The Process of Adapting a Sustainable Building Assessment Method Worldwide: SEAM as case study

Saleh. H. Alyami[1],Yacine Rezgui[2] and lan Kwan[3]

[1]Cardiff University, School of Engineering, the UK, dr.saleh.uk@gmail.com ,Tel. 00447715586979.
[2] Professor and Institute leader (BRE Institute in Sustainable Engineering) School of Engineering, Cardiff University- the UK.
[3]Reader and Head of the Architectural, Civil and Civil & Environmental; School of Engineering- Cardiff University- the UK.

ABSTRACT

The evolution of sustainable assessment tools created a competition amongst well-known tools toward international use. However, practical evidence shows that regional and sociocultural variations have been a strong obstacle to the direct use of those sustainable assessment tools. Hence this paper proposes to determine the applicable methodology supporting the adaptation of a sustainable building assessment method for any given region. The adaptation of the Saudi Environmental Assessment Method (SEAM) is taken in this paper as a subject of actual development. Because sustainable assessment tools involve multi-dimensional criteria, a mixed-methodology approach is used in conducting this study, given that the Delphi technique (DT) and analytical hierarchy process (AHP) have a proven record of reaching consensus by a panel of experts. Therefore, DT and AHP have been conducted; involving leading global experts in the domain of environmental and sustainable assessment schemes, as well as professionals and highly informed local experts from academia, government, and industry. The result shows that international sustainable assessment tools are not fully applicable to the Saudi built environment, as reflected in the development of a new building environmental and sustainability assessment scheme (SEAM).

INTRODUCTION

The field of environmental assessment method has been rapidly expanding. However, each built environment has its uniqueness, yet regional and sociocultural variations may hinder the implementation of well-known tools (e.g. BREEAM and LEED) in different parts of the world (Alyami and Rezgui 2012). Therefore this paper aims to (a) determine the applicable methodology supporting the adaptation of a sustainable building assessment method for any region worldwide (b) implement this methodology in identifying applicable building assessment categories and criteria for the evaluation of Saudi's built environment; and (c) customize an adapted weighting system prioritizing the *Saudi Environmental Assessment Method (SEAM)* categories. Following this introduction, a critical review of existing methods is presented. Furthermore, the process of developing such a tool in any part of the world is explained. SEAM development is an actual development case for the validity of this study, which is briefly explained in this paper.

CRITICAL REVIEW

In the early 1990s, sustainable building assessment methods had become a yardstick for interpreting sustainable development in practical terms. Sustainable assessment methods have emerged in different countries, providing a comprehensive evaluation of sustainable development across a broad range of criteria (AlWaer et al. 2008). However, given existing sociocultural and regional variations, it is both difficult and impractical to impose a single environmental assessment scheme (Todd and Geissler 1999). Therefore an applicable assessment scheme is essentially required for each country, which would factor in regional and cultural variations. The development of a sustainable assessment method is based on subjective approaches (Cole 2005). However, Grace (2008) argues that sustainable assessment methods involve a spectrum of criteria; using a single–dimension approach is not the most applicable way of meeting the desired objective of sustainable development principles. As an alternative, a multi-dimensional approach involving the participation of key stakeholders and decision-makers offers a more robust methodology, which would produce both quantitative and qualitative building assessment criteria (Grace K.C 2008).

