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A Framework for Assessing the Sustainable Urban Development

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Abstract

The aim of this paper is to propose a framework for rating sustainable practice in the urban development by reviewing some selected assessment tools in various countries around the world. For instance, CASBEE of Japan, LEED of the USA, Green Mark of Singapore and GBI of Malaysia. These tools adopted different methodology, however, their common goal is to measure the sustainable performance. The review will identify key factors for developing a framework for sustainable practice that will take some criteria into. This paper will propose a framework for rating sustainability of urban development for further testing in the local context.

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1. Introduction

Sustainable development is a common and contemporary goal of many urban development policies in various countries (Berke & Conroy, 2002; Chan & Lee, 2006). Development of the housing sector requires knowledge of urban development policies. In the present context, the housing develops in line with the goal of Habitat Agenda as well as the principles of Agenda 21. The Agenda 21 is a blueprint for sustainable development in the 21st Century. It was held in Rio de Janeiro in June 1992 and was adopted by 179 nations (including Malaysia). According to Tosics (2004), housing is one of the most important

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public policies affecting urban development and as such, it has significant potential to contribute to sustainability agenda.

Brundtland Commission (1987) defined Sustainable development as the development that meets the needs of the present without compromising the ability of future generations to meet their own needs. Blackburn (2007), further elaborate the concept of sustainability as a long-term development for countries. The efforts of sustainability practices embrace the rigorous use of the scarce natural resources through a good implementation of economy but without neglecting the environment and social factors. The philosophy of sustainability emphasizes the achieving of sustainability that integrates the economic, environmental, and social into performance.

Various aspects of construction, design, use and demolition can have significant impact on the environment (Huby, 1998, Panitchpakdi, 2012). The sustainable urban development involves ecological, economic, technological, cultural, and social sustainability. In term of urban housing, Edwards & Turrent (2000) suggested that housing is sustainable if everyone have the opportunity of access to a home that is decent and such housing will promote social cohesion, well-being and self-dependence.

Many countries around the world have developed tools for measuring sustainability for various types of development. For example, Japan designed standards and guidelines for sustainable building and urbanization with the Comprehensive Assessment System for Building Environmental Efficiency (CASBEE for an Urban Area+ Building). These system tools refer to CASBEE for Urban Development and CASBEE for building scale. In the United States, the rating system is known as LEED (Leadership in Energy and Environmental Design) for Neighborhood Development Rating Systems. It uses to evaluate the urban development for sustainability by integrating LEED for building scale assessment for sustainable building. Accordingly, the sustainable urban development is measures in term of the area developed according to sustainability criteria, including the environment, social, economics, site/land uses, communication, transportation and the assessment of building forms for housing performance (Soo Cheen and Abu Bakar, 2012).

According to Jasan (2004), houses built-in the past decade did not meet the essential criteria of sustainability. The problem details are as follows:

- Building design did not take into account energy efficiency and green affordable housing. Building green housing requires specialized designs that specify the purpose of the building installations and requirements relating to building structures and the calculation of projected energy use of proposed buildings. Kibert (2005) stated that to build a green houses, the building professionals required skills and experiences such as “extensive residential construction experience, drafting experience, building science backgrounds, indoor air quality investigation training, mechanical ventilation training and other related skills.
- Sustainability of housing development gives more emphasis to environmental, economic and social issues. Construction itself creates a variety of environmental problems, such as greenhouse gas emission and environmental pollution, mainly because of the materials used, nature of design, methods of construction, locations and layout, physical structure and the use to which buildings are put (Ramachandran, 1990).
- The development of housing sectors in urban area also covers groups of buildings that, as a whole, affect environmental performance. CASBEE for Urban Development has formulated a tool for this purpose, but most of developing countries have yet to introduce a tool for rating the sustainable housing development in both urban and suburban areas.

The aim of this paper is to propose a framework for assessing the sustainable development with the goal to improve the level of sustainable practices in urban development. The formula of the sustainability index in urban development will be based on factors critical to the success of sustainable urban development and the selected existing rating systems used in other developed countries.

