Development of Rating System For Sustainable Building In Malaysia

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Abstract
Existing environmental assessment methods attempt to measure improvements in the environmental performance of buildings relative to current typical practice or requirements. The assumption is that by continually improving the environmental performance of individual buildings, the collective reduction in resource use and ecological loadings by the building industry will be sufficient to fully address the environmental agenda. The choice of the term 'green building assessment' is seen as a useful term to convey this intent. Several environmental methodologies and methods for evaluating environmental performance of buildings are being currently developed. In a global scale it is worth mentioning SB (Sustainable Building) Tool, formerly known as GB Tool (Green Building Tool) which is an international project coordinated from Canada, LEED (Leadership in Energy and Environmental Design) a method developed in the USA with a world wide application and CASBEE (Comprehensive Assessment System for Building Environmental Efficiency), a method developed in Japan. In Europe, some of the most frequently used include BREEAM (Building Research Establish Environmental Assessment Method) in the UK and also it is worth mentioning the HQE (High Environmental Quality) developed in France during the last decade and the VERDE method developed recently in Spain (Maria Sinou 2006). In this paper several method will be discuss and will become main references for developing Sustainable building Tool for Malaysia.

Keywords: Building Performance, Sustainable, Building Rating, Practice, Assessment

1. Introduction

At the 2005 World Green Building Council Congress, the mayors of fifty of the world's largest cities signed an agreement that all new municipal buildings will be subject to green building rating systems by 2012. This event is only the latest in an exponential stream of activities that have served to transform the building delivery process over the past ten years to one that facilitates sustainable design, construction and operation. Rating system used because it is amongst the most effective means of encouraging sustainable building development. It provides a means for building owner or tenant to ask for a green building and to compare the green-ness of their building choices. Rating system represent key tools to evaluate and compare green buildings. The system provide systematic frameworks for specifying performance criteria, thereby enabling actors in the building industry to be more measured and accurate about the movement towards more sustainable forms of designing, constructing and operating buildings.(Elisa Campbell Consulting 2006). Indicators of sustainability are necessary for determining how well buildings perform against environment, social, socio-cultural and economic criteria on regional, national and global scales. Building rating tools have emerged in recent years as a means to evaluate the performance of buildings across a broad

range of sustainable considerations beyond established single performance criteria such as energy (Al Waer and Sibley 2005). Green building practice is the basis for green building assessment. To make it more feasible, the establishment or customisation of regional specific indicator framework for green building assessment should be initiated from the region(s) that have more active green building practices. Such practices not only provide us possibilities and opportunities to collect regional green benchmark data for the indicator framework, but also demonstrate the level, extent and availability of regional green building technology as well as indicates the core of regional environmental problems, which are important for setting up the regionally specific weighting system.

2. Definition

To reach sustainability of building, it is primarily important to define sustainability of building and construction. The definition usually focuses on how to deal with limited resources, especially energy, and how to reduce the impacts on the natural environment {Chung, 2005 #54}. Kibert's definition for sustainable construction: "the creation and responsible management of a healthy built environment based on resource efficient and ecological principles (Kibert, 1999)" can be considered a comprehensive definition for a sustainable goal. The emphasis to reach sustainability of building was mainly placed on the technical issues such as materials, building components, construction technologies and on energy related design concepts. Nowadays the significance of the non-technical issues, for example, economic, social, and cultural aspects has been emphasized gradually and considered crucial.

Kyvelou, (2006) identified that the assessment of building performance in terms of environmental impact and overall sustainability approach is carried out by several methods, so she reviewed the most frequent used tool and compared to suggest a future easy to use, sustainable building assessment tool. Further, more, they suggested that a proper definition of building assessment tool is needed to give designers a clear picture, sufficient detail to enable them to design a high quality design consistent. The assessment tool should provide a fair platform for users and public to evaluate the performance of sustainable building. The available assessment tools are based on original conditions and characteristic, whereas the alterations of the building elements' attributes are not taken into consideration. The lack of an efficient substructure (extensive databases, regulations and statistics) is one of the reasons. (Kyvelou, 2006).