It has been found that development of well-known assessment methods have been established on the basis of consultation processes, with the aim of reaching the most reliable consensus on applicable building assessment categories and criteria (Sam 2010; BRE 2008). However, the strategy employed for a worldwide adaptation process, in both BREEAM and LEED, lacks overall transparency. Some tools such as GBTool follow a systematic approach towards customization in different counties. This tool has enhanced its quality so as to overcome some of the environmental and regional variations. For instance, Chang et al. (2007) conducted a study of GBTool's adaptation in Taiwan. The research instrument utilized was the analytical hierarchy process (AHP), which aimed at prioritizing the environmental and regional dimensions to suit the local conditions of Taiwan territory (Chang et al. 2007). Using AHP can only develop the weighting system; this means that the criteria of the customized GBTool in Taiwan will be greatly influenced by the original GBTool's categories and criteria. According to a number of publications (Ali and Al Nsairat 2009; Haapio and Viitaniemi 2008; Grace K.C 2008; Chang et al. 2007; Lee and Burnett 2006; Cole 2001, 2000; Todd and Geissler 1999; Crawley and Aho 1999; Cooper 1999; Cole 1998), well-known sustainable assessment tools (*e.g. BREEAM, LEED*) have been developed through consensus-based processes. However, Cole (2005) claimed that, within the comparative analysis of well-known sustainability assessment tools, there is a robust starting point for the development of new methods. Hence, a comparison study between (*BREEAM, LEED, SBTOOL and CASBEE*) has been conducted, which lays down the fundamental aspects of a new system, while identifying potential assessment categories and criteria (Alyami and Rezgui 2012).

The findings of this comparison revealed that BREAM and LEED have overlooked a number of different sustainable categories and criteria, a case in point being the quality of services *(functionality and reliability of buildings, etc.),* and the financial and economic aspects *(construction cost & financial return, etc.).* Furthermore, there are no considerations in their evaluation framework of the sociocultural dimension.

Sustainable building developments involve complex decisions (Grace K.C 2008; Haapio and Viitaniemi 2008). The increased implication of environmental problems has further complicated the situation. The world is not concerned simply with current issues (such as urban sprawl, population and economic growth etc.), but also with the consequences of these issues in the long term. For this reason, sustainable development is a greatly effective strategy, once applied and derived from its three fundamental pillars: *(Environmental, Social, and Economic aspects).* There are, therefore, essential steps which ensure the correct handling of the complex sustainable assessment criteria for certain regions. These steps include (a) identification of applicable multiple criteria through a reliable instrument; (b) establishing of a valid weighting system, by which regional and cultural aspects may be prioritized. The use of sustainability *(applicable criteria and weighting system),* therefore, will greatly simplify the evaluation of sustainable development, thereby making a constructive contribution to the identification of best practices in design and operational strategy (Grace K.C 2008).

METHODOLOGY OF DEVELOPING A SUSTAINABLE ASSESSMENT TOOL IN ANY REGION

Sustainable assessment criteria are ***multi-dimensional***. This hinders the use of a single instrument with which to design a coherent tool. For this reason, a systematic process must be clarified. Therefore, after intensive investigation, the theoretical model (Fig.1) below was established as the proposed process by means of which to lay down the six main aspects of developing a sustainable assessment tool.

There are several essential stages in the development of a new environmental assessment method. These key stages are described below: **STAGE ONE: Consolidation:** It is claimed that the comparison of the most well-known environmental assessment methods can reveal areas of convergence and distinction. This, in turn, can work as starting point in the development of new environmental assessment methods, primarily by means of the consolidation of building environmental assessment criteria (Cole 2005). Also, the consolidated criteria form the foundation which will be tailored to accommodate specific and local conditions. **STAGE TWO: Identify regional variations**: It is well known that each country, even region, has unique regional characteristics, including issues such as government policy, available resources (e.g. water, energy material), economic, and social aspects. Therefore, it is essential to obtain sufficient data to identify these issues. **STAGE THREE: Panel of experts:** The panel composition is one of the essential tasks of developing new method. It is important to select and acquire expert opinions from a range of different fields on a common platform, such as government, academia, and industry (Chang et al. 2007). There are several guides giving details of robust techniques with which to build reliable samples (Dalkey 1951; Delbecq A 1975).

