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Cost Impact of GBI Criteria on Non-Residential Green Buildings in Malaysia

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Abstract

The most significant factor for whether or not to go for green goals is the incremental costs of a green building compared to a conventional building. Lack of data addressing incremental costs of green buildings has discouraged the pursuit of the green movement, including by contractors and stakeholders, to consider green goals in their projects. The aim of this paper is to identify the Green Building Index (GBI) criteria that contribute to less project costs for non-residential buildings in Malaysia. In order to achieve this aim, a 4-point Likert Scale questionnaire was designed and given to green building experts including GBI facilitators and Malaysian developers who had contributed in green projects. The green building experts were asked to rate the proportion of Cost Impact of each GBI Criterion. The purpose of the questionnaire was to obtain a perception regarding cost impact of GBI criteria on Non-Residential buildings. In addition, the green building experts were interviewed and their points of view were gathered to identify factors affecting cost impact of GBI criteria in Malaysia. The responses from the questionnaires have been analyzed by SPSS 17. In conclusion, this study has identified the cost impact of GBI criteria whereby all parties including contractors, consultants, and developers can readily obtain and idea about the cost impact of each GBI criterion in order to align the budget to the project's goals.

Keywords

Green Cost, Premium Cost, Green Building, Green Building Index

1. Introduction

Sustainable and green design is gaining significant momentum in the construction industry.

Engineers and architects are learning that with a green design, buildings can save energy and have a decreased impact on the environment (Pulaski, 2004). Although sustainable building may mean different things to different people, generally speaking, sustainable buildings use resources like energy, water, materials, and land much more efficiently than typical buildings (Langdon, 2004). They are also designed and operated to create a healthier and more productive workplace, learning, and living environments, through the use of natural light and improved indoor environmental quality. From a fiscal perspective, sustainable buildings are cost-effective, saving taxpayers money by reducing operations and maintenance costs. Despite the growing body of research detailing the environment and the human health benefits of sustainable construction, the decision to design and construct a green building is still largely based on green cost. Peter Morris (2004) emphasized the incremental cost of making a building green as a very substantial and discussable issue faced by the construction industry.

Cost for a green building could involve no additional cost depending on the building location, design factors and the level of efficiency targeted by the project brief. At the current time, higher rated buildings such as those targeting GBI gold or platinum ratings certainly will involve additional costs. However, it is theoretically possible to achieve GBI certification with no additional costs.

The two most important factors that affect the cost of a green building are 1) The coordination and experience of the project's consultant team, 2) Early adoption and implementation of a green design strategy in the building's design and planning stages. As many green features involve coordination between multiple consultants and team members, effective coordination of all parties (including clients, architects, engineers and contractors) is vital to keeping cost from escalating due to ineffective design and planning. In addition, many costs involved with GBI certification can be mitigated by the early adoption and implementation of a green design strategy. For example, green features and GBI items, which are captured in tender documents, can often be implemented at little to no additional cost as a function of the bidding process whereas implementation of these features at later stages of construction often incurs additional expenses due to the necessity for variation orders and the additional scope of work.

This paper is important in order to identify points that contribute to higher project costs. The Green Building effort needs to prove to the industry and public that Sustainability can come with no additional costs. Past projects have shown that green building will cost from 8% to 15% (GBI, 2010) more than conventional whilst in the USA the increment is 0-7% (Kats, 2003). This is partly due to availability of material, technology, and awareness.

2. Green Building Index (GBI)

The Green Building Index is an environmental rating system for buildings developed by PAM (Pertubuhan Arkitek Malaysia / Malaysian Institute of Architects) and ACEM (the Association of Consulting Engineers Malaysia). The Green Building Index is Malaysia's first comprehensive rating system for evaluating the environmental design and performance of Malaysian buildings based on the six (6) main criteria of Energy Efficiency, Indoor Environment Quality, Sustainable Site Planning & Management, Materials & Resources, Water Efficiency, and Innovation.