However, knowledge and perception of serving and prospective operation and maintenance practitioners about the key aspects of sustainable buildings and study the contribution of the current education and training means to their knowledge level is crucial for building practitioners. An understanding of the current state of operation and maintenance practitioner's knowledge and their perceptions about sustainable buildings is therefore crucial to filling the knowledge gap and to realisation of a sustainable built environment. . (Yik, 2006)

It is argued that a significant improvement in the regulations is required if large reductions in CO2 emissions are to be achieved in the first half of the next century and that considerable scope for regulation improvement exists (almost 90 per cent reductions in space heating are achievable). (Lowe, 2006) suggests demonstrating compliance and proposes new approaches that would increase consistency and enable a clear programmed of improvement to be established. Improving the performance of the existing building is therefore important issue for national environmental policy but these are likely to be problematic. Perhaps, better left to other more broadly based legislation designed rather than the strict application of building regulation.

Even though the sustainable building rating system has become popular to property owner but the nature of their success generally depends on the environmental response of property owner and building manager. There must be a guideline to introduce the system.

3. Assessment Methods

Several environmental methodologies and methods for evaluating environmental performance of buildings are being currently developed. In a global scale it is worth mentioning SB (Sustainable Building) Tool, formerly knowned as GB Tool (Green Building Tool) which is an international project coordinated from Canada, LEED (Leadership in Energy and Environmental Design) a method developed in the USA with a world wide application and CASBEE (Comprehensive Assessment System for Building Environmental Efficiency), a method developed in Japan. In Europe, some of the most frequently used include BREEAM (Building Research Establish Environmental Assessment Method) in the UK and also it is worth mentioning the HQE (High Environmental Quality) developed in France during the last decade and the VERDE method developed recently in Spain (Maria Sinou 2006).

Despite taking part in various sustainable development programme and Local Agenda 21, Malaysia has not yet to implement of any assessment method to measure the sustainable environmental performance of its buildings. Environmental assessment tools for buildings also have not yet been introduced in Malaysia. Countries that have introduced such schemes in a non-mandatory base, as in the Asian level: the Singapore with Green Mark, the Hong Kong with HK-Beam and European level: the UK with BREEAM, or the Netherlands with ECO – QUANTUM, have already understood its need and added stakeholder value. Their penetration rate is considerably high due to a well-based framework of sustainable construction and their approval by the construction sector.

Several Building Assessment methods are currently in use around the world, but the evidence in the context of Malaysian specific assessment system has not yet existed. Meanwhile, neighbouring country Singapore has developed their green building tool called Green Mark Building Scheme. Launched in Jan 2005, the Green Mark for Building Scheme is Building Construction Authority's (BCA) main initiative to promote environmental sustainability in buildings. This is an integral part of BCA's effort to shape a safe, high quality and people friendly built environment. Modelled after similar schemes adopted in countries such as USA and Australia, the scheme is used as the yardstick to rate the environmental sustainability of a building.

"Building environmental systems must reflect national, regional, and local differences if they are to be accepted and used" (Todd and Geissler 1999; Joel Ann Todd 2002). Hence, Singapore is the neighbouring country that successfully implemented the Green Mark Assessment Method. Due to similarity in the weather condition, social and cultural value, this assessment method looks applicable to Malaysian building for assessment but several adjustments has to be made to suit local conditions.

SBTool was selected as comparison to Green Mark as this tool could be set to suit the local condition. The benchmark and parameter of every issue in the tool could be adjusted to assessor's satisfactory level depending on local requirements. This research will determine how friendly the tool evaluates sustainability for Malaysian building.

This research intended to support the ongoing market transformation towards high performance buildings. In this context, its focus is on existing buildings, which is office building, and on tools that permit the rating of these buildings. The key objective of this research is to identify the communication of rating tool that could contribute individually to the collective effort to support the ongoing transformation of the building industry in Malaysia. For this reason, this research examines and communicates the characteristics and capabilities of the Green Mark and SBTool rating systems in order to permit different target audiences to assess their respective suitability to any given application.

4. Review of various Environmental Rating Method

The growth and use of buildings' environmental performance assessment methodologies, is considered to contribute

greatly to the integration of methods and practices favouring sustainability in the building sector. The methods that have been developed worldwide are built upon various principles and different evaluation items, data and criteria. However, most of the tools do not take into consideration the lifetime parameters. The assessment they measures is based on original conditions and characteristic, whereas the modification of the building elements' attributes are not taken into accounts.

