DEVELOPING HOLISTIC FRAMEWORKS FOR THE NEXT GENERATION OF SUSTAINABILITY ASSESSMENT METHODS FOR THE BUILT ENVIRONMENT

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It is essential for any development within the built environment aspiring to deliver a high degree of sustainability to consider the contribution that it will make to the local culture, place and systems; and the impacts of these on the wider region. In order to achieve this, a number of key issues need to be considered within the context of the entire life-cycle of a building. Current Sustainability Assessment Methods (SAMs) in the built environment are principally focused on the projected energy consumption and environmental impacts of new-build projects; tending to focus on assessment during design and construction phases, prior to the occupation of the building. A number of novel articulations of sustainable development have recently been expressed through holistic design theory and frameworks such as 'One Planet Living', emphasizing the need for a more holistic view to be adopted within the built environment. This paper presents the findings of an evaluation of current SAMs practice and novel articulations of sustainable development in order to identify a set of key factors required to develop a holistic framework. It explores the key social, economic and environmental factors that need to be taken into account and the requirements for future longevity and contribution to these areas. Further understanding is required of the strengths and weaknesses of different approaches to sustainability to enable key areas of focus to be established for the development of the next generation of SAM's and related policy on sustainability.

Keywords: built environment, life-cycle, sustainability, triple bottom line.

INTRODUCTION

Green buildings and the philosophical basis for sustainability in the built environment are not new concepts (Buck 2004). With theoretical applications which relate to historical building techniques and relationship to surrounding places the green building movement from the 1970's (McGinnis *et al.* 1998) onwards has reflected a place, people and resource sensitivity which to some extent fulfil requirements of the 'Triple Bottom Line' (TBL) approach to sustainability. Parallel to the TBL, Williamson *et al.* (2003) outline three images of sustainability, these being 'Natural', 'Cultural' and 'Technical' images to which a design relates. Following from the implementation in the UK of BREEAM (Building Research Establishment Environmental Assessment Method) as the first rating system in the early 1990's,

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there has been an increased awareness as to the requirement for building practices to be both sustainable and responsive to environmental issues. This has been illustrated through the worldwide adoption of 'green building rating systems' (GBRS) such as LEED, HK-BEAM, CASBEE (iiSBE 2010, WGBC 2010). As the emphasis of these systems has shifted from green to sustainable buildings, there has been criticism of the dominance of environmental criteria at the expense of the social and economic criteria (Haapio and Viitanieni 2008, Sinou and Kyvelou 2006, Cole 2005).

Sinou and Kyvelou (2006) credited the increased popularity of environmental performance assessment methodologies (also inclusive of GBRS) with contributing greatly to 'the integration of methods and practices favouring sustainability in the building sector'. When discussing green and sustainable methodologies it is also to be considered that there remains in parallel to mainstream industry's adoption of GBRS and other tools and rating systems a solid and experienced knowledge base of holistic green buildings and quality design. Within this knowledge base, novel articulations such as Bioregionalism (McGinnis *et al.* 1998), Permaculture (Tippet 2000) and Cradle to Cradle (C2C) (McDonough, and Braungart 2003), form the theoretical basis for connection to community, place, landscape and ecosystems and the interrelationships between them. These theories have been developed into frameworks addressing lifestyle and communities, the principal model discussed in this paper being 'One Planet Living' (OPL) (One Planet Communities) developed by BioRegional and WWF, applied to projects such as BedZed, One Brighton and Riverside One (Middlesbrough), with international applications in development, including: Masdar City (Abu Dhabi), Sonoma Mountain Village (USA) (Desai 2010). The novel articulations referred to are predominantly natural and cultural in their images of sustainability, while GBRS on the whole are technical.

International frameworks and initiatives such as the Green Building Challenge (GBC) (Todd *et al.* 2001, iiSBE 2010) and World Green Building Council (WGBC 2010) have promoted and supported the development of rating systems and international standards. A result of this is a significant increase in the number of national systems since 2000. Since 2005 there has been a shift in the number of tools addressing Green Building (GB) towards Sustainable Building (SB) (iiSBE 2010), this covers a range of tools types and applications. This paper refers to this range of tools as 'Sustainability Assessment Methods' (SAMs). These are increasingly covering a wider range of issues, including life-cycles, but most are still failing to sufficiently cover all of the dimensions of the TBL, natural and cultural approaches to sustainability.

