COMPARATIVE REVIEW OF EXISTING BUILDING PERFORMANCE ASSESSMENT SYSTEMS: APPROPRIATENESS FOR THE CONTEXT OF EMERGING/DEVELOPING COUNTRIES

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ABSTRACT

Emerging/developing countries have begun to realize that the implementation of building performance assessment systems (BPASs) have the potential to contribute towards achieving a sustainable built environment. Consequently, some BPASs from developed countries have been adopted or customized to be implemented in emerging/developing countries, including Malaysia. The objectives of this paper are to: 1) analyse the effectiveness of existing BPASs in assessing building sustainability in emerging/developing countries; and 2) investigate their appropriateness in addressing the Malaysian context. The paper comparatively reviews and critiques nine BPASs in terms of their characteristics and limitations by analysing the content of the systems' documentation as well as reviewing other documents related to the systems. Overall, the study finds that most existing BPASs are inadequate in addressing the complex concept of sustainability as well as many of the non-environmental priorities of emerging/developing countries, particularly Malaysia. In fact, priority issues of BPASs from emerging/developing nations reviewed in this paper still reflect those of developed countries. This paper concludes by recommending the specific requirements for developing the Malaysian office building sustainability assessment framework. These findings provide an appropriate basis for other emerging/developing countries to establish a country-specific building sustainability assessment framework that takes relevant priorities into account.

Keywords: *building performance assessment systems, sustainable building, office, sustainable construction, sustainable development, emerging/developing countries, Malaysia*

1. INTRODUCTION

The construction sector is responsible for huge solid waste generation, environmental damage and approximately a third global greenhouse gas emissions (de Ia Rue du Can & Price, 2008). Actions are needed to minimize the environmental damage and greenhouse gas emissions created by the built environment and construction activities. Addressing environmental issues alone is however insufficient because the construction industry also has the responsibility to ensure economic and social developments (UN, 1992).

Within the construction industry, "sustainable construction" is seen as a way for the industry to achieve sustainable development as part of an integrated whole and to depict the industry's accountability towards protecting the environment (Du Plessis, 2002). The concept of sustainable construction also transcends environmental sustainability (Green Agenda) to embrace economic and social sustainability (Brown Agenda), which emphasizes possible value addition to the quality of life of individuals and communities (Du Plessis, 2002).

The paper argues that the implementation of sustainable construction requires different approaches between developed and emerging/developing countries (i.e. countries whose economies have not reached advanced or developed status) due to the difference in priorities. Based on a global report on Sustainable Development and the Future of Construction (Bourdeau, et al., 1998), developed countries are in the position to place an emphasis on environmental issues to progress to a more advanced stage in the path towards sustainability. Emerging/developing countries on the other hand, need to focus more on social and economic sustainability which are not necessarily technical issues (Bourdeau, et al., 1998). Likewise, Libovich (2005) believed that nations in the emerging/developing world cannot afford to be looking at environmental performance only as the social and economic problems are at the top of these countries' agendas. Green building concepts in developed countries is often concerned with maintaining standards of living which differs from the concern of green building concepts in emerging/developing countries which focus on meeting basic human needs (Melchert, 2007). The key sustainable development priority in emerging/developing countries is to ensure that the basic needs of its citizen, such as food, health, safety and employment, are met (UN, 1992). It is also important that development designed to meet these needs involves educating and empowering people in order to ensure that impact can be multiplied, and is sustainable (UN, 1992, 2002). From the perspective of sustainable construction, emerging/ developing countries need to address and prioritize public awareness; efficiency, safety of processes and quality of products; environmental and human health impacts; affordability; social equity; semi-skilled labour; and participation of affected community (Du Plessis, 2002).

In responding to sustainable construction, there have, over the past decade, been a plethora of building performance assessment systems (BPASs) emerging as one of the strategies in, and perceived as tools for, promoting and contributing to sustainable construction (Ding, 2008). Many such BPASs have been developed in the form of rating systems that measure how well or poorly a building is performing, or is likely to perform, against a declared set of sustainability criteria. Examples of such BPASs include BREEAM in the U.K. (BRE, 2010), LEED in the U.S. (USGBC, 2010), Green Star in Australia (GBCA, 2010), SBTool (formerly known as GBTool) initiated in Canada (iiSBE, 2009), and many more.

Recently, many other countries, particularly emerging/developing countries have begun to realize that the development and implementation of BPASs have the potential to contribute towards achieving a sustainable built environment. Some early established BPASs from developed countries listed earlier have been widely accepted in the world and adopted or customized for emerging/ developing countries. For instance, China and India have adopted the US LEED, whereas Malaysia and Indonesia followed the Australia's Green Star and Singapore's Green Mark. Although the systems were indigenised to the local context, many such customizations have been criticized as inappropriate to cope with the specific regional conditions in many ways (Soebarto & Ness, 2010). More importantly, developed and emerging/developing countries need different models of BPAS because they have different priorities in implementing sustainable development and construction (Sha, et al., 2000).