There is some buildings' assessment evaluation tools recently developed, conduct detailed and through assessment, which seem to provide reliable results. The methods are as follows:

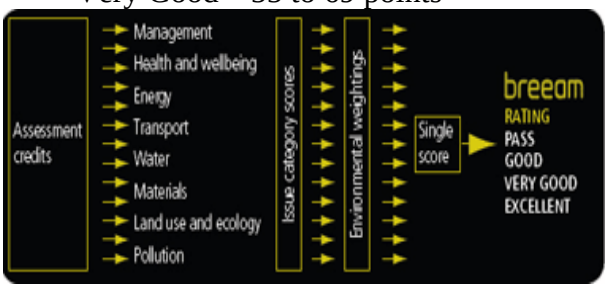
4.1. The BREEAM method

BRE's Environmental Assessment Method (BREEAM) Introduction to BRE and BREEAM: BREEAM is an environmental rating system mainly prevalent in the U.K. and to some extent in the countries in the European Union. It was developed in the 1990s by Building Research Establishment Ltd. (BRE) in the U.K. and is believed to be the first rating system for assessing buildings based on environmental issues. To review BREEAM it is first essential to understand the contribution of BRE to the building industry.

BRE was founded in 1921 to initiate advancements and improvements in building environments. It is involved in certifying and testing the built environment for its quality of space and environmental consciousness, providing consultancy for the use of new technologies, research in areas associated with building regulations in the U.K., fire safety issues, structural integrity and building-occupant interaction, and training people on a wide range of topics associated with the built environment.

One of the major contributions of BRE to the building industry was the creation of BREEAM for rating buildings for their environmental performance. BRE gradually launched BREEAM for various building sectors which include offices, retail buildings, hospitals, homes, schools and infrastructure. BREEAM Schools, introduced in 2005, is a recent induction to the family of rating systems. It was launched in response to the "Sustainable Development Action Plan" for schools by the Development for Education and Skills (DfES) of the U.K. Government. It is applicable to both new as well as refurbished school projects. Nine environmental categories are identified in the compliance manual for schools which are 1 1 stated in Table 1. The building is rated for its performance in each category and then summed to get an overall score. Based on the overall score the building is rated. There are four levels of rating.

Pass – 25 to 39 points
Good – 40 to 54 points
Very Good – 55 to 69 points



Source-www.bre.org.com

4.2. The SB Tool Method.

The SB Tool is a software system assessing the environmental and sustainability performance of buildings. It is an implementation of the green building challenge (GBC) assessment method, which has been under development since 1996 by a group of more than a dozen teams. The GBC process was launched by Natural Resources Canada, but responsibility was handed over to the International Initiative for a Sustainable Built Environment (IISBE) in 2002.The method was the flexibility of importing benchmark values according to the regional ones, therefore, applying it at local scale. The method comprises of two parts, Module A includes benchmarks and weights and is intended to be adjusted by third parties to suit local conditions and Module B results to the sustainability performance of the building in question. The tool is designed as a generic framework and it requires adjustments by the user, which expected to import value of weights, benchmarks and emission values. Benchmarks are of two types, could be express as numeric values and best described in text form. A scale ranging from -1 to +5 is

used to express the evaluation in ant cases. The scale is interpreted as -1 negative performance, 0 minimum acceptable performances, three (3) good practice and five (5) best practice.

Table 1. Environmental parameters involved in the BREEM method

Energy
1. CO2 emission
2. Building envelope performance
3. Drying space
4. Eco labelled white goods
5. External lighting

Transport
1. Public transport
2. Cycle storage
3. Local amenities
4. Home office

Pollution
2. Infrastructure 1. Insulation ODP and GWP
2. NOx emissions
3. Reduction of surface runoff
4. Zero emission energy sources

Materials
1. Timber: basic building elements
2. Timber: finishing elements
3. Recyclable materials
4. Environmental impact of materials

Water
1. Internal water use
2. External water use

Land use and ecology
1. Ecological value of site
2. Ecological enhancement
3. Protection of ecological features
4. Change of ecological value on site
5. Building footprint

Health and well being
1. Day lighting
2. Sound insulation
3. Private space

4.3. The LEED method

The LEED system, developed by the US Green Building Council, is a national standard for developing sustainable buildings. LEED applies to new commercial construction and major renovation projects (LEED-NC), existing buildings operations (LEED-EB), commercial interiors projects (LEED-CI), core and shell projects (LEED-CS), homes (LEED-H) and neighbourhood development (LEED-ND). A number of parameters are evaluated and result to a score, which gives a certification of certified, silver, gold and platinum construction.

