

# Key influencing factors for green public hospital building development in Malaysia

Shaza Rina Sahamir<sup>1</sup>, Rozana Zakaria<sup>2</sup>, Raja Rafidah Raja Muhd Rooshdi<sup>3</sup>, Noor Akmal Adillah Ismail<sup>3</sup>, and Zainab Mohamad Zainordin<sup>1</sup>

<sup>1</sup>Centre of Studies for Construction, Faculty of Architecture, Planning and Surveying, Universiti Teknologi Mara, 40450 Shah Alam, Selangor, Malaysia

<sup>2</sup>School of Civil Engineering, Faculty of Engineering, Universiti Teknologi Malaysia, 81310 Johor Bahru, Johor, Malaysia

<sup>3</sup>Centre of Studies for Quantity Surveying, Faculty of Architecture, Planning and Surveying, Universiti Teknologi Mara, 40450 Shah Alam, Selangor, Malaysia

**Abstract.** The green hospital movement began years ago, following by several countries release their green rating system for the hospital buildings. In the past few years, a few newly constructed private hospital buildings in Malaysia have strived for the green building index certification. Paucity studies demonstrate that public hospital buildings have established for certifying the index. Despite the recognition of the importance of green building in achieving sustainability goal and the existence of many studies on issues associated with green innovations adoption in general, few have specifically examined factors influencing the development of green public hospital building. As a result, with the intent to enhance green building promotion efforts, the primary objective of this study is to investigate the key factors influencing the development of green public hospital building. A review of literature has been conducted and a set of factors were identified. A questionnaire survey was carried out based on the literature review to solicit experts' opinions. The experts were requested to evaluate the degree to which factor was an important in the implementation of green public hospital buildings. Feedbacks from 82 design experts were collected and analysed using descriptive analysis. The findings indicate that several factors were identified as key factors for the development of green public hospital buildings. The identified factors have incorporated with the accomplishment of environmental stewardship, social responsibility and economic prosperity.

## 1 Introduction

Green building has been viewed as an effective means to implement environmental, economic and social sustainability in construction industry. As hospital construction projects continue to grow and remain on a steady uptrend, it is imperative to increasingly looking in introducing green initiatives and environment-friendly practices into the design, building and management of hospital buildings. This shift to sustainable healthcare oriented where the main concern is primarily centred around reducing the carbon footprint of hospitals and the incorporation of modern green building design elements into the healthcare environment to improve hospital functionality.

With the rising sustainability trends, the healthcare industry is encouraged to implement the green in its practice. Demographic changes, followed by the alterations in disease patterns and technological advancement [1], have led to an increased interest in the way hospitals are designed today[2]. Nevertheless, although the healthcare buildings represent one of the largest sectors of economy in the West, hospitals have been very

slow in addressing the sustainability issue [3]. Surprisingly, only few studies have been carried out concerning the sustainable development of healthcare units, mostly focusing on business or waste management and energy efficiency [4][2]. Paucity has been given to the importance of ensuring the sustainability of public hospital building in Malaysia [5]. Therefore, it revealed that public hospital buildings in Malaysia have lagged behind other type of buildings in 'green building' initiatives.

As things stand, little research has been done in the field of sustainability for public hospitals in Malaysia, since sustainability is not on the priority list of the hospital owner. Therefore, it is pertinent to explore the green implementation when it comes to sustainability for the hospital building [5]. This study investigates the key influencing factors for encouraging the development of green public hospital building.

To facilitate the sustainability evaluation of healthcare facilities, several certification tools have been developed. To name but a few, there are GBI and GreenRe for rating tools in Malaysia. For instances, the Green Building Index (GBI) Hospital

Tool launched by Green Building Index Sdn Bhd in 2016 covers six key criteria — energy efficiency, indoor environmental quality, sustainable site planning and management, materials and resources, water efficiency and innovation. The tool provides for accreditation of existing hospitals and the construction of new hospitals.

## 2 Literature review

A better understanding of green building concept is necessary in encouraging and leading green buildings to accept and continue to adopt green innovations. This section presents a review of key influencing factors for green hospital building addressed by previous studies.

Previous study has shown there were factors need to be considered for green public hospital building development, namely; 1. Siting, 2. Water efficiency, 3. Energy and air pollution, 4. Materials and resources, 5. Indoor environmental quality, 6. Green education, 7. Procurement, 8. Contaminants, 9. Green cleaning, 10. Waste reduction and 11. Healing gardens [6]. Table 1 depicts the sustainable indicators based on previous research for green materials selection.