The significance of these issues has prompted research into developing an appropriate assessment framework that enables sustainability to be addressed and incorporated in office building development, relevant to emerging/ developing countries, particularly the Malaysian context (Shari, 2011). This paper is the first part of overall results of the first author's three-year research activities in the area. The purpose of this paper is to evaluate the effectiveness of existing BPASs to support sustainable development, and to reflect the priorities of emerging/developing countries. Additionally, BPASs in emerging/developing countries are reviewed to investigate their appropriateness in addressing the Malaysian context.

This paper comparatively analyses nine existing BPASs in developed and emerging/developing countries. It focuses on BPASs used for new construction of office or commercial building type; however, the approach taken in the study can be implemented in assessing BPASs for other building types. It complements previous comparative studies which look at the effectiveness of BPASs worldwide for the following purposes: 1) to develop a new framework that fills the knowledge gap identified (Chew & Das, 2008; Ding, 2008; Kajikawa, et al., 2011; Wallhagen, et al., 2013); 2) to develop a new framework applicable to different scale, context, users, or building type (Horvat & Fazio, 2005; Retzlaff, 2008; Sev, 2011; Sinou & Kyvelou, 2006); and 3) to recognise areas for future research (Nguyen & Altan, 2011; Cole, 2005; Todd, et al., 2001). This paper serves as a starting point in the development of Malaysian office building sustainability assessment (MyOBSA) framework and provides an appropriate basis for emerging/developing countries to establish a country-specific building sustainability assessment framework that takes relevant priorities into account.

The paper first explores the Malaysian context to understand its conditions and priorities. It then presents the framework used for analysing the selected BPASs as well as the rationale for selecting the nine BPASs. Based on this framework, the paper then presents and discusses the comparative analysis results of the selected BPASs. The paper concludes by offering some recommendations on the specific requirements for developing the MyOBSA framework.

2. THE MALAYSIAN CONTEXT

Economically, Malaysia has one of the fastest growing construction industries in the world (Australian Business Council for Sustainable Energy (ABCSE), 2007); and currently categorized as a "newly industrialized country" (Mankiw, 2008) or an "emerging market/economy" (Dow Jones Indexes, 2011). However, the industry's emphasis on providing buildings with the best possible (lowest) cost has taken its toll on certain environmental and social issues in the country. The exploitation of resources, uncontrolled, and improperly planned development has resulted in the deterioration of the environment for decades such as land pollution due to uncontrolled solid wastes disposal, as well as soil erosion and silting of water course, which in turn causes water pollution, flooding in low-lying areas and flash floods in urban areas (Mohd Jahi, et al., 2009). On top of this, the industry's reliance on foreign labour has resulted in low level of productivity and quality (Chan, 2009; CIDB Malaysia, 2007a), as well as higher rate of work-related accidents (Chong & Low, 2014).

These predicaments reflect the imbalance between environmental and socio-economic development; thus the benefits of development may be negated by the costs of environmental and social impacts. If this is the case, then the current Malaysian construction and building practices can be deemed as not sustainable. In addition, the formation of new development corridors in the southern, northern, and eastern regions of Peninsular Malaysia will further add huge pressure to the environment if not approached in a sustainable manner. The adoption of sustainable development (i.e. balancing economic development with environmental protection and social development) in Malaysian construction industry is therefore very timely and crucial.

Malaysia has one of the best sets of environmental legislations among emerging/developing countries, comparable even with those of some developed countries (Sani & Mohd Sham, 2007), including a plethora of sustainable development frameworks, policies or various enabling legislations and regulatory frameworks deployed to reduce and overcome sustainability issues. As such, one might wish to question why there is continuous presence of and increasing environmental problems in Malaysia. Arguably, moving towards the path of sustainability requires education, information dissemination, communication and participation across disciplines, which are still lacking in the context of emerging/developing countries (Du Plessis, 2002). The level of knowledge on environment issues and sustainability among Malaysians, including building stakeholders, has generally remained low (CIDB Malaysia, 2007b; Shari, et al., 2006; Zainul Abidin, 2010). Unless there is willingness among the public to align their attitude with the requirements of sustainability, no legislation and no conservation programme, however well designed, will be successful or have the desired impact (Sani & Mohd Sham, 2007). People's motivation to change indeed comes from knowledge (Fiedler & Deegan, 2007).

In summary, the main priority issues for Malaysia to achieve sustainability in the construction industry are: 1) environmental issues including, (a) exploitation of natural resources, (b) uncontrolled and improperly planned development, (c) high use of energy and non-local materials; (d) huge solid waste generation; and non-environmental issues including, (a) emphasis on initial capital cost alone, (b) use of foreign labour with low level of quality and productivity; (c) high rate of work-related accidents; (d) lack of education and environmental awareness; and (e) lack of communication and participation across disciplines.