The LEED method involves several parties along the process of the evaluation and certification. The LEED for homes provider is an organization, which employs raters that provide the verification of the installation measures as well as the performance testing of homes. The LEED professionals are mainly consultants linked to builders.

Table 2. Environmental parameters involved in the LEED method

Location and linkages
1. Site selection
2. Community resources
3. Compact development

Sustainable sites
1. Site stewardship
2. Landscaping
3. Shading of hardscapes
4. Surface water management
5. Non-toxic pest control

Water efficiency
1. Water reuse
2. Irrigation system
3. Indoor water use

Indoor environmental quality
1. Combustion venting
2. Humidity control
3. Outdoor air ventilation
4. Local exhaust
5. Supply air distribution
6. Supply air filtering
7. Contaminant control
8. Radon protection
9. Vehicle emission protection

Materials and resources
1. Home size
2. Material efficient framing
3. Local resources
4. Durability plan
5. Environmental preferable products
6. Waste management

Energy and atmosphere
1. Insulation
2. Air infiltration
3. Windows
4. Duct tightness
5. Space heating and cooling
6. Water heating
7. Lighting
8. Appliances
9. Renewable energy

10.	Refrigerant management
Homeowner awareness	
1.	Homeowner education
Innovation and design process	
1.	Innovative design

Finally, the LEED faculty provides training and program development services. The verification process consists of four phases, namely inspection, performance testing, rating and certification. In all the phases, the participating of the provider is mandatory.

LEED (Leadership in Energy and Environmental Design). The Leadership in Energy and Environmental Design Reference Guide is a rating system which grades buildings for their overall environmental performance. The reference guide is divided into environmental categories with weighted importance such as, sustainable sites (22%), water efficiency (8%), energy and atmosphere (27%), materials and resources (20%), indoor environmental quality (23%), and innovation and design process. Under each category there are guidelines addressing environmental concerns, which the design and construction team must try to achieve. There is a credit associated with each guideline and the more the number of credits a building accomplishes, the better it achieves environmental design objectives according to LEED. The rating scale of 0 – 69 points is classified at four levels: platinum (52 points or more), gold (39 to 51 points), silver (33 to 38 points), and certified (26 to 32 points) – in descending order of environmental sensitivity. The guidelines under each category are tabulated in Table 13 – Appendix A. The U.S. Green Building Council (USGBC) is the organization which developed the LEED rating system in 1998. Since its inception, LEED has undergone revisions (version 1.0, 2.0, 2.1, and 2.2) to address changing environmental issues and to simplify the method of evaluation. The USGBC acts as a third party, assessing the building of the applicant project team, based on LEED guidelines and then rates it. At present LEED is being modified to incorporate the long-standing demand of the architectural and engineering community and, to have separate guidelines with respect to the functional typology of buildings. Until now the USGBC has released LEED for New Construction, LEED for Existing Building Operations, LEED for Commercial Interiors, LEED for Core and Shells, and LEED for Homes: LEED for Neighbourhood Development is in its pilot test stage.

4.4. The CASBEE method

CASBEE is a Japanese environmental labeling method for buildings, based on assessment of their environmental performance. CASBEE is developed based on three major concepts. Firstly, it is designed for the assessment of buildings which corresponds to their lifecycle. Secondly, it is based on a concept that early distinguishes environmental load (L) and quality of building performance (Q) as the major assessment targets. Thirdly, it introduces a new indicator, namely BEE (building environmental efficiency) based on the concept of eco-efficiency. BEE is defined as Q/L to indicate the overall result of environmental assessment of buildings, where Q is further divided into three items for assessment:

- Q1, indoor environment;
- Q2, quality of services; and
- Q3, outdoor environment on site.

Similarly L is divided into:

- L1, energy;
- L2, resources and materials; and
- L3, off-site environment.

CASBEE can be applied to both private and public buildings, which are broadly divided into residential and non-residential and further into building types. The tool comprises of a set of four basic assessment tools, namely CASBEE for pre-design (CASBEE-PD), CASBEE for new construction (2004) (CASBEE-NC), CASBEE for existing buildings (CASBEE-EB) and CASBEE for renovation (CASBEE-RN), which correspond to the individual stages of the building's lifecycle. A brief introduction for each of the tools follows.