2. Methodology

This study is a review on available sustainable rating systems in practice throughout the world. Major rating systems in practice such as Comprehensive Assessment System for Building Environmental Efficiency (CASBEE), Leadership in Energy and Environmental Design (LEED), British Research Establishment Environmental Assessment Method (BREEAM), Green Building (GB) Tool, Green Star, Green Building Index (GBI) and many more are the main source of information on the criteria used in their rating system. The sustainability criteria comprised multiple variables to be evaluated as leverage for achieving urban development sustainability in the develop area. The criteria can be categorized in six categories namely; Environment, Social, Economics, Building Forms, Site or Land usage, and Communication and Transportation. The design indicators consist of 30 measurement criteria which are important in urban design or neighbourhood development plus building performance considerations highlighted in many green assessment systems (see figure 1). From the criteria, more than 130 short listed considerations are possible to be incorporated in the model of the assessment pending verification through a pilot study for reliability and validity testing to suit the local context.

3. Existing sustainability assessment systems

Recently, Green Building Council (GBC) published Malaysia first edition (version 1.0) of the Green Building Index (GBI) Assessment Criteria for Non-Residential which measures new building construction since April 2009. Following that, more tools have been developed, including GBI tool for New Residential and also GBI tool for Township in 2011 intended for new development in Malaysia. These tools are similar to that of the BREEAM for EcoHomes in the U.K., the LEED for Homes in the U.S., the CASBEE for Homes (detached houses) in Japan, Green Star for Multi-Unit Residential in Australia, and Green Mark for Residential Building in Singapore. Following is a brief review on the available sustainable assessment tools for urban development around the world.

3.1. Available assessment tools for sustainable urban development

Several systems for evaluating environmental performance of urban development are currently available and actively in practice around the world. The growth in the utilization of environmental performance assessment methods for new construction has contributed to sustainability practices in various stages of building performance. Assessment tools have been developed with different evaluation criteria based on conditions to suit the characteristics of the countries for which the tools are designed. Table 1 identifies some of the rating tools employed by various countries. Key criteria identified by most widely used assessment tools are site, indoor environment, energy, material resources and water. The sustainable urban assessment tools which include measurements of economic and social sustainability in the development of the designated area based on local conditions of each country. Key existing assessment systems are shown in Table 1.

Table 1. Assessment tools for sustainable urban development in various countries

No	System Name	Country	Year
1	CASBEE for Urban Development	Japan	2007
2	LEED for neighborhood Development	US	2008
3	RHSI (Rural Housing Sustainability Index)	Ireland	2004
4	FGBC-Green Development	Florida, US	2009
5	DDC-Sustainable Urban Site Design	New York, US	2008
6	ACI - Adriatic Common Indicators	Greece, Italy, Slovenia	2004
7	ACTEUR - Analyze Concerté des Transformations et des Equilibres Urbains	France	2004
8	Baden-Württemberg-Indicators in the framework of the Local Agenda 21	Germany	2004
9	Catania - State of the Environment Report	Italy	2004
10	CI - Cercle Indicateurs	Swiss	2004
11	CEROI - Cities Environmental Reporting on the Internet Indicator Database	Czech Republic, Finland, Others	2004
12	Cities21® Assessing Mutual Progress Toward Sustainable Development	Czech Republic, Finland, Latvia, Poland, Others ¹⁴	2004
13	Core Indicator System of the cities Basel and Zürich	Basle, Zurich	2004
14	Czech Republic - Environmental indicator	Czech Republic	2004
15	Czech Republic - Transport Yearbook 2002	Czech Republic	2004
16	Denmark National Strategy for Sustainable Development	Denmark	2004
17	Nature Balance	The Netherlands	2004
18	EcoBUDGET	Germany, Greece, Italy, Sweden, United Kingdom	2004
19	Ecosistema Urbano	Italy	2004
20	EEA - Core set of environmental indicators	Europe	2004
21	EEA - Environmental Indicators	Europe	2004
22	The Integrated Regional Framework for the North East	England	2004
23	Environment Explorer Amsterdam	The Netherlands	2004
24	TISSUE - Trends and Indicators for Monitoring the EU Thematic Strategy on Sustainable	Finland, the Netherlands, UK, France, Italy, Switzerland, Czech Republic	2004
25	SUDEN - Sustainable Urban Development European Network	France, Italy, Denmark, Romania, Belgium, Poland	2004
26	Indicators for Sustainable Development in Scotland	Scotland	2004
27	ISD - Indicators For The Sustainable Development In The Mediterranean Region	Mediterranean area	2004
28	Quality of Life indicators	United Kingdom	2004
29	SURPAM - Sustainable Urban Renewal Project Assessment Model	Hong Kong	2008
30	GBI - Green Building Index for New Residential Development and Township	Malaysia	2011