Since the lack of knowledge and awareness in sustainability is paramount among the building key players, specific means and programs need to be developed for raising their awareness in order to promote sustainability in the Malaysian building sector. It was argued that benchmarking, assessment and knowledge sharing should be the immediate work that needs to be focused on in emerging/developing countries (South-east Asia in general, and Malaysia in particular) and considered as one of the technology enablers for sustainable development and construction (CIDB Malaysia, 2007b; Du Plessis, 2002; Shafii & Othman, 2005).

In line with this realisation, Malaysia has developed and implemented its BPAS i.e. the Green Building Index (GBI) system (GSB, 2010). Since Malaysia needs a context-specific system that serves not only as an assessment system but also an educational medium, this paper examines the effectiveness of GBI (and eight other BPASs) in serving this purpose and acknowledging the local context, and addressing the priorities of emerging/developing countries.

3. METHOD

This paper is based on a literature review and a framework was developed and used to evaluate and compare BPASs. This is a common method used in similar comparative studies as highlighted earlier. The framework for analysis of the BPASs consists of the following principles:

1. Spatial scale: Is the BPAS concerned with individual buildings, sites, communities and regions, or global impacts?
2. Prioritization of issues and scope of assessment: Which issues are given the most priorities in the BPAS? Does the BPAS focus on environmental issues only or other concerns as well, such as economic development and social equity? Does the BPAS able to enhance stakeholders' awareness and education on sustainable development?
3. Local adaptation and context: Does the BPAS have a method for adapting to local or regional conditions and goals? Can a BPAS in developed countries be simply adopted in the emerging/developing countries?

In order to analyze the BPASs using this framework, the study involved an analysis of the content of the documentation of each of nine BPASs as well as reviewing other documents related to the systems. The reasons for using content analysis, which uses the same frame of reference to analyze each of the systems, are twofold: 1) to discover features that might not be apparent without close, detailed examination; and 2) to treat various types of documents in the same way (Krippendorff, 2004). Therefore, internal systematic bias often associated with comparative analysis can be minimised.

In order to check the accuracy of the content analysis and to analyse aspects raised by the framework that could not be addressed through content analysis, relevant literature was reviewed and the conclusions are reinforced by using more than one source of references. It should be noted that the aim of this comparison is not primarily to compare how the systems are actually performing in practice; instead, the systems are compared according to their intended use. The comparison is made with an emphasis on the main differences in the systems.

3.1 Spatial Scale

The spatial scale at which a criterion is assessed is critical because it defines the spatial boundary separating outcomes that will and will not be considered (ISO/TS 21931-1, 2006). The spatial scale at which the project is assessed has much to do with the focus of the assessment. Systems that assess only building-level criteria may produce energy efficient buildings but miss other important issues such as siting and connections to the community; hence, may be considered as insufficient to address sustainable development issues. The boundary between the building and its surroundings is not always clear, as a building interacts with the infrastructure and the ecosystem.

In determining the spatial scale of BPAS criteria, each criterion of each BPAS was classified into one of the categories listed in Table 1, adapted from a scaling system developed by the International Energy Agency (IEA Annex 31, 2005) for an assessment of international BPASs.

It is however, important to note that certain criteria may be relevant at narrower spatial scale but they may also have impacts at broader scales. For example, construction activity pollution prevention may include measures to protect soil, air, water bodies and habitat on site, so it would be classified under the site-level category, because it addresses site-specific issues. However, protection of water bodies, such as rivers, also has significant community and regional effects. Thus, criteria have been categorised into the smallest scale at which they have impacts, although many have broader implications.

Table 1. Determining the spatial scale of BPAS criteria

Spatial scale	Examples
Global level: *Impacts on resources specifically identified to be global*	• Greenhouse gas emissions • Emissions of ozone depleting substances
Community and regional level: *Impacts on the neighbourhood, community, and region.*	• Sun shading and glare to neighbouring property • Access to basic services and public transportation • Site selection e.g. development of brownfields • Planning considerations – land use, mixed use, neighbourhood density • Light and noise pollution • Load on local infrastructure – stormwater management • Regional materials • Job creation
Site level: *Site-specific attributes*	• Landscaping, green roof, and open space • Onsite energy sources • Rainwater harvesting • Protection of soil, air, water bodies & habitat on site • Onsite parking capacity & priority, cyclist facilities
Building level: *Certain construction techniques, attributes of buildings, or types of building materials.*	• Water consumption • Energy consumption • Commissioning and maintenance • Waste management • Materials reuse, recycled content, sustainable products • Health and safety of users • Barrier-free use of buildings • Reuse of structure/facade
Other: *Criteria that do not fit the above, usually administrative- and communication/process-related.*	• Project innovation • Accredited professional • Provision of building manual • Users' and community participation in the process

3.2 Prioritization of Issues and Scope of Assessment

Each BPAS group the criteria assessed into categories. Many systems have generally similar categories (e.g. energy, indoor environmental quality, sites, water, building materials); however, the number of criteria categorized under each category varies widely across the systems. Different systems also often classify similar criteria under different category. Therefore, the first stage of the analysis identified the ranking of common categories emphasised by each system. These rankings were determined based on the weightings given or the total number of points allocated on that category.

