AN OVERVIEW OF GREEN BUILDING RATING TOOLS

TN Sebake[1]

[1]CSIR, Built Environment, P.O. Box 395, Pretoria, 0001. ssebake@csir.co.za

1 Introduction

The built environment uses large amounts of scarce resources and contributes significantly to the production of global emissions and waste (Edwards, 2002 in van Wyk and Chege, 2004). For instance, construction and post construction activities consume 50% of all resources globally, 40% of global water usage is used for sanitation and other user within buildings and 60% of agricultural land (lost to farming) is used for construction activities (Edwards, 2002 in van Wyk and Chege, 2004). This negatively affects the health of people and the state of natural environment (Forsberg and von Malmborg, 2004).

Since the detrimental affects of construction practices on the natural environment were highlighted, the performance of the buildings has become a major concern for occupants and built environment professionals (Crawley and Aho, 1999; Ding, 2008; Cooper, 1999; Kohler, 1999; and Finnveden and Momberg, 2005). In response to this concern of reducing environmental impact of the design and operation of buildings, many researchers have developed methods for measuring environmental performance o buildings with the intention of creating a sustainable built environment (Crawley and Aho, 1999; Blom, 2004). The British Research Establishment Environmental Assessment Methodology (BREEAM) developed in 1990 by the British Research Establishment was the *"first real attempt to establish a comprehensive means simultaneously assessing a broad range of environmental considerations in building"* (Haapio, 2008). Subsequent to this numerous tools have been developed or adapted from existing assessment tools (Cole, 2005; Haapio, 2008). Green building rating tools are also referred to (but not limited to) as green building rating systems (Yudelson, 2008), building environmental assessment tools/methods/systems (Gomes, 2007; Cole, 1998), and environmental assessment tools (Blom, 2004).

These tools enhance the environmental awareness of building practices and provide fundamental direction for the building industry to move toward environmental protection and the achievement of sustainability (Ding, 2008). They provide a way of showing that a building has been successful in meeting an expected level of performance in various declared criteria (Cole, 2005). Their adoption and promotion has had a major contribution to creating a market demand for green buildings and has significantly shifted the public's awareness and perceptions of what building quality is (Cole, 2005). This is confirmed by the increasing number of people demanding information on environmental aspects of buildings, such as whether or not a building is good for their health or if it fits into a sustainable society (Carlson & Lundgren, 2002).

1.1 Aim of the section

The aim of this section is to provide an overview of green building rating tools, in terms of what they are, why they are used, who uses them, where they are used, how they are used and when they are used.

1.2 Scope of the section

This section only provides an overview of qualitative green building rating tools. It does not extensively list environmental assessment tools, detail their use, nor compare any of the tools listed.

1.3 Structure of the section

This section has been structured under the following headings:

- The **Introduction** provides some background on reason for the development of green building rating tools and what the primary functions of these tools are. This also outlines the aim and scope of the section.
- The **Review of green building rating tools** presents character, application of the tools as well as examples of existing green building rating tools, in terms of what categories used and which building types are assessed.
- The **Discussion of emerging trends and conclusion** concludes with discussions of emerging trends in the field of green building rating tools.
- The **References** provide a list of resources cited in the text.

2 A review of green building rating tools

Since 1990 when BREEAM was developed, there has been an increasing interest in green building rating tools (Haapio, 2008; Gomes da Silva, 2007). Furthermore, the standardisation of issues relating to the environmental impact of buildings has increased (Haapio, 2007). The International Organization for Standardization (ISO) and the European Committee for Standardization (CEN) have been active in defining standardization requirements for the environmental assessment of buildings, for instance three standards / technical specifications were recently published by ISO(Haapio, 2008).

Although diverse and providing different results, rating tools comprise of similar elements organised in a sequence (e.g. designing an effective user interface, setting targets, establishing systems boundaries, selecting evaluation criteria, fulfilling data requirements, aggregating and weighting, validating results and analysing and presenting results) that allows users to make decisions (IEA, 2001). These tools emphasize different elements in the process and results are achieved in different ways.