Primary criteria for measuring sustainability have been identified for some selected sustainable urban development assessment tools by various countries (see Table 2).

Table 2. Primary criteria identified in each assessment tool for sustainable urban development

No.	Assessment Tools	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	CASBEE	X		X	X	X	X	X	X		X	X	X	X	X	X
2	LEED	X		X	X	X	X	X	X	X		X	X	X	X	X
3	RHSI	X	X	X	X	X	X		X	X			X			
4	FGBC	X	X	X	X	X	X	X	X			X	X	X		X
5	DDC	X		X	X	X	X	X	X	X		X	X	X	X	X
6	SURPAM	X	X	X	X	X	X	X	X	X			X			X
7	TISSUE	X	X	X	X	X	X	X	X	X			X			
8	CI	X	X	X	X	X	X	X	X	X	X					
9	CITIES21®	X		X	X	X	X	X	X			X	X			
10	CEROI	X		X	X	X	X	X	X	X		X	X	X		
	frequency	10	5	10	10	10	10	9	10	7	2	6	9	5	3	5

Notes: 1. Site, 2. Indoor Environment, 3. Energy, 4. Material Resources, 5. Water, 6. Transport, 7. Health, 8. Social, 9. Economy, 10. Comfort, 11. Management, 12. Services, 13. Long term performance, 14. Design aesthetics, 15. Functionality

From Table 2, 15 criteria for measuring sustainability of urban development are mapped and the frequency of occurrence is obtained for future consideration in formulating a new framework for measuring sustainability of urban development. From the table, it shows that some key criteria are essential to be taken into account such as site, energy, material resources, water, transport, social, health, services, and economy in formulating a new sustainable tool for urban development. The less importance criteria are the indoor environment, long term performance and functionality and the least importance are the design aesthetics and comfort.

4. Establishing a rating system for urban development

Since 2009, Malaysia has established a rating system for achieving sustainable development in building with incorporating criteria of green architecture. The rating system is known as the “Green building Index (GBI)” which developed by the Architect Association of Malaysia (PAM) and Association of Consulting Engineers of Malaysia (ACEM).

In conjunction with the sustainable environment, the Green Building Council has taken initiative to establish rating tools that differentiated between the non-residential and residential type of buildings. The design specification of these rating tools was established based on the Malaysia tropical climate and geographical identities, which is hot and humid for the whole year, and to protect the sake of environmental, cultural and social developments. The GBI’s rating system tools for building has incorporated six key assessment criteria embraces energy savings, water savings, a healthier indoor environment, better connectivity to public transport and the adoption of recycling and greenery for their projects and reduce the impact on the environment (GBI, 2009). However, these rating systems tools did not cover all buildings within the designated area. According to CASBEE for Urban Development (Japan), the measurement should cover the group of buildings in the designated area. The assessment of environment can be extensive when comprises multiple buildings and other elements on a single and large-scale site under a unified design concept (CASBEE-UD, 2007). The LEED for Neighbourhood Development (LEED-ND) has also adopted the same approach by including the assessment criteria to

enhance the overall health, natural environment, and quality of social communities' life in order to achieve the sustainable development in particular designated area.