Because the listed common categories are only those that are addressed by all the evaluated BPAS, examining this alone provides a poor indication of the whole scope addressed by each BPAS. The analysis of scope is important as it provides an indication whether or not existing BPASs are based on, and promote, the three dimensions of sustainable development i.e. environmental protection, economic development and social equity. Therefore, the second stage of the analysis evaluates the scope of issues addressed in BPASs, each criterion of each system was classified as "environmental" or "other". All of the criteria classified into the "environmental" category specifically related to environmental issues, while all of the criteria classified into the "other" category had potentially broader, non-environmental implications.

3.3 Local Adaptation and Context

A review of relevant literature was conducted to analyse other aspect raised by the framework that could not be addressed by content analysis. In particular, qualitative analysis of documents was used to understand how each system allows for local adaptation.

3.4 Selecting Systems for Review

Nine BPASs were identified for the review in order to cover a range of types, geographical representations, inclusion of a life cycle perspective, and level of sophistication. It is acknowledged that the number of the systems included in the study had to be controlled; otherwise the study would have been too wide and complex. The majority were identified in literature as successful BPASs. This study focuses on criteria-based passive systems that assess the built environment on a building scale, with the unit of assessment being the whole building. These systems are referred to as "Environmental Assessment Frameworks and Rating Systems" in the third category of Haapio and Viitaniemi's (2008) combined classification of ATHENA and IEA Annex 31 classification systems. It was expected that more could be learned from the comprehensive BPASs. All of the BPASs selected for this study are the latest versions applicable to new construction of office or commercial building type at the time of the study. BPASs chosen to represent those from developed countries are:

- BREEAM Office 2008 – UK (Building Research Establishment (BRE), 2010);
- LEED 2009 for New Construction and Major Renovations (LEED-NC v.3.0) –US (US Green Building Council (USGBC), 2010);
- SBTool 2010 – Canada/International (International Initiative for a Sustainable Built Environment (iiSBE), 2009; Larsson, 2010);
- Green Star Office Design and Office As-Built v.3 – Australia (Green Building Council of Australia (GBCA), 2010); and
- Green Mark for New Non-Residential Buildings v.4.0 (NRB/4.0) – Singapore (Building and Construction Authority (BCA) Singapore, 2010).

All of the systems have significantly evolved over their life span and the buildings that have been certified under these systems have been used and occupied for a period that makes analysis of their effectiveness in achieving sustainable built environment possible. They are known and well represent existing BPASs. Even though Green Mark is considered newer than the rest (introduced in 2005), the system is included in the analysis as it has been used by Malaysian developers and consultants to obtain a differential identification in the market. SBTool differs to the rest of the selected systems in that it is not a building specific method in itself but does provide a comprehensive framework around which such a system might be developed. Although SBTool was initiated in Canada, it is now an internationally followed system.

BPASs selected to represent those from emerging/developing countries are:

- LEED-India Green Building Rating System for New Construction and Major Renovations (LEED-India NC v.1.0) – India (Indian Green Building Council (IGBC), 2008);
- Green Building Evaluation Standard (GBES) or the Three Star System, public building version – China (Ministry of Construction of the People's Republic of China, 2006);
- Green Building Index Non-Residential New Construction (GBI NRNC v.1.0) – Malaysia (Greenbuildingindex Sdn. Bhd. (GSB), 2010); and
- Greenship – Indonesia (Green Building Council of Indonesia, 2010).

Green Building Index is obviously relevant as Malaysia is the context within which the study intends to be applied. In general, however, these BPASs were chosen because they are among the most recently developed and implemented in emerging/developing countries within the Asia Pacific region.

4. RESULTS AND DISCUSSION

4.1 Spatial Scale

Many of these BPASs share a common methodology but differ in measurement scales and individual criteria. As Table 2 shows, all BPASs, regardless of whether they originated from developed or emerging/developing countries, assess performance at a fairly small scale, like that of the individual building. The three BPASs containing the most criteria at the site scale or smaller are Green Mark, GBES/ Three Star System, and GBI, with 93%, 90%, and 83% of criteria respectively. These three BPASs contain the least criteria at the community/regional level and above, compared to the rest of the BPASs reviewed. BPASs containing the most criteria assessed at scales broader than the site are SBTool (23%), LEED-NC (18%) and Greenship (17%).