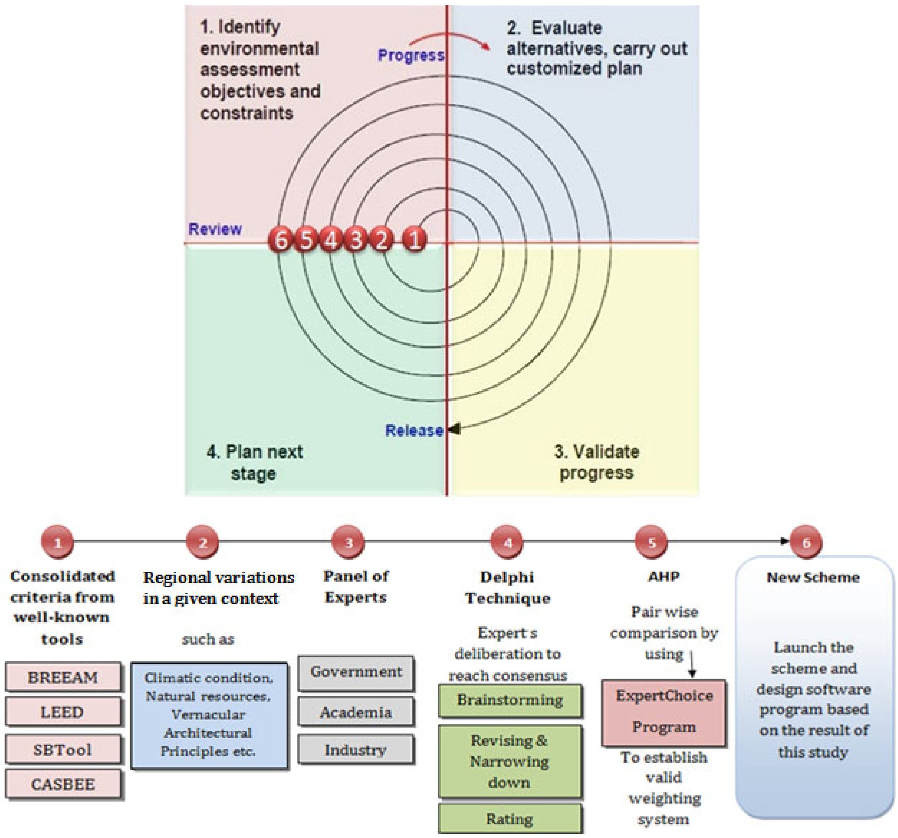

Figure 1. Methodology of developing a new assessment scheme(Alyami and Rezgui 2012)

STAGE FOUR: Delphi Technique: Building environmental assessment dimensions are considered multi-dimensional criteria (Grace K.C 2008), Evidence suggests that the consensus-based process is the most applicable approach for developing a comprehensive and effective building environmental assessment criteria (Chew and Das 2008).The Delphi technique has a proven record of reaching consensus on complex issues; in this respect it is the most applicable approach, given its use of a three-round system, including a brainstorming round; a narrowing-down round; and finally, a rating round. **STAGE FIVE: Analytical Hierarchy Process:** As building environmental assessment categories vary noticeably with regard to weight, AHP can therefore play an important role in the development of a potential weighting system capable of reflecting the degree of local needs as accurately as possible, as well as being able to prioritize building environmental assessment categories for any given location. **STAGE SIX: Launch new scheme**: Before launching the new environmental assessment method, it is important to subject it to a testing and validating stage. This can be carried out in different ways (a) The new scheme may be compared against most well-known schemes currently used in order to allow for scientific justification of the similarities and differences (b) The new scheme can be tested by conducting a partial comparative testing or sensitivity analysis, using building simulation software such as Integrated Environmental Solution (IES-VE).

SEAM

There are a number of exclusive criteria; new, major categories have been identified through these multi-stage processes. More details may be found in (Alyami et al. 2013)