The Green Building Index was developed specifically for the Malaysian tropical weather, environmental and developmental context, cultural and social needs. The GBI initiative aims to assist the building industry in its march towards sustainable development. The GBI environmental rating system was created to:

- Define green buildings by establishing a common language and standard of measurement;
- Promote integrated, whole-building design;
- Recognize and reward environmental leadership;

- Transform the built environment to reduce it's environmental impact; and
- Ensure new buildings remain relevant in the future and existing buildings are refurbished and upgraded properly to remain relevant.

3. Green Cost

Despite the growing body of research detailing the environmental and human health benefits of sustainable construction, the decision to design and construct a green building is still largely based on initial cost. Although cost data is increasingly available, the "premium" for greening is still hard to pin down and is therefore often presented as a large range. The popularly cited range for building to the LEED™ Certified or Silver rating is 1 to 5% of the total base project cost.
More recent projects are generally incurring costs on the lower side of that range, but there are examples of projects that have come in under budget and others that have cost upwards of 10% more. Therefore, the more relevant questions seem to be:

What are the factors that make some projects cost less than others?

Why do some projects cost so much more, and how could costs be better managed in the future?

There is little published data about the actual cost of green buildings and particularly about actual cost premiums for LEED-rated green buildings. The USGBC, the developer and administrator of the LEED certification process, does not require that cost information be included with submissions for LEED certification. However, from KEMA Xenergy's surveys of the industry, the capital costs of design and construction vary significantly, depending on the specific project goals. While there are some green building measures that may be achieved as a matter of course with no change in cost (e.g., recycled content structural steel), some green building features involve a change in practice that effectively moves costs from one budget to another, usually shifting costs from operation and tenant budgets to design and construction.

The challenge is that while lifecycle analysis may fully justify additional investment up front in the project design, there may be no source of supplementary funds available at the time of construction. This section surveys completed projects to determine the magnitude of the green premium required for design and construction.

The cost to achieve LEED certification can depend upon a variety of factors and assumptions, including (Geof Syphers 2003):

- Type and size of project;
- Timing of introduction of LEED as a design goal or requirement;
- Level of LEED certification desired;
- Composition and structure of the design and construction teams;
- Experience and knowledge of designers and contractors or willingness to learn;
- Process used to select LEED credits;
- Clarity of the project implementation documents;
- Base case budgeting assumptions.

In addition, the costs will vary, depending upon whether only capital costs are considered or if costs are calculated over the life of the building. Finally, successful enforcement of a policy based on the adoption of LEED will depend on the level of up-front financial commitment to internal program support, policy implementation, and external market transformation.

Each of these factors will contribute to the overall cost of implementing LEED, and because each factor can vary significantly on a project-by-project basis, the cost of each LEED project is different. However, as more and more projects go through the LEED rating process, a general picture of costs is beginning to emerge.

Many building industry professionals maintain that if the stakeholder is committed at the project conception and the design and construction team has moderate sustainable design and construction experience, a LEED Certified building can be achieved on a conventional building budget. Projects throughout North America have already proven this. However, it would be shortsighted to simply assume that all building projects in all marketplaces can currently achieve a LEED Certified rating on a conventional budget.

Across the U.S., green building consultants in all building sectors have been revising their expected cost of achieving a LEED Certified rating downward in recent months, based on experience and on research, such as the companion report on The Costs and Financial Benefits of Green Building. Previously, consultants would identify a typical range of 2 to 5% additional cost for Certified projects and upwards of 5 to 10% or more for higher LEED ratings (Silver, Gold, or Platinum). The range is a percentage of total construction costs and includes design- and construction-related fees (Figure 1).