Singapore's Green Mark seems not to address any impacts on the community/regional scale, whereas China's GBES ignores criteria for the most significant global environmental impacts. This is surprising because China is one of the world's top energy consuming, hence greenhouse gas emitting, nations (Ministry of Construction of the People's Republic of China, 2006). Note that even though Green Building Council Australia has recently developed a rating tool for sustainable communities called "Green Star – Communities" (GBCA, 2012) and Greenbuildingindex Sdn. Bhd. has now developed "GBI Township" (GSB, 2011), these tools remain separate and the criteria are not part of their rating tools for assessments at a building scale.

Table 2. Percentage of points of criteria at different spatial scale in BPAS

Spatial Scale	BPAS in developed countries					BPAS in emerging/developing countries			
	BREEAM 2008	LEED-NC v.3	SBTool 2010	Green Star v.3	Green Mark v.4	GBES / Three Star	LEED-India v.1	GBI v.1	Greenship
Global	3%	4%	6%	5%	4%		3%	2%	4%
Community/regional	12%	14%	17%	9%		8%	14%	9%	13%
Site	17%	18%	9%	11%	18%	13%	15%	18%	16%
Building	65%	60%	65%	66%	75%	77%	61%	65%	60%
Other	3%	5%	3%	9%	4%	1%	8%	6%	7%

Note:
Blank cells mean the system had no criteria at that scale. Columns may not add to 100% due to rounding.

This finding reinforced the argument by Kaatz et al. (2006) and Cole (2006a) that criteria in BPASs are often geared toward the building itself and the site itself, with little regard for off-site or global impacts. In fact, focusing exclusively on an individual building is considered as insufficient to address sustainable development issues. Accordingly, Cole (2006a) encouraged future BPASs to link across varying scales to permit the comprehensive framing of sustainability assessment.

4.2 Prioritization of Issues and Scope of Assessment

Table 3 lists the common categories addressed by the nine evaluated systems, and their ranking (first to third) in terms of relative importance or prioritization emphasised by each system. It shows that energy issues are a high priority in all of the systems. Likewise, indoor environmental quality and site are the second or third priorities in many of the systems. The issues related to water are high priority in the Greenship, Green Star and Green Mark but less important in other BPASs. Building material issues were less important in many of the BPASs, with six out of nine BPASs prioritize this issue lower than the third ranking.

Table 3. The first, second and third priority categories emphasized by nine building performance assessment systems

Common categories	BPAS in developed countries					BPAS in emerging/developing countries			
	BREEAM 2008	LEED-NC v.3	*SBTool 2010	Green Star v.3	Green Mark v.4	GBES / Three Star	LEED-India v.1	GBI v.1	Greenship
Energy	1	1	n/a	1	1	1	1	1	1
Indoor environmental quality	2	3	n/a	2		2	2	2	3
Site		2	n/a		2	3	3	3	
Water			n/a	3	3				2
Building Materials	3		n/a				3		

Note:
'1', '2' and '3' mean that the system gives first, second and third priority to that category respectively. Black cells mean the system gives lower priority to that category. These are determined based on the weightings given or the total number of points allocated on that area of concern.
* The weightings in the SBTool system are meant to be adjusted by the national team. Further, the categorization of criteria within SBTool is unique compared to the rest of the evaluated systems, making this exercise difficult, if not impossible.

As noted earlier however, examining the common categories alone provides a poor indication of the whole scope addressed by each BPAS. Therefore, criteria of all the systems are divided into environmental and non-environmental to better understand the scope of the nine BPASs examined.

4.2.1 Environmental issues

The analysis of the existing BPASs has shown that a plethora of environmental issues are examined in all cases. Reinforcing the result from Table 3 where the priorities given by all BPASs from developed and emerging/developing countries are environmental and human health issues, Table 4 reveals that most of the criteria within these issues are well covered in many of these systems. It is worth noting however, that a few environment-related criteria remained excluded in most of the BPASs. For example, while using regional, recycled, reused, sustainably sourced materials are basically addressed, using durable materials or design for robustness is generally ignored by most BPASs. Further, most of the BPASs seem to focus on the environmental impacts on the site level and only partly or not at all, addressing the environmental impacts on the immediate surroundings. Likewise, it seems that all of the BPASs assess only the operation energy, except SBTool which explicitly assesses the embodied energy of construction materials.

4.2.2 Non-environmental issue

In terms of addressing non-environmental issues, as Table 4 shows, where BPASs do these, they normally also relate to an underlying environmental concern. For example, connection to community by selecting proper location and providing linkages is important for social and economic reasons, but also provides environmental advantages. Very few BPASs in developed countries address purely non-environmental issues, such as safety and security; social, cultural, and heritage; and economic aspects. Surprisingly, none of the BPASs in emerging/developing countries has taken any of these non-environmental issues into consideration. Other important non-environmental priorities in emerging/developing countries that are missing in BPASs are creating jobs for local people, and emphasizing on the usage of semi-skilled labour.