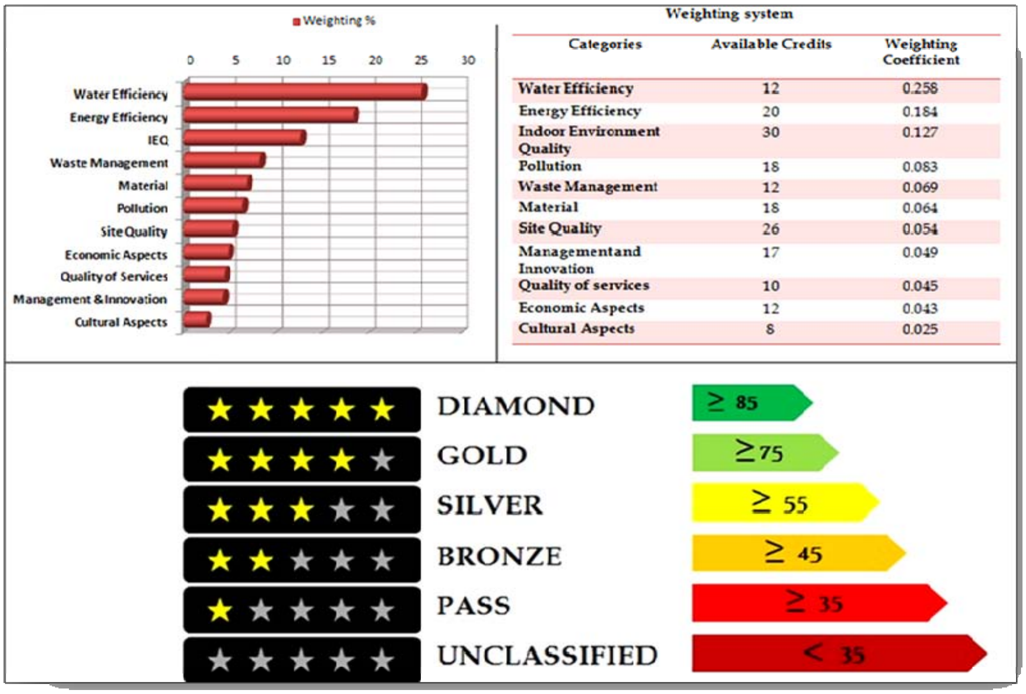

Figure 2. Weighting system and benchmarks

1.1. RATING FORMULAS

According to the weighting system (Fig 2) derived from AHP, the SEAM will be able to provide a single score, which will reflect the level of sustainability in the Saudi built environment. This will be calculated by the following procedure: (a) determine the rate of each building environmental category (as shown in Equation 1); As SEAM has 11 categories: this will result in 11 different rating scores; (b) determine the summation of these 11 rating scores (as shown in Equation 2), which will provide the overall rating within a maximum of 100 credits available.

$$BEC = \frac{CA}{AC} \times W \times 100 \qquad (1)$$

Where:
BEC: *Building Environmental Category (includes 11 Categories)*
CA: *Credits Achieved*
AC: *Available Credits*

W: *Weighting Coefficient*

$$\text{Overall Rating} = \sum_{n=1}^{n=11} BECn \qquad (2)$$

1.2. WEIGHTING SYSTEM

SEAM categories were subjected to the use of AHP. A hierarchy model was built relying on the consensus of 35 experts. A pair-wise comparison was conducted so as to prioritize these categories, based on the Saudi Arabia local context. Figure 2 illustrates the weighting coefficients, as well as the available credits for each category. Moreover, in SEAM, the overall rating value may be benchmarked as follows: buildings rated below 35 will be considered ***UNCLASSIFIED***; buildings rated between 35 and 45 will be considered ***PASS;*** buildings rated between 45 and 55 will be considered ***BRONZE;*** buildings rated between 55 and 75 will be considered ***SILVER;*** buildings rated between 75 and 85 will be considered ***GOLD;*** and finally, buildings rated over 85 will be considered ***DIAMOND*** *(Five stars).*

2. Conclusion

International assessment tools such as BREEAM and LEED have been critically revised in the development of an assessment tool for Saudi Arabia. However, regional, cultural, and environmental variations in Saudi Arabia support the further development of suitable categories and criteria. During the development process, a clear consensus has been reached; that a number of categories and criteria have not been recognized by an international assessment tool. Hence, applying the above methodology has yielded substantial results when developing SEAM. A number of new features and aspects, in the domain of sustainability development, have been obtained. This may be summarized as follows: (a) SEAM is the first developed tool with which to assess the level of sustainability in the Saudi Arabia built environment (b) SEAM is developed through new a process that combines reliable approaches, including: *Consolidation; Regional variation; Panel of experts; Delphi technique; AHP; Testing stag*. This process may be utilized in developing a potential, new, sustainable assessment tool for any given region (c) SEAM includes exclusive categories and criteria originally designed to suit the Saudi Arabian climatic condition and economic and social aspects (d) SEAM is delivering a new, applicable weighting system with which to prioritize the Saudi national plan, in accordance with sustainability principles. The future work will involve conducting of the testing stage, which will be reported in publications to follow.