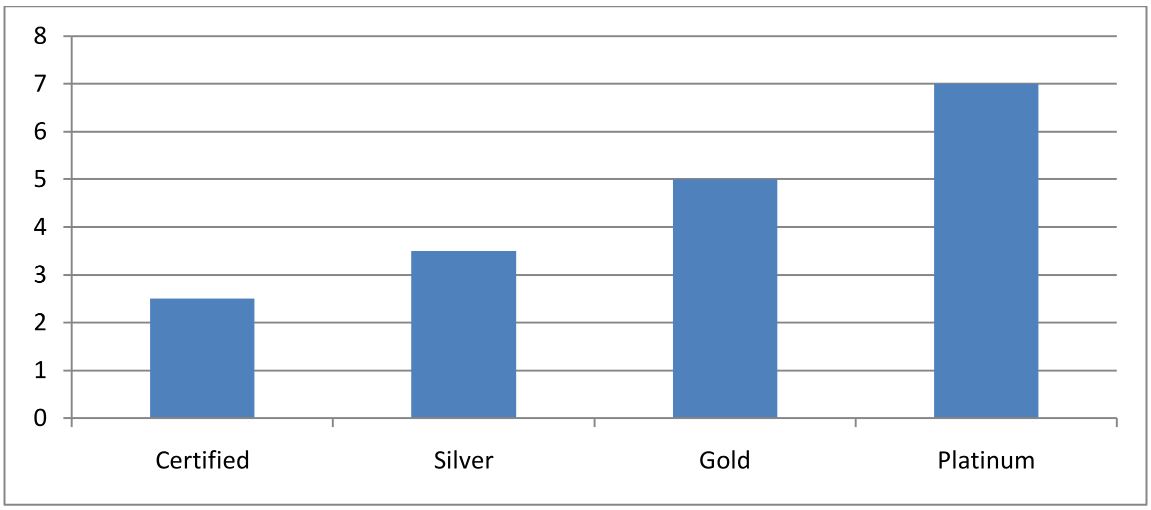

Figure 1: Typical incremental percentage capital cost of meeting

Note that these ranges are considerably lower than previously assumed. The general consensus, based on conversations with green building consultants, until very recently had been that Certified costs from 1 to 3%, Silver 2 to 6%, Gold 5 to 10%, and Platinum 7% and up. Those numbers are now markedly lower.

4. Methodology

The methodology used in this study is considered based on the needs of the researcher to achieve the projected objectives. The methodology adopted in this paper briefly explains the steps from the initial stages of preliminary study to data analysis and report writing.

The primary data collection is mainly to identify GBI criteria and their cost impacts on Non-Residential buildings in Malaysia. The questionnaire survey in this step is divided by two phases of interview with structured questionnaire and questionnaire survey with unstructured questionnaire.

The purpose of the phase 1 is to conclude the main data to be used for the analysis for this study. The data collection for this phase is from the questionnaire survey. The data collected through this questionnaire survey was delegated to Green Building experts and green construction developers around Malaysia. The questionnaire structure was based on two types of answering techniques, namely rating based and open-ended format. Under the rating based format, respondents were instructed to rate their opinion for a specific fact by ranking them using a 4-point Likert Scale from Low Impact to High Impact.

Data Analysis consists of examining and categorizing the evidence to address the initial propositions of the study. The data gathered from the interview were processed and analyzed using Microsoft Excel from Microsoft Professional Windows and statistical tool, SPSS 17. With this analysis, the author was able to determine whether the research objectives had been achieved. Since the data collection for this study was divided into two parts, different methods of data analysis were used to analyze the data from different types of data collection methods.

5. Identification of GBI Criteria that Contribute to Lower Project Costs

The purpose of this objective is to indentify GBI criteria that contribute to lower project costs. In order to achieve this objective, questionnaires have been distributed between green building experts including GBI facilitators and Malaysian green developers. The respondents were asked to rate the proportion of Cost Impact of each GBI criterion in the related box based on the table 1:

Table 1: Proportion of Cost Impact

Cost Impacts NO	**1**	**2**	**3**	**4**
Description of Cost Impact (Per 1000SF)	No Premium (0)RM	Low Premium <RM80/1000SF	Moderate Premium (80-200) RM/1000SF	High Premium >RM200/1000SF

The summary of the results is presented in Table 2. This table shows Weighted Average and classification of for each GBI criterion.