This paper will explore recent SAMs developments in a comparative overview of assessment criteria. This comparison will be assessed in terms of TBL and 'images of sustainability' to determine what gaps or overlaps are within the existing SAMs market. This will be cross-referenced in relation to the 'images of sustainability' (Williamson *et al.* 2003) and the emerging novel articulations of sustainability. This addresses how the images of sustainability can be merged to fulfil broader aspects of the TBL and address potential 'realistic' sustainable solutions in the mainstream Built Environment sector. This relates to whether we are sufficiently preparing ourselves with buildings for the future and future generations without exploiting other resources currently available (Rees 2009). Are our developments and expectations within current and future resource, environment and cultural means?

BACKGROUND AND INVESTIGATION

Requirements for a 'realistic' approach to sustainability

It is generally accepted that the 'Triple Bottom Line' (TBL) of sustainability, Social, Economic and Environmental factors are required for sustainability to be achieved. Other approaches to sustainability have been challenged and developed, such as those which include other related factors, such as Equity, Ecology and in the case of SPeAR developed by Arups: Natural Resources (McGregor and Roberts 2003), Ecological Footprinting is used as a basis for One Planet Living (Desai 2010). Sinou and Kyvelou (2006) cite the French National Council of the Ordre of Architects (2005) charter of eight fundamental considerations: cultural anchoring and local development, social integration and solidarities, protection of the environment and eco-efficiency, economy and collective performance, public consultation and education, conformity transparency and governance, research innovation and creativity and finally, long-term vision. For the purposes of this research the accepted 'Triple Bottom Line' will be applied, however, as indicated by the above examples, this does not mean that it is the most appropriate approach to achieve 'realistic' sustainability, but it does cover a broad range of issues appropriate to the Built Environment.

Policy agenda has tended to operate around the 'weak' understanding of sustainability. This has allowed for tradeoffs to be culturally part of the agenda between the three dimensions of the TBL. If we want to move towards a more environmental limits focused approach there is a need for tools to move to align with a 'stronger' interpretation of the concept. 'Realistic' sustainability in the context of this research is sustainability which closes ecological and industrial loops, by working within the means of natural resources and the environment for current and future generations, without compromise and requirement for future intensive adaptation, the outcome of which is to sustain quality of life and environments.

Table 1: The Three images of architectural sustainability source: Williamson et al. *(2003)*

Image	Dominant concerns	Dominant horizon	Symbolism/aesthetics	Approach
Natural	Environmental place, ecosystems, health, balance	Local	'Touching the earth lightly' with forms echoing nature	Study local natural systems; emphasize sensitivity and humility in relation to nature
Cultural	Cultural place, people, genius loci, difference, cultural sustainability	Local	Highly contextual with forms, materials and construction methods echoing the local vernacular	Study local culture and building; emphasize local involvement and local expertise
Technical	Technologies, global environmental impacts, cost-benefit analysis, risk management	Global	Leading edge contemporary international systems	Study science, economics and technology; emphasize transnational expertise

Table 1 expands on the 'images' of sustainability presented by Williamson *et al.* (2003). These are general categories which relate to the dominant concerns of an architectural design, this does not mean however that a design is mutually exclusive to an 'image', overlap is encouraged to achieve a broader, grounded approach within the project. In general, the dominant concerns of 'novel articulations' range between Natural and Cultural 'images'. Conventional SAM approaches relate to Technical

'images' with some overlap to Natural, more recent tools, such as DGNB, Pearl and VERDE have criteria in all three 'images', although this is not equally distributed.

Overview of Sustainability Assessment Methods (SAM's)

Contextual overview

The research sought to gain insight into the nature of the current SAMs landscape and conducted a comparison of over 30 existing ratings systems specific to Green and Sustainable Buildings. In general there are three roots behind the development of the range of national tools currently available. Firstly, those based on the GBC frameworks, GBTool/SBTool (Green Building / Sustainable Building); secondly, those based on LEED (Leadership in Energy and Environmental Design); and thirdly, those which have been developed from an analysis of other tools available but often with culturally unique assessment criteria, such as DGNB, Pearl and HQE. One common root to most tools, is that BREEAM was also studied during their development, this being a well established tool by the time others were developed. Tools have been developed from a range of backgrounds, specifically research, policy and independent. A number of tools have benefited from a mixture of both and endorsement by national governments.

Three dominant roots of SAMs

The Green Building Challenge (GBC) was established in 1995 (Todd *et al.* 2001) through research and contribution from over 20 countries (iiSBE 2010). From this the GBTool (Green Building Tool) was developed as a framework for rating tools, which was then adopted and developed by several countries (for example, Australia, Italy and Spain) into their own place specific tools. The GBC ended in 2005, but the International Initiative for a Sustainable Built Environment (iiSBE) retain contact with member groups and have since developed the SBTool (Sustainable Buildings) tool, which looks at the wider impacts of buildings within Life Cycle contexts. This remains as a third party framework from which other tools can refer and be developed specific to regional requirements (iiSBE 2010).