Table 1 Sustainable indicators [7]

Dimensions	Indicators	References
Economic	Initial cost	[8–14]
	Maintenance cost	
Environment	Disposal cost	[8,10,11,13–19]
	Meet user needs	
	Energy saving	
	Potential for recycling and reuse	
	Raw material	
	Land acquisition	
	Usage of water	
	Waste management	
	CO <sub>2</sub> emission	
	Soil consumption	
	Transportation Fuel consumption	
Social	Operational life	[8–11,13,14]
	Local material	
	Health and safety	

According to [20], it shown that indoor environmental quality (IEQ) is the most important element for green healthcare buildings. Mainly for architect, it is obviously shown how important the IEQ element to the green public healthcare concept, while the least element was the material and

resources. Civil engineers chose siting as the most important element and the material and resource as the least important element for a green healthcare concept. Structural engineer agreed that energy and air pollution element give higher influence for development of green healthcare than material and resources and green cleaning in development of green hospital building. Mechanical and electrical engineer agreed IEQ is the most important element. In overall result, it shows that material and resources is the least important element for green healthcare development. The overall result shows the IEQ has chosen as the first ranking, followed by siting and energy elements. The last rank has gone to materials and resources elements [20]. Proper development and operation of building projects, such as hospital building, can contribute significantly to the success of sustainable development [6].

Based on the result of the study [21], among the factors need to consider is largely that of initial cost, energy consumption, maintenance cost that meet the performance standards in the most economical way. The designer must know the limits within which their choices must be made in terms of the considered criteria [i.e. materials selection, design principle, associated cost and others] [21].

Mondor [22] study demonstrated that: 1. investment in green systems can yield direct savings and improved sustainability operations and maintenance practices. Yudelson [23] identified 14 benefits that build a business case for Green Building, e.g., reduced operating and maintenance costs, marketing benefits, productivity benefits, and increased building value. There were plenty of factors affecting the development of public hospital building development.

## 3 Methodology

In this study, some implications and limitations exist which need to be focused and scrutinized in further studies. First, there were a small number of experts in fulfilling the survey for this study. As sophisticated analysis is derived by the large sample size of the respondents [24].

This study adopts literature review and a questionnaire survey as the main method of data collecting. Ranking analysis using SPSS were conducted to achieve the aim of the study. A survey approach was adopted as a means of gathering information and necessary data collection. It was aimed at investigating the perceptions from the experts on the influencing factors attributes in developing green public hospital building development. The survey collected data with the help of a professional website [survey monkey] and hand delivered. It composed of two sections: 1)

respondents' information; and 2) factors evaluation. The first section was intended to obtain background information on the respondents. This section requests the respondent to fill in appropriate information relating to his/her organization type, job designation, total years of work experience and others. The respondents were requested to evaluate the "importance" [the factors encouraging the green public hospital buildings development] on a 5 point Likert Scale (1 Very Low, 2 Low, 3 Moderate, 4 high, 5 Very High). Rowlinson [25] suggests that for a research study, well-known factors are more applicable, because respondents could be able to respond easily.

Based on the literature review discussed, a questionnaire was designed to solicit professional opinions from the experts. The questionnaire was composed of three parts. The first part explained the research objectives and presented contact details. The second part was designed to collect background information regarding the respondents' position, profession, years of experience, nature of experience, and whether they had been involved in activities related to the adoption of hospitals and green buildings. The third part consisted of a list of potential influencing factors to the adoption of green public hospital buildings [see Table 2]. The experts were requested to evaluate the degree to which each factor was important to green public hospital buildings implementation using a five-point scale (1 = not important and 5 = very important). The five-point Likert scale was selected, because it gives unambiguous results that are easy to interpret [29]. Prior to the questionnaire survey, a pilot study was conducted to test the comprehensiveness and relevance of the questionnaire [26]. The pilot study involved senior lecturers, designers and engineers from hospitals project who were experienced in this research area. The questionnaire was finalized based on feedbacks from the pilot study.

Based on a detailed review of the literature, a large number of factors for adopting green buildings were identified and clustered, from which a list of 40 factors found to have received relatively considerable attention in the literature was compiled for this study (Table 2).