Table 2: Cost Impact of GBI Criteria

ITEM	**WA**	**Cost Impact**
EE1 - Minimum EE Performance	1.88	Low Premium
EE2 - Lighting Zoning	2.23	Low Premium
EE3 - Electrical Sub-Meeting	2.15	Low Premium
EE4 - Renewable Energy	3.81	High Premium
EE5 - Advanced EE Performance	3.31	Moderate Premium
EE6 - Enhanced Commissioning	2.54	Moderate Premium

EE7 - Post Occupancy Commissioning	2.54	Moderate Premium
EE8 - EE Verification	1.96	Low Premium
EE9 - Sustainable Maintenance	1.77	Low Premium
EQ1 - Minimum IAQ Performance	1.92	Low Premium
EQ2 - Environmental Tobacco Smoke (ETS) Control	1.46	No Premium

Cont. Table 4.2: Cost Impact of GBI Criteria

EQ3 - Carbon Dioxide Monitoring and Control	2.19	Low Premium
EQ4 - Indoor Air Pollutants	2.27	Low Premium
EQ5 - Mould Prevention	1.69	Low Premium
EQ6 - Thermal Comfort : Design & Controllability of System	1.65	Low Premium
EQ7 - Air Change Effectiveness	2.27	Low Premium
EQ8 - Day Lighting	2.08	Low Premium
EQ9 - Daylight Glare Control	2.31	Low Premium
EQ10 - Electric Lighting Levels	1.88	Low Premium
EQ11 - High Frequency Ballasts	2.12	Low Premium
EQ12 - External Views	1.50	Low Premium
EQ13 - Internal Noise Levels	2.04	Low Premium
EQ14 - IAQ Before & During Occupancy	2.08	Low Premium
EQ15 - Post Occupancy Comfort Survey : Verification	1.54	Low Premium
SM6 – QLASSIC	1.50	Low Premium
SM8 - Public Transportation Access	2.15	Low Premium
SM11 - Storm water Design – Quantity & Quality Control	1.69	Low Premium
SM12 - Greenery & Roof	2.65	Low Premium
SM13 - Building User Manual	1.73	Low Premium
MR1 - Materials Reuse and Selection	2.38	Low Premium
MR2 - Recycled Content Materials	2.35	Low Premium
MR3 - Regional Materials	1.50	Low Premium

MR4 - Sustainable Timber	2.85	Low Premium
MR5 - Storage & Collection of recyclables	1.35	No Premium

Cont. Table 4.2: Cost Impact of GBI Criteria

MR6 - Construction Waste Management	1.27	No Premium
MR7 - Refrigerant & Cleans Agents	1.77	Low Premium
WE1 - Rainwater harvesting	2.58	Moderate Premium
WE2 - Water Recycling	2.88	Moderate Premium
WE3 - Water Efficient – Irrigation 0 landscaping	2.15	Low Premium
WE4 - Water Efficient Fittings	2.38	Low Premium
WE5 - Metering & Leak Detection System	2.31	Low Premium
IN1 - Innovation in Design & Environment Design Initiatives	3.08	Moderate Premium
IN2 - Green Building Index Accredited Facilitator	1.58	Low Premium

Based on the findings of the first objective (Table 2), GBI criteria that contribute to a lower cost, such as sustainable timber and indoor air pollutant, stand in contrast to the GBI criteria with a higher cost impact, such as renewable energy and advanced EE performance. These have been identified to give an idea to the project team about cost allocation strategy.

6. Conclusion Remarks

The objective of this paper has been achieved by the establishment of 40 criteria which are stated in the Green Building Index (GBI) manual for Non-Residential buildings. The green building experts were asked to rank each criterion from no cost impact to high cost impact based on their experiences in green buildings. Finally, based on Table 2, GBI criteria that contribute to lower costs, such as sustainable timber and indoor air pollutant, and in contrast, GBI criteria with higher cost impact such as renewable energy and advanced EE performance have been identified to give a perception to the project team in terms of their cost allocation strategy.

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