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Sustainable building assessment tool development approach

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ABSTRACT

Following expansion in the field of environmental assessment methods, existing methods cannot be applied to all regions for a number of reasons, one of which is regional variation. This paper investigates the most important and globally widespread environmental assessment methods: *BREEAM*, *LEED*, *SBTool*, and *CASBEE*. It identifies areas of convergence and distinction in order to enable the consolidation of environmental criteria into new potential schemes. As well as considered a starting point for the procedure of *consensus-based process*, it also provides a generic model for the development of an effective environmental assessment method intended for the establishment of environmental assessment method suited to Saudi Arabia.

1. Introduction

The achievement of all human activities require the investment of resource and energy; factors such as improved living standards, high levels of economic growth, urban sprawl and continuous industrialisation have had a profound impact on the demand for the most effective way of energy generation, which is currently combustion of fossil fuel (Dakwale, Ralegaonkar, & Mandavgane, 2011). However, growing evidence of global warming and climate change has increased the necessity for immediate action to avoid potentially serious consequences for future generations (IPCC, 2007).

As buildings account for one sixth of world's fresh water withdrawals, one quarter of wood harvested and two fifths of all material and energy flows (Emmanuel, 2004). This in turn exacerbates global environmental problems, particularly from developing countries that have relatively high levels of CO_2 emissions. As an illustration of this, CO_2 emissions in the GCC countries are approximately three times higher than the average of 25-EU (IEA, 2011). This may be attributable to the absence of environmental assessment tools capable of diagnosing built environments for best practice. It is for this reason that a scheme for the measurement of the environmental performance of buildings was essential (Crawley & Aho, 1999). Significant effort worldwide has therefore gone into the development of such systems to measure the environmental performance of buildings, with intensive studies employed for this purpose (Ali & Al Nsairat, 2009; Chang, Chiang, & Chou, 2007; Cole, 2006; Cooper, 1999; Crawley & Aho, 1999; Grace, 2008; Haapio & Viitaniemi, 2008).

Since 1990s, there has been extensive development of building environmental assessment methods, many of which have subsequently gained considerable success (Cole, 2006; IEA, 2001; Seo, Tucker, Ambrose, Mitchell, & Wang, 2006; Todd et al., 2001). The Building Research Establishment Assessment Method (BREEAM) was the first real attempt and various schemes such as Sustainable Building Tool (SBTool), Leadership in Energy and Environmental Design (LEED) and Comprehensive Assessment System for Building Environment Efficiency (CASBEE) have subsequently emerged; this is illustrated in Table 1, which includes the primary features of each method. In parallel with that evolution, the standardisation of issues that pertain to environmental building has also improved. For instance, The International Organization for Standardization (ISO) and the European Committee for Standardization (CEN) have been active in providing definitions for the standardised requirements for the environmental assessment of buildings (CEN, 2005, 2007; ISO, 2000, 2006a, 2006b).

The following sections will address these key issues: the justification for the development of a new scheme; an explanation of the methodology utilised by this study; and an explanation of the weighting systems employed by each selected environmental assessment method. In addition, a comparison of building environmental criteria in all selected environmental assessment methods will also be provided, along with the consolidated criteria derived from this comparison. Finally, a model for the development of an environmental assessment method will be presented, supplemented by a discussion of the salient facts, along with a conclusion from the important issues that arose during the comparative stage and proposed plans for future work.

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Table 1
Main features of BREEAM, LEED, SBTool and CASBEE.

Comparison items	BREEAM	LEED	SBTool	CASBEE
Location, year	UK, 1990	US, 1998	Canada, 1998	Japan, 2001
Developed by	BRE (*non-profit third party*)	USGBC (*non-profit third party*)	iiSBE (*international non-profit collaboration*)	JaGBC (*joint of government, industry, academy*)
Sustainable categories	Management, health and wellbeing, energy, transport, materials, water, waste, land use and ecology, pollution and innovation	Sustainable site, indoor environmental quality, water efficiency, energy and atmosphere, materials and resources, innovation, and regional priorities	Site selection, project planning and development, energy and resource, environmental loadings, indoor environmental quality, service quality, economic and social aspects, cultural and perceptual aspects	*Building environmental* quality: indoor environment, quality of service, outdoor environment on site; *environmental load:* energy, resources and materials, offsite environment
Assessed building	Residence, retail, industry unit, office, court, school, healthcare, prison, multi-function building, unusual building	Residence, school, retail, commercial building, multifunction building, healthcare	Almost any building	Residence (multi-unit), retail, industrial temporary construction, multi-function building
Flexibility	Flexible in the UK, and relatively overseas	Flexible in the USA, and relatively overseas	High flexibility around the world	Flexibility in Japan, and relative low flexibility overseas
Approach to scoring criteria	Additive pre-weighted credits approach	Additive Simple approach (1 for 1)	Additive improved weighted scoring approach	Special
Ratings	Unclassified <30 Pass ≥30 Good ≥45 Very good ≥55 Excellent ≥70 Outstanding ≥85	Certified 40–49 points Silver 50–59 points Gold 60–79 points Platinum 80+ points	1 = unsatisfactory 0 = minimum acceptable performance 5 = best practice 1–4 = intermediate performance levels 2 = normal default	BEE = 3.0 (*excellent*) BEE = 1.5–3.0 (v. *good*) BEE = 1.0–1.5 (*good*) BEE = 0.5–1.0 (*fairy poor*) BEE = less than 0.5 (*poor*)
Reference	Mao et al. (2009) and Cole and Larsson (2002)	Cole and Larsson (2002) and CASBEE (2011)	Cole and Larsson (2002) and Trusty (2000)	Laustsen and Lorenzen (2003) and Cole and Larsson (2002)

2. Justification for developing new scheme

Almost all environmental assessment methods have been designed to suit a specific territory. Evidence suggests (Cole, 1998; Cooper, 1999; Crawley & Aho, 1999; Kohler, 1999) that existing environmental assessment methods were developed for different, local purposes, and are not fully applicable to all regions. More specifically, certain environmental factors may hinder the direct use of any existing environmental assessment. Examples of such factors are as follows:

- Climatic conditions
- Geographical characteristics
- Potential for renewable energy gain
- Resource consumption (such as water and energy)
- Construction materials and techniques used
- Building stocks
- Government policy and regulation
- Appreciation of historic value
- Population growth
- Public awareness

BREEAM-UK has developed and evolved steadily during the last couple of decades. This evolution process has been criticised for its lack of overall transparency (Inbuilt, 2010). BREEAM has a great influence not just on BREEAM Gulf/Middle East, but on almost all