instant stop work to the entire Malaysia to prevent the spreading of virus. All the construction projects have suffered from massive delays. When a green building is applied and registered, but the completion date is delayed due to the force majeure, thus, the certified of the building will be affected due to the completion of project has been delay. According to Esa et al. [23], the Covid-19 pandemic has caused the delay in the processes of the construction development. During the MCO period, the businesses were not allowed to operate, and this led to the material suppliers not being allowed to ship the materials to the construction site. Besides, the shipment of materials was not allowed to across the state or region during the MCO period [23]. The delayed material supplies resulted in the delayed of the construction process. Therefore, the current green building development status has been showing a decreasing trend in these few years.

According to Algburi et al. [24] and Yee et al. [25], there is still lack of awareness among clients, property developers and contractors. Although the green building concept has been promoted in the Malaysian construction industry, the awareness and promotion for green building development is still deficient. Besides, the absence of knowledge and expertise is also one of the restrictions of green building development [26]. According to Wright and Wilton [27], lacking in the knowledge and awareness of top management and client will stop the intension of green building implementation in construction firms. Furthermore, the workers in the construction industry are not literate in the new technology, most of the workers are not willing to accept and learn about the technology and this further resulted in the difficulties in green building development.

Overall, the green building development is still in the initial stages in Malaysia, so the sustainable materials and technology are still insufficient and unmature [24]. Therefore, this affects the number of green building development in the Malaysian construction industry. In addition, Yap [28] has mentioned that there is lack of green technology that practice in the construction industry. Although Malaysia government has promoted and encouraged the development of green building, there is still insufficient monitoring and enforcement of pertinent laws and regulations.

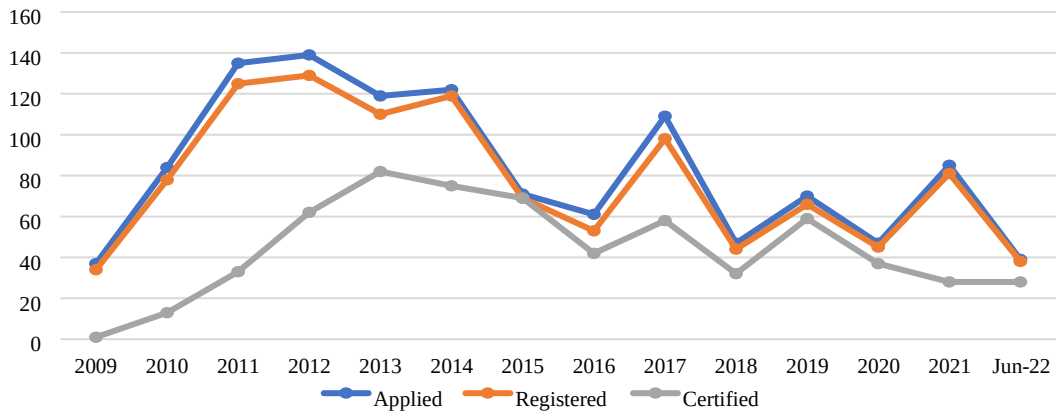

Fig. 4 Status of Green Building Development in Malaysia Since 2009 to June 2022.

5 Conclusion

This research presented the current status of green building development in Malaysia. The sustainable green building development in Malaysia still having a down trend but the knowledge to comply with the GBI's six criteria is improved. GBI implemented since 2009 until today which has only 1165 applications, 1089 registered green buildings and only 619 certified green buildings. This shows the speed of sustainable green building development is extremely slow. Besides, the possible reasons that cause the low percentage of green development in the Malaysian construction industry were discussed in this research too. Since the critical barriers that restricting the green building development has been identified, the related parties should focus on the potential solutions to resolve these identified barriers which ultimately will increase the development rate of green buildings in Malaysia. This study has also identified the current status of green building implementation in Malaysia which could be used as a benchmark for the policy makers and key construction stakeholders in the Malaysian construction industry to benchmarking the current development status of green buildings.

Declaration of Conflict of Interest

The authors declared that there is no conflict of interest with any other party on the publication of the current work.

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