Communication issues to enhance public awareness and education as well as to support social cohesion are an integral part of sustainable development, and one of the important priorities to be addressed in emerging/developing countries. Ding (2008, p.463) suggested that "greater communication, interaction and recognition between members of the design team and various sectors in the industry" are required to promote the popularity of BPASs. As Table 4 indicates, however, only a few of the BPASs address communication through information sharing such as the provision of maintenance manual or information to the client or building management. Surprisingly, in the emerging/developing countries, only GBI and Greenship take this communication-related criterion into account. This type of communication however, is only written communication at the building level. Spoken communications at the site and community levels such as collaboration between various actors and participation of affected community in the development process, which are the priorities in emerging/developing countries, are missing from all BPASs examined. As Kaatz, Root and Bowen (2005) critiqued, BPASs are mainly focusing on the product of development while ignoring the process.

Table 4: Environmental and non-environmental criteria in BPASs

	BPAS in developed countries					BPAS in emerging/developing countries			
Scope	**BREEAM 2008**	**LEED-NC v.3**	**SBTool 2010**	**Green Star v.3**	**Green Mark v.4**	**GBES / Three Star**	**LEED-India v.1**	**GBI v.1**	**Greenship**
Resource consumption									
• Land – brownfield, urban	x	x	x	x		x	x	x	x
• Operation energy	x	x	x	x	x	x	x	x	x
• Embodied energy			x						
• Potable water	x	x	x	x	x	x	x	x	x
• Materials – recycle, reuse, sustainable	x	x	x	x	x	x	x	x	x
• Materials – durable/robust	x		x						
• Materials - regional	x	x	x			x	x	x	x
• Materials – reuse structure/facade	x	x	x	x		x	x		
Environmental loadings									
• Atmospheric emissions	x	x	x	x	P		x	x	
• Solid waste – management, storage,	x	x	x	x	x	x	x	x	x
• Liquid waste – wastewater, stormwater	x	x	x	x	x		x	x	x
• Impact on site – water bodies, soil, flora & fauna	x	x	x	x	P	x	x	x	x
• Other impacts – light pollution, impact on adjacent properties, heat island effect	P	P	x			P	P		x
Indoor environmental quality									
• Air, thermal, visual quality	x	x	x	x	x	x	x	x	x
• Noise & acoustics	x		x	x	x	x		x	x
• Controllability of systems	x	x	x	x			x	x	
Transport issue									
• Cyclist facilities, green vehicle	x	x		x	P		x	x	P
• Parking capacity	x	x		x			x	x	
• Public transportation access	x	x	x	x		x	x	x	x
Project/construction management, commissioning, maintenance plan	x		x	P				x	
Innovation		x		x	x		x	x	
Urban design – development density, mixed uses, community connectivity i.e. location, linkages	x	x	x				x	x	x
Safety & security	x		x						
Functionality & efficiency			x						
Quality of workmanship & products					x			x	
Flexibility & adaptability			x						
Communication – manual or information	x		x	x				x	x

This weakness should be addressed, as Kaatz et al. (2005, p.1782) predicted that the "future evolution of building assessment will most likely be geared towards the enhancement of the building process and the empowerment of stakeholders through their direct experience in sustainability oriented decision-making." These critically important notions, they indicate, will require placing equal, if not greater, emphasis on the quality of social processes as on the development of technical competence.

Maybe one wishes to argue that SBTool is not part of this critique as it is the most comprehensive framework reviewed in this study, covering the environmental, social, and economic aspects of sustainability, as shown in Table 4. It is argued, however, that SBTool is still a research product and has been used in Canada more as a framework for discussing environmental performance and establishing performance targets than as a whole building rating system (Reeder, 2010). More importantly, certain issues that are of paramount importance for emerging/developing countries, as noted earlier, are still missing. Nonetheless, national and global BPASs, such as SBTool, is valuable to provide a starting point for developing a more contextual system, as aimed in this study.

4.2.3 Scope of Assessments

Existing BPASs have long been criticized for following a single-dimensional approach or being restricted to the environmental dimension of sustainability only, with limited ability to assess the broader social and economic dimensions (Cole, 2006b; Kaatz, Root, & Bowen, 2005). Specifically, they have focused on incremental environmental improvements designed to produce 'green' or 'greener' buildings. According to Cooper (1997), four main principles underlying sustainable development should include equity, futurity (concern for future generations), public participation, and environment, but he finds that BPASs focus only on environment and futurity, and ignore issues of equity and public participation. Therefore, Lutzkendorf and Lorenz (2006) summarizes that these BPASs cannot appropriately assess the contribution of single buildings to sustainable development.