The proposed assessment model for urban development sustainability index will be addressed as Comprehensive Assessment System for Urban Development (CASSUD). It comprises three major levels, that is, the outcome, design measurement indicators, and sustainability criteria level. The schematic diagram is as shown below in the conceptual framework in Figure 1. The goal level describes the ultimate achievement of the model. It attempts to generate the most sustainable urban development for an area either undergoing new development or redevelopment. The proposed assessment model attempts to evaluate an area of development as a whole and also evaluates the environmental performance of individual buildings within the designated area as well.

4.1. Proposed assessment model for sustainable urban development

In order to address the sophisticated problems of urban sector development, the authors suggest the Comprehensive Assessment System for Sustainable Urban Development model (CASSUD) to be used to measure the overall score of the sustainability level of urban development. Using index that is derived from the collection of a broad range of individually generated values or indicators that are used to characterize or evaluate specific aspects of the system (Gray and Carton-Kenny, 2004). The calculation method is similar to the CASBEE for Urban Development and SURPAM of Hong Kong measurement.

The overall score of the sustainable urban development area is calculated by using the proposed formula below:

$$CASSUD = \sum SC_n \times W_n$$

Where *CASSUD* is Comprehensive Assessment System for Sustainable Urban Development, *n* is the numeric indicator for each of the sustainability criteria parameter, *SC_n* is the score of the Sustainability Criteria of each of the *n* indicator and *W_n* is the weightage attribute to the *n* indicator to each Sustainability Criteria.

The calculation of final score of CASSUD on a particular project is as listed below:

$$CASSUD = \sum EnxW_{En} + ScxW_{Sc} + EcxW_{Ec} + BxW_B + SxW_S + CTxW_{CT}$$

Where *En* is represent Environmental criteria, *Sc* is represent Society criteria, *Ec* is represent Economics criteria, *B* is represent Building Forms criteria, *S* is represent Site/ Land uses criteria and *CT* is represent Communication & Transportation criteria.