Table 2: Factors identified for encouraging adoption of green public hospital buildings

Code	Drivers factors
KF1	Passive design
KF2	Low energy consumption
KF3	Control energy consumption
KF4	Reduction in earthwork cost
KF5	Reduce greenhouse emissions
KF6	Minimise land use
KF7	Minimise site impact
KF8	Enhancing ecological process
KF9	Human comfort
KF10	Affordability

KF11	Safety and health
KF12	Low-embodied energy
KF13	Increase building lifespan
KF14	Low cost consumption
KF15	Non-toxic materials
KF16	Low lifecycle impact
KF17	Reduce solid waste production
KF18	Improve indoor environment quality
KF19	Adaptability and awareness of end user / occupants
KF20	Low maintenance cost
KF21	Locally manufactured material
KF22	Low environmental impacts
KF23	Reduce natural resources
KF24	Optimise energy performance
KF25	Aesthetic value
KF26	Reduce water consumption
KF27	Reduction in operating cost
KF28	Reduction of sewage volume
KF29	Health effect
KF30	Reduce flooding
KF31	Environmental friendly
KF32	Public safety
KF33	Reduce energy lost
KF34	Reduction of non-renewable resources
KF35	User friendly
KF36	Buildability
KF37	Reduce air pollution
KF38	Improve quality of living
KF39	Increase building performance
KF40	Reduce waste generation

## 4 Results

A better understanding of the key issues influencing green adoption is crucial. The survey was sent to numerous contacts that play key roles in designing the green public hospital buildings. Respondents from various professional backgrounds engaged in green public hospital building development were selected for this study. A total of 82 completed surveys were received out of 100 attempted responses, indicating a response rate of 64%. There were 20% of architect from the total respondents who have participated in this survey. While 37% were Civil and Structural Engineer, 20% of Electrical engineer and 23% of mechanical engineer (Table 3).

The total years of work experiences of the respondents are categorized into 5 groups of 5 years, 6 to 10, 11 to 15, 16 to 20, and more than 21 years. Over a half of the professionals have been practicing their trades in the construction sector for 5 years and above as seen in Table 4.

Table 3: Designation of respondents

Respondents	Percent
Architect	20
Civil and Structural Engineer	37
Electrical Engineer	20
Mechanical Engineer	23

Table 4: Years' of working experience

Working experience	Percent
5 years and below	38
6-10	28
11-15	13.5
16-20	7
21 years above	13.5

As a systematic technique of data collection, the questionnaire survey method has been widely used to solicit professional opinions. The experts were requested to rate the importance level of 40 factors in encouraging the implementation of the public hospital building development. The results of the experts' opinion are shown in Table 5. It indicates the ranking of key factors based on the preferences of professional opinions. The results are expected to contribute valuable information for policy-making in term of the implementation in the future. The findings contribute to deepened the understanding of the issues related to sustainability of hospital buildings. The result of this study also indicate the strength of green building research and education for developers and policy makers related to factors contribute to the implementation of green public hospital building development.

Table 5: Ranking on key factors influencing the development of public hospital buildings

Code	Mean	Std. Deviation	Rank
KF3	3.9634	1.03572	1
KF33	3.9268	.93993	2
KF31	3.9268	.95297	-
KF2	3.9268	1.00346	-
KF24	3.9024	.96366	5
KF39	3.8659	.95274	6
KF18	3.8537	.94440	7
KF11	3.8537	.98284	-
KF37	3.8537	.94440	-
KF35	3.8293	.95329	10
KF29	3.7927	.95242	11
KF15	3.7927	.97800	-
KF38	3.7927	.89908	-
KF9	3.7927	.95242	-
KF27	3.7805	1.06602	15
KF34	3.7683	.97244	16
KF20	3.7561	1.09501	17
KF5	3.7439	.95337	18
KF32	3.7439	.92711	-
KF19	3.7439	.94033	-
KF26	3.7439	.97893	-
KF12	3.7439	.90008	-
KF22	3.7195	.94640	23
KF40	3.7073	.96209	24
KF7	3.6951	.95179	25
KF14	3.6707	1.08928	26
KF13	3.6707	1.00683	-
KF1	3.6585	1.03303	28
KF8	3.6585	.94568	-
KF10	3.6341	1.04836	30
KF17	3.6220	.97677	31

KF36	3.6220	.97677	-
KF16	3.5976	.94097	33
KF30	3.5854	.96802	34
KF28	3.5732	.95621	35
KF23	3.5000	1.03339	36
KF25	3.5000	1.00922	-
KF4	3.4756	.95872	38
KF6	3.4024	1.06411	39
KF21	3.3780	1.00173	40

## 5 Conclusion

Control energy consumption and reduce energy lost have been identified as the major factors contribute to the development of green public hospital buildings. Evidence also exist that energy was the major concern presented by most of green rating tools [5]. While locally manufactured material was discovered as the least factors contribute to the green public hospital buildings development. A study conducted by [6] has shown the experts have chosen the material and resources as the least element considered for green public healthcare concept.

There were some limitations of this study that warrant future research attention. Although the sample size was adequate to conduct statistical analysis, it is appreciated that it is nevertheless a relatively small sample. Future research is required to employ a larger sample to see whether the results would differ from what have been reported in this study.

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