The CASBEE for pre-design (CASBEE-PD) tool aims to assist owners, architects and planners during the pre-design stage of the project and serves two major roles:

- to assist in understanding issues such as the basic environmental impact of the project and selecting a suitable site; and
- to evaluate the environmental performance of the project at the pre-design stage.

The CASBEE for new construction (CASBEE-NC) tool is a self-assessment check system which enables architects and engineers to raise the BEE value of the building during its design process. It makes assessments based on the design specification and the expected performance. It can also serve as a labeling tool. With this tool parties involved in the design process are able to apply correction strategies towards a higher BEE value, therefore a more efficient building. The former two CASBEE tools could be correlated with the HQE method, since they both inform the planners during the design stage.

The CASBEE for existing building (CASBEE-EB) tool concerns existing building stock, based on records of environmental management for at least one year after completion. Lastly, the CASBEE for renovation (CASBEE-RN) tool, which also concerns existing buildings, can create proposals for new renovated more environmentally efficient building stock.

The CASBEE tool does not take into consideration aesthetic design parameters or economic parameters, namely assessment of cost and profitability. Also, it should be mentioned that it does not account for any social parameters .The assessment items presented above are scored according to the scoring criteria set for each at a level form 1 to 5. The points for each item are assigned as one point for level one to five points for level five. In order to produce the assessment result for the building as a whole, an aggregated average of the scores for each item, according to the ratio of floor areas for each section is calculated. The results are presented into two forms, first the score sheet, which presents the scores of each of the Q and L subcategories and second the assessment result sheet, which presents results for each field as radar charts, bar graphs and numerical data for Q (environmental quality and performance of the building) and LR (the building's load reduction). The BEE is also calculated at this stage presenting an overall evaluation of the environmental efficacy of the building into consideration. BEE is calculated from SQ and SLR, the scores for Q and LR, according to the formula below.

$$\mathrm{BEE} = \frac{Q:\text{Building environmental quality and performance}}{L:\text{Building environmental loadings}} = \frac{25\times(S_Q-1)}{25\times(5-S_{LR})} \quad (1)$$

BEE values are represented by plotting L on the x axis and Q on the y axis. The higher the Q value and the lower the L value, the steeper the gradient and the more sustainable the building is. This simple graph has provided a graphical representation of the environmental efficiency of a building. The tool has introduced a labeling classification of five areas, where class C is regarded as poor in terms of sustainability, class B 2 , class B þ , class A, are regarded as average and class S as excellent.

4.5. The HQE method

The HQE project methodology was developed in France and presents a mostly open character. It integrates a great number of parameters, requires a mode of management of the operations inspired by the international standard ISO 14001, and consists of a project methodology instead of a simple ex-post certification like the majority of the other existing methods. Thus, it offers an interesting framework for capitalizing experience feedbacks, and for seeking common denominators. Launched in 1996, the HQE programmed enables developers and project owners to adopt construction options appropriate to sustainable development, at all stages of a building's life cycle (manufacture, construction, use, maintenance, conversion and end of life). The HQE Association defined 14 targets specifying the particular environmental requirements that a building, whether new or rehabilitated, must satisfy. The method is applicable in all phases of design, namely.

- building decision making;
- design;

- construction;
- use of the building; and
- end of the building.

Environmental management system (EMS) is needed to implement the HQE method. In fact, most of the builders in France refer to a general declaration without an operative EMS. Few of them are developing a specific approach based on an environmental policy, objectives and targets, requirements and evaluation. In the context of ISO14001, EIC are the criterion of environmental performance to design, build, and use and deconstruct (end of life) the building. The implementation of the HQE method requires the consideration of a number of environmental issues, which have to be taken into account. Identification of polluted areas before building; best practices to implement a building based on accessibility, utilities; Information on environmental impact of products and services;

- energy used during all phases of the life cycle of the building (embodied energy, energy used to implement, etc.);
- water used during every phases of the building's life cycle;
- waste produced during all the phases of the building's life cycle;
- emission and pollution produced during all the phases of the building's life cycle; and
- the global cost of the building including investment, utilities, maintenance, life span, and also take into account avoided pollution, best health protection and avoided GHG.

