Key influencing factors for green public hospital building development in Malaysia

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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 instance, 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.

| Dimensions | Indicators | References |
|------------|------------|------------|
| Economic   | Initial cost Maintenance cost Disposal cost [8–14] |            |
|            | Meet user needs Energy saving Potential for recycling and reuse [8,10,11,13–19] |            |
|            | Raw material Land acquisition Usage of water Waste management CO₂ emission Soil consumption Transportation Fuel consumption [8–11,13,14] |            |
| Social     | Operational life Local material Health and safety [8–11,13,14] |            |

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: 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).

| Code | Drivers factors                      |
|------|--------------------------------------|
| KF1  | Safety and health                   |
| KF2  | Low embodied energy                 |
| KF3  | Increase building lifespan          |
| KF4  | Low cost consumption                |
| KF5  | Non-toxic materials                 |
| KF6  | Low lifecycle impact                |
| KF7  | Reduce solid waste production       |
| KF8  | Adaptability and awareness of end user / occupants |
| KF10 | Low maintenance cost                |
| KF20 | Locally manufactured material       |
| KF21 | Reduce natural resources            |
| KF22 | Low environmental impacts           |
| KF23 | Reduce energy lost                  |
| KF24 | Environmental friendly              |
| KF25 | Public safety                       |
| KF26 | User friendly                       |
| KF27 | Buildability                        |
| KF28 | Reduce air pollution                |
| KF29 | Improve quality of living           |
| KF30 | Increase building performance       |
| KF31 | Reduce waste generation             |

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                         |

Table 3: Designation of respondents

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

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.
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.

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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