Although these critiques are mainly referred to BPASs in developed countries, it seems that they can also be extended to BPASs in emerging/developing countries reviewed in this study. As Soebarto and Ness (2010) argued, BPASs in Southeast Asian countries such as GBI, Green Mark and Greenship focus particularly on rating the 'greenness' of the building design itself. They highlighted that "there is no place in these tools to assess the social and economic impact of new developments on the existing communities or areas these buildings are replacing" (Soebarto & Ness, 2010, p.8). Further, social issues are only addressed indirectly, usually by referencing other standards that have social equity components built into them. One example is the reference to wood supply certified by the Forest Stewardship Council (FSC) that forms the basis for a credit in all of the systems reviewed (except SBTool, Green Mark, and GBES). The FSC certification system requires explicit consideration of social as well as environmental issues in managing forests. Financial aspects are also found missing in all of the BPASs reviewed, with the exception of SBTool. This may contradict the ultimate principle of a development as financial return is fundamental to all projects because a project may be environmentally sound but very expensive to build. Therefore, the primary aim of a development, which is to have an economic return, may not be fulfilled making the project less attractive to developers even though it may be environment friendly. Environmental issues and financial considerations should go hand in hand as part of the assessment framework.

These critiques highlight the need to modify the existing building assessment practice to respond effectively to the new challenges and requirements posed by the sustainability agenda. However, there have been recurring debates on the possibilities, necessity, and extent of integrating a wider range of issues into building assessment. On the one hand, there are challenges exist if the scope is sustainability assessment rather than environmental assessment, mainly due to the fact that the former is broader and may consequently include more topics. Many researchers concede that shifting from 'green building' to 'sustainable building' approaches will lead to more complex BPASs and that developing appropriate indicators of sustainability that are appropriate for a single building is extremely difficult (Kaatz, et al., 2006; Lutzkendorf & Lorenz, 2006). On the implementation side, this difficultly requires greater effort and cost of making assessment.

On the other hand, various researchers advocate that there is an increased demand for complete and comprehensible assessment results, and for applicable tools that can be used to validate a single building's contribution to sustainable development (Cole, 2005; Lutzkendorf & Lorenz, 2006). In fact, research indicates that BPASs have begun to move towards having broader scopes (Cole, 2005; Kaatz, et al., 2006).

In resolving this conflict, two solutions have been suggested namely, a less complex list of indicators and allowance for flexibility and adaptability. Whilst acknowledging that having a much simpler BPAS with a less complex list that permits easy access and use is commendable, Cole (2006b, p.369) questions whether such system would require "new knowledge, skills, experience or investments are needed by industry to create high performance green, sustainable or 'regenerative' buildings". He goes on to suggest that this approach raises a number of important issues regarding the role of such system in enhancing the knowledge within the building sector (Cole, 2006b). Therefore, a less complex list must be agreed but it must be able to be extended at any point in time when the severity of certain issues become more acute or of greater political and public concern (Cole, 2006a; Lutzkendorf & Lorenz, 2006). Kaatz et al. (2006) describe the provision of mechanisms that allows for flexibility and adaptability of the assessment methodology as crucial, and called the process as a scoping procedure. This procedure does not only facilitate the necessary integration of issues and views in building assessment but also facilitate participation and transfer of knowledge among stakeholders (Kaatz, et al., 2006).

4.3 Adaptation and Context

In addition to the need to bring broader sustainability and performance-based concerns into the framework, currently there are discussions about tailoring BPAS to the regional needs. One of these is related to the issue of cross-cultural transferability between developed and emerging/developing countries. Most BPASs emerged as a response to the specific needs of buildings and environments in their respective countries of origin. They were developed to suit the context of developed countries and for local use and thus lack the adaptability necessary to apply them in other countries, especially in the emerging/developing ones.

As an example, China and India, have adopted the US LEED, whereas Malaysia and Indonesia have followed the Australia's Green Star and Singapore's Green Mark. Whilst acknowledging that the adopted systems have been customized to suit the local context, the priority issues of these adopted-but-customized systems still reflect those of countries of origin instead of being defined based on the local conditions. There is always a danger of homogenization and reduced sensitivity to the need for acknowledging and promoting regionally appropriate design strategies. In line with this realisation, Soebarto and Ness (2010) recommend for world BPASs to be modified to include socio-economic and contextual considerations when applied in developing country contexts.

To some extent, the SBTool might provide a solution as it attempts to move away from being a national, or context related system. It does this through avoiding reference to national standards and using internationally accepted methods and units. Also, users with authority are encouraged to adjust the default weights and benchmarks within SBTool to reflect regional variations; however, regional, social and cultural variations are complex and the boundaries are difficult to define. There are cultural and social variations between regions and countries, and measuring sustainability may vary from one region to another, even when the same criteria are applied. On top of this, since the default weighting system can be altered, the results may be manipulated to improve the overall scores in order to satisfy specific purposes.