Using the ISO 14001 requirement, the builders define and check the environmental impacts of the building. All the EICs could describe the requirement for a HQE method, which is defined as a voluntary step beyond the regulation. The major reference is the French building regulation, which has been supplemented by the EIC. The implementation of the method requires:

- the organization of the project according to ISO 14001 principles; and
- the selection of the level requirements, which are relevant to the use of the building, the environmental policy of the builders, and the comfort and health of the users.

The HQE association published in 1997 a formal text which contains the framework of the HQE method. These texts are generic for all buildings and contain two parts:

(1) A part to manage the implementation of the method based on ISO140001 concepts.

(2) A part which describes in the framework of each environmental issue of concerns, the requirements needed to conduct the implementation of HQE method.

The Association HQE texts, for the moment, do not contain specific parameters, indicators, or environmental levels of performance. The builders conserve the choice to fix some environmental performance levels.

4.6. The VERDE method

VERDE is a Spanish method for evaluating the environmental performance of buildings. It is developed by the Arquitectos, Urbanistas e Ingenieros Asociados, S.L.U.in the GBC Spain Consejo Superior de los Colegios de Arquitectos de Espana.

The method applies to new buildings of various types, namely residential, offices, commercial, hotels, hospitals and educational. VERDE is designed to allow assessments at various phases of the life cycle of a project. The method comprises of three phases:

i) HV1, the pre-design phase assessment is intended to indicate the future potential sustainable performance of the project, based on the information available at the end of the pre-design phase.

ii.) HV2, the design and construction phase assessment is intended to indicate the future potential sustainable performance of the project, based on the information available at the end of the design phase or at the end of the construction and commissioning phase, but at any case before occupancy.

iii) HV3, assessment during the operation phase is intended to provide an objective and factual indication of the actual performance of the project, and the results may be useful for certification purposes.

At the moment, only VERDE-HV2, the design and construction phase, tool is completed and can be used for environmental assessment. The main objectives and parameters of the tool are briefly presented below. The system covers a wide range of sustainable building issues, environmental loadings, resources exhaustion, emission to air, water and solid wastes, local and regional impacts, factors affecting building environment, indoor environment quality and quality of service, as well as social and economic aspects.
The selection criteria on HV2 are in accordance to the future ISO Standard with compulsory environmental aspects of the building included in the assessment of environmental ISO/TC 59/SC 17 "Sustainability in building construction – framework for methods of assessment for environmental performance of construction works – Part 1: buildings" draft ISO/DTS 21931. The intention of VERDE-HV2 is to evaluate the environmental impact of newly constructed buildings. It is mainly based on the SBTool using benchmarks and weights appropriated for each criterion. The benchmarks are classified into two main types: those that can be expressed as numeric values and others that are best described in text-based parameters. A value scale is introduced ranging from 0 to þ5, with 0 representing the reference scale, minimum acceptable performance and five representing best practice, and maximum performance achieved using the best available technology with affordable cost.

4.7. The Green Mark Method

The BCA Green Mark Scheme was launched in January 2005 as an initiative to move Singapore's construction industry towards more environment-friendly buildings. It is intended to promote sustainability in the built environment and raise environmental awareness among developers, designers and builders when they start project conceptualisation and design, as well as during construction.

BCA Green Mark is a green building rating system to evaluate a building for its environmental impact and performance. It is endorsed and supported by the National Environment Agency. It provides a comprehensive framework for assessing building performance and environmental friendliness. Buildings are awarded the BCA Green Mark based on five key criteria:-

- Energy Efficiency
- Water Efficiency
- Site/Project Development & Management (Building Management & Operation for existing buildings)
- Good Indoor Environmental Quality & Environmental Protection
- Innovation

Under the Green Mark assessment system, points are awarded for incorporating environment-friendly features which are better than normal practice. The assessment identifies designs where specific targets are met. Meeting one or more indicates that the building is likely to be more environmental friendly than buildings where the issues have not been addressed. The total number of points obtained provides an indication of the environmental friendliness of the building design.

The assessment process consists of an initial assessment leading to the award of the Green Mark. Subsequently, buildings are required to have triennial assessment. This is to ensure that the Green Mark building continues to be well-maintained. Buildings are awarded **Platinum, Gold^{PLUS}, Gold or Certified rating** depending on the points scored. Apart from achieving the minimum points in each rating scale, the project has to meet all pre-requisite requirements, and score a minimum of 50% of the points in each category, except the Innovation category.