LEED was launched in 1999 by the US Green Building Council. Since then it has become one of the most widely recognized and applied tools internationally. It has been adapted by a number of countries, including Canada, India, Brazil (LEED 2009) into their own region specific tools. LEED v.3 was launched in 2009, assessment criteria have been updated to include more holistic assessment criteria (LEED 2009), but these remain predominantly focused on environmental issues.

Since 2006 a number of tools have been developed, or are in development, which aim to respond to the TBL, with sustainability as their goal. These include Pearl, Lider-A and most recently, DGNB. There are core conceptual differences between these tools and those of roots 1 and 2, they are also culture specific through language and approach, with their criteria following different patterns and agenda to the former roots, and proposed periodical assessment over the life of the building.

Background on comparisons

The comparison of different SAMs have related to phases of update and inception, most notably, 1999-2001, 2004-2006 and 2008 onwards. Most papers comparing tools agreed that the areas covered by rating tools were not broad with the TBL (Haapio and Viitanieni 2008, Sinou and Kyvelou 2006, Cole 2005). Haapio and Viitanieni (2008) and Papadopoulos and Giama (2009) found that tools were not easily compared due to a wide range of assessment criteria and application to different types of project, for example, office, residential. It may be as a result of this, and also

tool availability that previous SAMs comparisons have focused on the most common tools available, such as LEED, BREEAM and GB-Tool. More recent comparisons have addressed a wider range of tools, but these tend to have similar criteria to the common tools and do not address issues related to social and economic sustainability, for example, Papadopoulos and Giama (2009). There have been comparisons between market competitors by Reeder (2010) and Cole (2006), but these have mostly focused around the popular tools, those with similar approaches and assessment criteria based in North America.

In 2005-2006 a number of tools were developed (Green Mark, LiderA, VERDE) and revised (BREEAM, CASBEE, GB-Tool, Green Globes, LEED), coinciding with evaluations and comparisons of tools (Cole 2005 and 2006). A number of these tools have continued to be developed, with revisions in 2009-2010 (BREEAM, Green Star, LEED, LEED-Canada, VERDE) including new tools, for example the German Green Building Council (DGNB) certification system (DGNB 2009) and the Estidama Pearl Rating System in Abu Dhabi, United Arab Emirates (Estidama 2010). The new tools have been developed in line with criticism and developed thinking that the existing systems were insufficient to achieve sustainability (Cole 2005). Despite this, the majority of these tools are still self referred, and through the World Green Building Council (WGBC 2010) as 'Green Building Rating Systems'. Assessment and development continues through the Sustainable Buildings Alliance (SBAlliance 2010) and through independent and national research.

The SBAlliance has been undertaking tools comparison and benchmarking analysis with a view to developing a common language and approaches to SB (SBAlliance 2010). The limitation of this is that inclusion of tools is voluntary by member organizations, therefore some tools which are a departure from the mainstream, such as Pearl have not been included. This has the potential to risk repeated approaches to assessment structure and criteria where a different, more flexible approach may be required to address issues of scale, context, image and ultimately the TBL. On the other hand, this is the first assessment which has included DGNB, this is potentially also recognition of it being an essential world player in the next generation of tools.

Comparison of SAMs

Through online searches, over 30 nationally focused tools from around the world were identified, these were reflective of national context, but in some cases (BREEAM, LEED) are being applied internationally. They were in varying stages of development and responded to a range of uses, but most included a tool for Offices and Multi-residential developments. A number of tools showed clear connections to the 3 developmental roots, this was particularly evident in the evaluation criteria applied. There was also an emerging pattern as to the location of developing tools in relation to their root, in particular the adaptation of LEED for use in South American. A number of these tools had broached application to building Life Cycles, and in some cases, continued assessment, but many were limited in their application or required additional tools to be applied as part of a wider toolkit. From the tools identified, 14 tools were selected for further comparison based on 4 criteria:

1. Established reputation (e.g., BREEAM, LEED, Green Star, CASBEE);
2. Leader of a developmental root (e.g., LEED, SBTool);
3. Variant theoretical basis from the mainstream (e.g., DGNB, Pearl);
4. Broader coverage of TBL, LCA and holistic issues (e.g., DGNB, Pearl, VERDE).

Table 2: A comparison of the general assessment categories for key established international Green Building Rating Tools.