5. CONCLUSIONS AND RECOMMENDATIONS

It has been demonstrated that sustainable construction is seen as a way for the sector to respond to achieve sustainable development. It was revealed that decision makings to support sustainable construction involve a balanced and holistic approach to the three dimensions of sustainable development i.e. social equity, environmental protection, and economic development. It would appear that it is necessary to ensure that the assessment framework is based on, and promotes, these three dimensions. In this way, the framework can become holistic, more comprehensive, and incisive in terms of the range of issues addressed.

The implementation of sustainable construction requires different approach between developed and emerging/developing countries due to the difference in priorities which depend on the historic and cultural context, local economic situation, local climate, level of urbanization, and national policies. This implies that building sustainability assessment frameworks should also be different from countries to countries.

While developed countries can emphasise on environmental issues to progress to a more advanced stage in the path towards sustainability, emerging/ developing countries need to focus more on social and economic sustainability which are nontechnical issues. The specific priorities of emerging/developing countries in implementing sustainable construction identified in this paper include addressing and prioritizing the following aspects: public awareness; efficiency, safety of processes and quality of products; environmental and human health impacts; affordability; social equity; semi-skilled labour; and participation of affected community.

This paper has comparatively reviewed and critiqued nine existing BPASs from developed and emerging/developing countries. It has been revealed that most existing BPASs are single-dimensional in their framework structure; hence, inadequate in addressing the complex concept of sustainability as well as many of the non-environmental priorities of emerging/developing countries, particularly Malaysia. In fact, BPASs from emerging/developing countries were found to have no obvious differences than those from developed countries in terms of their scope of assessment. Very few BPASs address non-environmental issues such as safety and security; social, cultural and heritage; and economic aspects, all of which are necessary according to the original definition of sustainable development (UN, 1992). This indicates that they do not fully reflect the shift in emphasis from environmental impact to sustainable development that has occurred. Missing issues from all BPASs reviewed include job creations for local people, usage of semi-skilled labour, and communication to enhance public awareness and education as well as to support social cohesion beyond the individual building.

Even though SBTool addresses all three dimensions of sustainable development, certain issues that are the priorities in emerging/developing countries, such as communication at the site and community levels or collaboration between various actors and participation of affected community in the development process, are still missing. Nonetheless, SBTool is valuable to provide a reference point for developing a more contextual system.

Accordingly, the development of the Malaysian Office Building Sustainability Assessment (MyOBSA) framework should be guided by the following requirements:

1. Embracing the holistic concept of sustainability, addressing the priorities of emerging/developing countries, and reflecting the current trend of BPASs in moving towards having broader scopes. Accordingly, the formulation of criteria within the MyOBSA framework should incorporate the following two recommendations:
    a. International Organization for Standardization (ISO) (ISO/TS 21929-1, 2006) notes that all aspects of sustainable development are inter-related; hence, certain issues should be given attention when analysing the sustainability of a building as a whole.
    b. Lutzkendorf and Lorenz (2006) recommend taking into account and gearing to methodological basics for a combined assessment of environmental, social and economic issues as formulated in ISO CD 21931-1 (ISO/TS 21931-1, 2006) and other ISO documents, for the further development of BPASs. This will substantially increase the systems' comparability and allow for more robust benchmarking of assessment results (Lutzkendorf & Lorenz, 2006). The framework of environmental, economic and social indicators is specified in ISO/TS 21929-1 (2006).

2. Acknowledging the local context. On top of learning from the strengths and weaknesses of existing BPASs, criteria within the MyOBSA framework should reflect the local conditions and constraints.

3. Linking across varying spatial scales. This means the spatial scales at which the whole criteria in the MyOBSA framework are assessed must not only regard for building and site impacts, but off-site and global impacts as well.

4. Addressing all building life cycles. An ideal building sustainability assessment framework will include all the requirements of the different stakeholders involved in the development and effectively influence the decision-making processes occurring at every level and stage of the building process (Kaatz, Root, & Bowen, 2005). These requirements are illustrated in an ISO standard (ISO/TS 21931-1, 2006, p.9).

5. Involving participation of local building stakeholders through communication and dialogue, commitment and cooperation. As Kaatz, Root and Bowen (2005, p.448) note:

    Stakeholders provide valuable input into the process of identifying significant issues to be assessed, setting targets and, most importantly, establishing project values. Empowerment through participation and knowledge exchange is another significant spin-off. Moreover, catering to stakeholder participation can make building assessment more context-sensitive, effective, and practical.

    This means, stakeholder participation is essential for the successful implementation of MyOBSA framework as it contributes to the market acceptance and support from the industry.

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