The International Energy Agency (IEA) is an intergovernmental organization, whose mandate includes energy security, economic development and environmental; the latter with a focus on mitigating climate change (www.iea.org. In the IEA project, *Annex 31: Energy-related environmental impact of buildings* (IEA, 2001) environmental assessment tools are categorized into five classes (IEA, 2001); namely i) energy modelling software, ii) environmental Life Cycle Assessment (LCA) tools for buildings and building stock, iii) environmental assessment frameworks and rating systems, iv) environmental guidelines or checklists for design and management of buildings, and v) environmental product declarations, catalogues, reference information, certification and labels.

Categories (iii) *environmental assessment frameworks and rating systems* and (ii) *environmental Life Cycle Assessment (LCA) tools for buildings and building stock* can be further referred to as qualitative and quantitative (Reijnders and van Roekel, 1999; Forsberg and von Malmborg, 2004), respectively. These classes are described below:

- The **qualitative** assessment tools (the focus of this review) are generally based on the auditing of buildings, followed by a rating (or scoring) of an assessed criteria, which results in an overall rating (score) for the building performance (Forsberg and von Malmborg, 2004). The most commonly known qualitative assessment tools are BREEAM and the Leadership in Energy and Environmental Design (LEED). Subsequent tools, like the Green Building Tool (now known as the Sustainable Building Tool), Green Star, Hong Kong Building Environmental Assessment Method (HK BEAM) and the Sustainable Building Assessment Tool (SBAT) are based on these tools.

  Criteria used in qualitative tools tend to be open to wider interpretation by assessors and therefore require the time, energy and commitment of an unbiased third party to be successful (Cole, 2005).
- The **quantitative** assessment tools (are also referred to as LCA tools) use a physical life cycle approach with quantitative input and output on flows or matter and energy (Forsberg and von

Malmborg, 2004; Cole, 1999). Some examples of quantitative assessment tools include Envest from UK, EcoQuantum from the Netherlands and ATHENA from Canada.

Quantitative assessment tools include qualitative criteria; however greater care and precision is given to the description of the qualitative criteria in order to reduce misinterpretation. In addition, the presentation of the performance results distinguishes between the scores obtained from the qualitative and quantitative criteria (Cole, 2005).

Examples of existing green building rating tools

Table 1 presents three of some of the most common qualitative green building rating tools. The developer, year of establishment, categories and current versions (pilot versions are listed in brackets) are reviewed. Buildings are assessed at various stages of the building life cycle, including new and existing construction.

Although these are freely available online for self-assessment, trained third party is required to undertake an assessment for certification. The rating tools reviewed may be used at both a national and global level (Haapio, 2008). Globally these tools have either been adapted to a specific country (e.g. the US LEED adapted for Canada and Australian Green Star adapted for New Zealand and South Africa) or developed into a new tool (i.e. the development of Green Star and SBAT were influenced by BREEAM and LEED).

Table 1 Examples of existing green building rating tools

Name of Rating Tool	Developer, Year	Categories	Versions	Source
BREEAM	Building Research Establishment (BRE) in 1990	1. Energy use 2. Transport 3. Water 4. Ecology 5. Land use 6. Materials 7. Pollution 8. Health and well-being 9. Management.	1. Offices 2. Housing 3. Healthcare 4. Courts 5. Industrial Units 6. Prisons 7. Retail 8. Schools 9. Multi-residential 10. Neighbourhoods	http://www.breeam.org
LEED	United States Green Building Council (USGBC) in 1993.	1. Energy and atmosphere 2. Water efficiency 3. Sustainable sites 4. Materials and resources 5. Indoor environmental quality (IEQ) 6. Innovation	1. Offices 2. Homes 3. Neighbourhood development 4. Retail 5. Healthcare 6. Schools	http://www.usgbc.org/LEED
Green Star	Green Building Council of Australia (GBCAUS) in 2003	1. Energy 2. Transport 3. Water 4. Ecology and use 5. Emissions 6. Materials, 7. IEQ 8. Management, 9. Innovation	1. Offices 2. Retail 3. Schools 4. (Industrial buildings) 5. (Mixed use residential) 6. (Mixed use) 7. (Healthcare)	http://www.gbcaus.org

A majority of the existing green building rating tools are voluntary in their application (Cole, 1999) can be used to assess the performance of existing buildings or the design of new buildings (Cole, 1998). It is therefore crucial that the potential and actual performances are differentiated. Although existing evidence suggests that the actual performance of the building in use is the most significant measure, the potential performance provides information that can be used to guide the future actions of built environment professionals (Bordass and Leaman, 1997 in Cole, 1998).