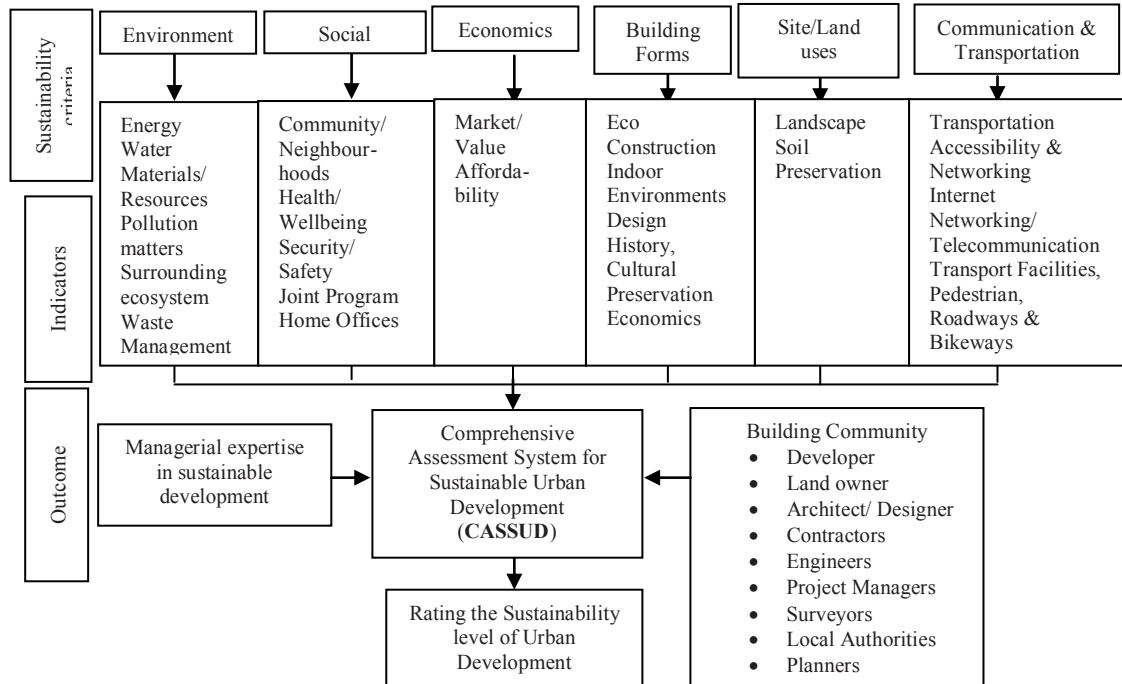


Fig. 1. Conceptual frameworks for Comprehensive Assessment System for Sustainable Urban Development

In order to calculate the overall score, it is necessary to define the value of the component of each indicator. The element of criteria and the indicators for urban development assessment rating system in fact retrieve from the literature review and also from other established assessment rating systems. The recognition of sustainable urban development assessment criteria are as shown as in the conceptual framework of CASSUD as in figure 1. The elementary of sustainable development of residential area should embraced various criteria including environmental, social, economic, building form, land utility and the convenience of transportation and facility. Gibberd (2005) suggested that the social and economic issues are essential to be included in the sustainable development of developing countries. In addition, the CASSUD will also take into consideration the health advantages for the whole of residential society. The establishment of CASSUD rating system reciprocal the research study of the building forms, climate conditions, economic of the local state, group of society in local community, authorities of those stakeholders in housing development and the system being established. According to Hikmat and Saba (2009), the uniqueness of each rating system is distinguishable from the aspects of local context, the country cultures, political issues, resources availability, priorities of the stakeholders' expectations, country developing performance and the structure of organization institutions.

4.2. Justification of CASSUD assessment system

The rapid urbanization is often leads to the loss of valuable ecosystems and lands for satisfying the urban demands (Shen et al., 2011). Moreover, if the current and future urban areas continue with the same resource consumption practices without regarding the future needs, serious environmental, social and economic problems are expected (Millennium Ecosystem Assessment, 2003). Hence, the right and

suitable sustainability tools need to be introduced as efforts in promoting the mission of sustainable urban development.

CASSUD is proposed for measuring the overall score of the sustainability level of urban development practices. This tool is developed based on a comprehensive literature review on the indicators that have been applied by several institutions from both developing and developed countries including Japan, USA, Ireland, Florida, New York, Greece, etc. The proposed framework of assessment system for urban development should later be the benchmark for the quality of Malaysian sustainable urban development. Currently, there is no acceptable tool for measuring the sustainable urban development in Malaysia. In the next stage the framework will be further validated to determine its effectiveness.

5. Conclusion

Most developed countries, have their own established building assessment systems to assess for sustainability. For example BREEAM in the UK now has multiple tools for different building designs, such as Ecohomes, Healthcare, Industrial, Multi-residential, Prisons, Office, Retail and Education Buildings. However, it is also important to evaluate environmental performance for a group of buildings. This means evaluating the surroundings of the designated area or in other words, assessing the buildings' neighborhood. The common area for buildings within a district can raise environmental quality and performance throughout the area. Thus, the Comprehensive Assessment System for Sustainable Urban Development (CASSUD) is proposed to take into account a wider scope of urban development.

The analysis of the existing assessment tools and design methodologies has shown that there is considerable emphasis on environmental issues. However, in the holistic approach, every aspect of the sustainability parameters must be assessed to ensure a more pragmatic effort in conservation of the environment. The assessment tools are intended to be used as guidelines during the design process and as a more general sustainability assessment rather than as a specific architectural evaluation tool. The evaluation of housing sector development in the urban area not only includes the surroundings of the building being developed but also should include the assessment of building performance, since the building's performance will have significant impact on environmental issues.

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