Country	Tool	Initiated	Recent revision	Sustainable Site	Land-use & ecology	Energy Efficiency	Water efficiency	Materials & resources	Environmental loadings	Indoor Environmental	Service Quality	Transport	Social aspects	Economic aspects	Cultural aspects	Regional Priority	Management	Innovation & design	Awareness & education	Life Cycle Assessment	References
1. International	GB/SB-Tool	1996	2007	✓		✓	✓	✓	✓	✓	✓		✓		✓						http://www.iisbe.org/sbmethod [Accessed 19/04/2010]
2. Australia	Green Star	2003	2010		✓	✓	✓	✓	✓	✓	✓	✓						✓			http://www.gbca.org.au/green-star/ [Accessed16/04/2010]
3. Canada	LEED-Canada	2004	2009	✓			✓	✓	✓	✓								✓			http://www.cagbc.org/leed/what/index.php [Accessed 16/04/2010]
4. France	HQE	2004	NA	✓	✓	✓	✓	✓	✓	✓	✓		✓				✓				http://www.asshqe.org/ [Accessed 16/04/2010]
5. Germany	DGNB Certification	2009	NA	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓			✓	http://www.dgnb.de/en/certification/the-german-sustainable-building-certification/index.php [Accessed 16/04/2010]
6. Japan	CASBEE	2001	2007/08	✓	✓	✓		✓	✓	✓	✓							✓			http://www.ibec.or.jp/CASBEE/english/index.htm [Accessed 19/04/2010]
7. Malaysia	GBI	2009	NA	✓		✓	✓	✓		✓								✓			http://www.greenbuildingindex.org/ [Accessed 19/04/2010]
8. Portugal	LiderA	2005	NA	✓	✓	✓	✓	✓	✓	✓	✓		✓					✓		✓	http://www.liderа.info/?p=index&RegionId=3&Culture=en [Accessed 19/04/2010]
9. Singapore	Green Mark	2005	NA	✓		✓				✓		✓						✓			http://www.bca.gov.sg/GreenMark/green_mark_buildings.html [Accessed 19/04/2010]
10. Spain	VERDE	2005	2009	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓			✓				http://www.gbce.es/tools/general-information [Accessed 19/04/2010]
11. Abu Dhabi (United Arab Emirates)	Pearl Rating System	2010	NA	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	http://www.estidama.org/estidama-home.aspx?lang=en-US [Accessed 19/04/2010]
12. United Kingdom	BREEAM	1990	2008		✓	✓	✓	✓	✓	✓		✓	✓				✓				http://www.breeam.org/ [Accessed 19/04/2010]
13. United States of America	LEED	1998	2009	✓		✓	✓	✓	✓	✓		✓				✓		✓	✓		http://www.usgbc.org/DisplayPage.aspx?CategoryID=19 [Accessed 19/04/2010]
14. Canada / USA	Green Globes	2000	2006	✓	✓	✓	✓	✓	✓	✓						✓				✓	http://www.greenglobes.com/ [Accessed 16/04/2010]

The 'Assessment Criteria' from the 3 development roots were evaluated, and placed within broad related headings, the 14 tools were then compared under these headings, this is shown in Table 2. Very few tools covered TBL and LCA, but significantly more than in comparisons undertaken between 2004-2006 (Walton *et al.* 2005, Cole 2006, Sinou and Kyvelou 2006). Those which had covered TBL had applied limited criteria to Social and Economic aspects, DGNB incorporated Social and Cultural criteria together. This was also evident in more recent evaluations (El-Haram *et al.* 2009, Fenner and Ryce 2008, Papadopoulos and Giama 2009, Haapio and Viitaniemi 2008).

DGNB, VERDE and Pearl specifically covered TBL aspects. DGNB and Pearl addressing LCA within assessment and reassessment. While LEED had developed its criteria for Version 3 to cover a broader, more sustainable analysis, coverage of economic and social aspects were still limited. On the basis of this comparison, the established tools of BREEAM and CASBEE were limited in their scope, and to some extent may be compromised in their inflexibility to develop with a 'sustainable' rather than 'green' framework, as suggested by Cole (2005). It remains to be seen how recent developments within tools will be progressed to cover TBL and be more flexible for future adaptation.

While the breadth of coverage is increasing, many of the criteria are still based on quantitative data, and less on the responsive and developmental impacts on social, cultural and economic issues. While health is covered by some tools within the criteria of "Indoor Air Quality", this does not address materials and health related issues, apart from Pearl. Beyond this the environmental impact of materials is still limited. The application of criteria would suggest that the majority of tools remain focused on the 'technical' image of sustainability. While some independently developed tools, such as Pearl are beginning to address issues of 'Natural' and 'Cultural' images of sustainability. The apparent implication of this is that the tool is limited to its region, as it states that it can be used by other member states of the United Arab Emirates (UAE), but it would need to be adapted for that region (Pearl 2008). This is a significantly different approach to the international application of tools such as LEED and BREEAM. With tools such as Pearl which are much more tailored and context specific for individual regions, in contrast how do wider, national specific tools for climatically diverse nations, i.e. US or France, address regional variations to be equally responsive?