REFERENCE

Ali HH, Al Nsairat SF (2009) Developing a green building assessment tool for developing countries – Case of Jordan. Building and Environment 44 (5):1053-1064. doi:10.1016/j.buildenv.2008.07.015

AlWaer H, Sibley M, Lewis J (2008) Different Stakeholder Perceptions of Sustainability Assessment. Architectural Science Review 51 (1):48-59. doi:10.3763/asre.2008.5107

Alyami SH, Rezgui Y (2012) Sustainable building assessment tool development approach. Sustainable Cities and Society 5 (0):52-62. doi:http://dx.doi.org/10.1016/j.scs.2012.05.004

Alyami SH, Rezgui Y, Kwan A (2013) Developing sustainable building assessment scheme for Saudi Arabia: Delphi consultation approach. Renewable and Sustainable Energy Reviews 27:43-54

BRE (2008) Multi-residential, BREEAM Scheme Document., vol SD 5064 Issue: 2.0. BRE Global Ltd,

Chang K-F, Chiang C-M, Chou P-C (2007) Adapting aspects of GBTool 2005—searching for suitability in Taiwan. Building and Environment 42 (1):310-316. doi:10.1016/j.buildenv.2005.08.015

Chew MYL, Das S (2008) Building Grading Systems: A Review of the State-of-the-Art. Architectural Science Review 51 (1):3-13. doi:10.3763/asre.2008.5102

Cole R (2005) Building environmental assessment methods: redefining intentions and roles. Building Research and Information 33 (5):455-467. doi:10.1080/09613210500219063

Cole RJ (1998) Emerging trends in building environmental assessment methods. Building Research and Information 26 (1):3-16. doi:10.1080/096132198370065

Cole RJ (2000) Building environmental assessment methods: assessing construction practices. Construction Management and Economics 18 (8):949-957. doi:10.1080/014461900446902

Cole RJ (2001) Lessons learned future directions and issues for GBC. Building Research and Information 29 (5):355-373. doi:10.1080/09613210110064286

Cooper I (1999) Which focus for building assessment methods – environmental performance or sustainability? Building Research & Information 27 (4-5):321-331. doi:10.1080/096132199369435

Crawley D, Aho I (1999) Building environmental assessment methods: Applications and development trends. Building Research and Information 27 (4-5):300-308

Dalkey N, & Helmer, O (1951) The use of experts for the estimation of bombing requirements. A project Delphi experiment. USA

Delbecq A VA, Gustafson D (1975) Group techniques for program planning: a guide to nominal group and Delphi processes. Glenview: Scott, Foresman;

Grace K.C D (2008) Sustainable construction—The role of environmental assessment tools. Journal of Environmental Management 86 (3):451-464. doi:10.1016/j.jenvman.2006.12.025

Haapio A, Viitaniemi P (2008) A critical review of building environmental assessment tools. Environmental Impact Assessment Review 28 (7):469-482. doi:10.1016/j.eiar.2008.01.002

Lee WL, Burnett J (2006) Customization of GBTool in Hong Kong. Building and Environment 41 (12):1831-1846. doi:10.1016/j.buildenv.2005.06.019

Sam K (2010) Chapter 2 - Basic LEED™ Concepts. In: LEED Practices, Certification, and Accreditation Handbook. Butterworth-Heinemann, Boston, pp 19-48. doi:10.1016/b978-1-85617-691-0.00002-3

Todd JA, Geissler S (1999) Regional and cultural issues in environmental performance assessment for buildings. Building Research & Information 27 (4-5):247-256. doi:10.1080/096132199369363