Most rating tools are currently used toward the end of the design phase. This, in terms of building performance, limits the ability to influence the design (Haapio, 2008), because problems experienced in the operation of a building (i.e. downstream) are symptomatic of neglect in design (i.e. upstream), see dotted line in Figure 1 (Sparrius, 1998 in Conradie and Roux, 2008). Therefore in order to positively influence the building performance, ambitions to contribute to sustainability should be dealt with at the initial stage (Edén *et al*, 2003).

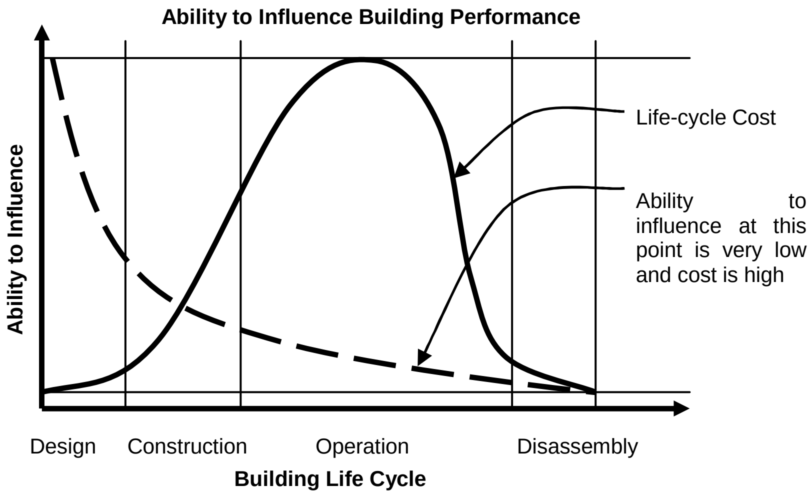

Figure 1 Ability to Influence Building Performance (after Sparrius, 1998 in Conradie and Roux, 2008)

The first generation of rating tools originated in developed countries (Cole, 2005) and primarily focused on environmental assessments of buildings (Cole, 1998). Rating tools that have been created in developing countries, which have more pressing social and economic concerns, need to reflect these concerns (Kaatz *et al*, 2002). An example of a rating tool developed in a developing country, namely South Africa, is the SBAT, developed to relate strongly to the context of a developing country and to support sustainable development. The support of sustainable development is reflected in the headings used for the tool's objectives, namely environmental, economic and social (Gibberd, 2003).

3 Discussion of emerging trends and Conclusion

The current rating tools have several structural limitations; the development of second generation rating tools will be affected by the following emerging trends (Cole, 1998):

- **An increased understanding of sustainability:** Unlike first generation rating tools, whose major focal point was environmental performance of buildings, second generation tools need to accept the new agenda, which focuses on broader sustainability aspects (Cole, 1999; Cooper, 1999). The structure of the second generation rating tools should ensure that it allows for change as our understanding of sustainability unfolds.
- **The adoption of LCA methodologies:** There have been several advances made in the development tools for the description and assessment of the environmental performance of buildings. The work has moved (and continues to move) from simple descriptive qualitative tools to more comprehensive 'eco-profiles', quantitative tools based on rigorous LCA protocols. (Reijnders and van Roekel, 1999)
- **The need to change occupant expectation or use patterns:** Some current rating tools evaluate the intention of building owners in terms of anticipated management practices of the building in operation. Since human activities have significantly contributed to the current environmental crisis, it is important that the performance be measured during the operation of the building in order to capture the use patterns.
- **Globalization and standardization:** Globalization over the last decade has increased the identified need for standardization within various industry activities in terms of environmental criteria and standardized assessment protocols. This has begun to provide a basis for a common dialogue and will eventually enable the ability for comparison between different tools.

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