BCA Green Mark has assessment criteria for two main categories: **New Buildings** and **Existing Buildings**. The scheme for new building will provide the opportunity for developers to design and construct green, sustainable buildings which can promote energy savings, water savings, healthier indoor environments and adoption of greenery

for their projects. The scheme for existing building will enable building owners and operators to meet their sustainable operations goals and to reduce adverse impacts of their buildings on the environment and occupant health over their entire life cycle.

New buildings assessed under the Green Mark will require triennial assessment to maintain their Green Mark status. They will be assessed under the existing buildings criteria during the triennial assessment. For existing buildings, they will be assessed under the existing buildings criteria unless they are undergoing a major refurbishment programme.

4.8. HK-BEAM method

HK-BEAM is owned and operated by the HK-BEAM Society an independent not-for-profit organization whose membership is drawn from the many professional and interest groups that are part of Hong Kong's building construction and real estate sectors. Following initial funding from The Real Estate Developers Association of Hong Kong (REDA) HK-BEAM development is funded from assessment fees and the voluntary efforts of HK-BEAM Society members and associates.

HK-BEAM integrates the assessment of many key aspects of building performance, embracing:

- hygiene, health, comfort, and amenity;
- land use, site impacts and transport;
- use of materials, recycling, and waste management;
- water quality, conservation and recycling; and
- energy efficiency, conservation and management.

An assessment under HK-BEAM is voluntary, providing an independently certified performance rating for a building in clearly defined terms. HK-BEAM covers all types of new and existing buildings: residential, commercial, institutional, and industrial. It embraces and endorses exemplary practices in the planning, design, construction, commissioning, management and operation of buildings in the context of Hong Kong's densely populated, predominantly high-rise development.

The benchmark (zero credit level) for particular performance criteria is established by reference to legal requirements, which may be required as a pre-requisite. HK-BEAM uses local performance standards, codes and guides where these are available (e.g. indoor air quality). Where these are not available (e.g. impact noise) international or national standards, codes and guides are referenced. Where there are differences in the performance criteria set by the various authorities HK-BEAM will generally avoid specifying the performance criteria (e.g. thermal comfort), allowing the Client to specify what they consider to be appropriate for their building. A HK-BEAM assessment seeks to establish that the specified levels of performance are acceptable and have been achieved. Where performance standards are not well defined (e.g. energy use) HK-BEAM establishes its own performance benchmarks based on available data and stakeholder consensus. Credits are awarded for achieving higher levels of performance. It is intended that the assessment criteria be updated periodically as new information becomes available and as legal requirements evolve. Since the Hong Kong Building Environmental Assessment Method (HK-BEAM) was launched in 1996, the number of real estate developments that have been certified under this voluntary assessment scheme has recently reached 100, covering some 6 million square meters of built area.(Yik, 2006)

5. Description of the applied tools.

BCA Green Mark has assessment criteria for two main categories: **New Buildings** and **Existing Buildings**. The scheme for new building will provide the opportunity for developers to design and construct green, sustainable buildings, which can promote energy savings, water savings, healthier indoor environments and adoption of greenery for their projects. The scheme for existing building will enable building owners and operators to meet their sustainable operations

goals and to reduce adverse impacts of their buildings on the environment and occupant health over their entire life cycle.

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International Initiative for a Sustainable Built Environment (IISBE) has developed SBTool since 1996. SBTool is a generic framework for rating the sustainable performance of buildings and projects. It may also be thought of as a toolkit that assists local organizations to develop rating systems. The system covers a wide range of sustainable building issues, not just green building concerns, but the scope of the system can be modified to be as narrow or as broad as desired, ranging from 145 criteria to half a dozen. The system allows third parties to establish parameter weights that reflect the varying importance of issues in the region, and to establish relevant benchmarks by occupancy type, in local languages. Thus, many rating systems can be developed in different regions that look quite different, but share a common methodology and set of terms. The main advantage, however, is that a SBTool version developed with local knowledge is likely to be much more relevant to local needs and values than other systems. The system permits assessments to be carried out at four distinct stages of the life-cycle and provides default benchmarks suited to each phase. Local organizations can select up to three building types out of a total of 18, and apply them separately or in a mixed-use project. SBTool takes into account region-specific and site-specific context factors and these are used to switch off or reduce certain weights, as well as providing background information for all parties. The system handles large projects or single buildings, residential or commercial, new and existing construction, or a mix of the two. The system can provide approximations of annualized embodied energy for structural and building envelope components. Designers can specify performance targets and can score self-assessed performance. Assessors can accept self-assessed performance scores submitted by designers, or can modify them.

Elements of the SBTool system:

- SBT06-Region is used by regional third- party organizations to establish eligible occupancy types, and locally valid weights, benchmarks and standards;
- SBT06-ProjectData-1 allows designers to provide very preliminary information about the project characteristics;
- SBT06-ProjectSetting is used by Regional organizations or Assessors to take data from the Region and ProjectData-1 files in order to establish weight and benchmark settings appropriate to the project type;
- SBT06-ProjectData-2 is used by designers to establish performance targets, provide detailed project information, and to report self-assessment scores;
    - SBT06-ProjectAssess provides a file for the Assessor to review the designer's self-assessment values and, if desired, to adjust them,
    - SBT06-Project-IDP is a file that can be used by the design team Project Manager to ensure that the design process takes into account all relevant issues. This file uses the preliminary design information reported in the SBT06-ProjectData-1 file.

6. Evaluated building in Malaysia – Low Energy Office Building in Malaysia

The LEO building is the first government building to be built with integrated energy efficient design. It was designed as a showcase building to demonstrate energy efficient and cost effective features so that other public and private sector buildings can replicate such measures. It was targeted to achieve a building energy index (BEI) of 100kWh/m2 per year

and energy savings of more than 50% compared to buildings without energy efficient design.

The aim of this assessment is to evaluate existing tools on Malaysian context and to establish the comprehensive references for contributors of sustainable construction, including designers, constructors and occupants. More studies on Green Mark assessment tool has been done rather than SBTool due to similarity in regional context of Malaysia.

In order to establish the comprehensive references for contributors of sustainable construction, including designers, constructors and occupants, the assessed results should be facilitated to guide the actions to build environment sustainable. It is significant to accumulate the evaluated result and implementation experience to improve the appropriateness of the tools.

The objectives of the research are:

- To explore the suitability of the tools by understanding how the tools evaluate sustainability.
- To evaluate adaptability of the tools by comparing the criteria and benchmark to Malaysia's practice.
- To determine suitability and adaptability of applied tools to Malaysian office building by applying on practical project and getting expert reviews.

This research was conducted within Malaysian context and Klang Valley area only. As mentioned above, the tools can be applied on both new and existing buildings. This research focuses on the case of existing buildings and in scenario analysis, which aims to evaluate the effectiveness and suitability of applied tools to existing building and had been conducted on an office building (LEO) building in Putrajaya .The scenario approach is the means for investigating important decisions and enables decision makers to detect and explore various results.

This assessment method is using the Green Mark for Existing Building dated January 2007 and SBTool January 2007 version.

The establishment of the building assessment method for Malaysian building will advance the effort of the government to make the building industry more sensitive to environmental issue. This evaluation technique will persuade new category of building type to adopt the assessment method.

This study also provides an opportunity to the building practitioner to put forth their opinion. The suggestions from this study could be incorporated in the evaluation method of office building projects and other building types where applicable.

Rating tools for assessing the performance of buildings can therefore be considered as a "technology" that can help transform the building industry towards higher performance buildings that minimize impacts on the environment, optimize economic, and ensure achievement of social goals and quality of life. They are an important market-based tool for transforming the building industry, raising consumer awareness and stimulating competition and dialogue.

7. Conclusion

Based on the result of both tools, Green Marks seems to be more popular and completely accepted by our experts. They could give comments on the LEO building based on Green Mark criteria. The nature of the tool is simply appreciated and appraised by the experts. It is indicate that, the adopting process of Green Mark to be used as assessment tool in Malaysia is successful. However, several adjustments have to be made to suit our local condition. A further study has to be carried out to determine the area of relevant criteria to be adjusted. Furthermore, Malaysia has been adopted the Qonquas (Quality building assessment system) from Building Construction Authority of Singapore as Qlassic to determine the quality of our building projects. This seems to be a very good shift to move our construction quality to an international standard.On the other hand, SBTool gave the impression of being too complicated with the structure of the tool. The experts conclude that, this tool is not suitable to be used in our country due to many skipped criteria from the assessment. A very great amount of adjustment has to be made. In developing country like Malaysia, most of the common environmental practice yet to be

implemented. Lack of required important data such as embodied energy made the tool not relevant to our context.

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