Overview of novel articulations of sustainability

Novel articulations are increasingly emerging which have the potential to provide the foundations for a new wave of assessment regimes and frameworks. As previously discussed holistic approaches within the 'images' of sustainability (Williamson *et al.*2003) relate to Natural concerns, emphasizing local natural systems and relationships between buildings and nature. This lies within Permaculture theory of relationships and balance between natural systems, this is frequently applied within community consultation frameworks, therefore also applying to Cultural 'images'.

Bioregionalism (McGinnis *et al.* 1998) predominates to Cultural 'issues', contextualizing buildings in relation to their local landscape, place, culture and communities. Application within the built environment can translate to closing local loops through local material sourcing, micro enterprise and responsive design for communities (Stevenson and Ball 1998). This overlaps to Natural images through the materials used and relationship to ecology.

Cradle to Cradle (C2C) (McDonough and Braungart 2003) emphasizes connection with ecology and sensitivity in relation to nature, this is analysed and applied through engineering, scientific and economic impacts but relates to local scale and wider equitable factors, therefore referring to Natural and Technical images.

These articulations manifest themselves within the 10 principals of 'One Planet Living' (OPL). Designed to be applied flexibly at community level for new and refurbishment projects it is related to enterprise through to building scenarios, and local policy, for example the Major of London's Green Procurement strategy and the London Olympic Games. It has been implemented through several build projects, including BedZED, Brighton One, and Middlesbrough. Through the use of Ecological Footprinting the benefits of applying OPL are the broader application to TBL and all 'Three images', and overall flexibility of application, which is reflected in the local, bottom-up approach of sourcing and evaluation of requirements. This also requires some adaptation to individual projects and type specific scenarios.

INTEGRATION OF APPROACHES TO SUSTAINABILITY AND ASSESSMENT

There is potential for these frameworks informed by novel articulations to form the basis in the development of new tools for more specific uses at local scales and in relation to people and buildings (El-Haram *et al.* 2007). Given the expertise and time invested in the development of SAMs, the frameworks and quality of these should not be overlooked. Through further analysis of gaps and overlaps of existing frameworks and novel articulations; these can be applied as potential add-ons related to locality instead of tool type.

Quantitative data is generally applied to SAMs assessment criteria. This enables easily comparable responses which are scientific and objective. This may not be the best approach to criteria assessment and data collection when referring to issues of society and culture. As the novel articulations described relate to locality and community, they require a degree of flexibility in response to people and varying situations. Therefore to evaluate them, qualitative data needs to be collected, i.e. through stakeholder engagement (Thomson 2009), much of this is subjective. Herein lies the problem, when associating SAMs with novel articulations in the development of a framework which allows for the quantitative, qualitative, objective and subjective. This needs to be assessed through better understanding of design, construction, stakeholders and users relationships with the building and its related lifecycles, and ultimately the links between stakeholders and policy when a tool is selected.

FURTHER RESEARCH

This paper is an overview as to the development of a contextual, practice based evaluation of the application of tools and the links between tools, stakeholders and policy to develop a balanced holistic framework with a view to achieving 'realistic' sustainability throughout the whole life cycle of a building and it's related places. There needs to be better understanding established through industry consultation and case studies of the transfer, integration and application of tools. It is all very well having a well designed appropriate tool but if it is not properly used this can be detrimental to the project, and potentially the sustainability of this. Overarching within all of these approaches is the application of quality, most of the tools assessed were aimed at a wide range of stakeholders, but used by few with the language and understanding which was specific to certain professional groups.

CONCLUSIONS

A need has been identified to streamline approaches internationally and to benchmark sustainable buildings, there is however still the issue that variation and flexibility is required within tools to allow for regional and local differences that reflects stakeholder values. This has been addressed through the SBAlliance, but is still limited through the involvement of all tool developers within a WGBC driven market. Current policy at National and EU level is gradually being informed by SAMs and their success in driving sustainability within mainstream markets, and the current emerging generation of SB tools will also do this. The Built Environment sector is at an important juncture to address appropriate directions for 'realistic' sustainability in preparation for mainstream application through policy. This needs to be achieved by finding solutions which can be developed in line with current markets to direct development to enable more positive outcomes.

This has the potential to be achieved, however it needs to relate to the project, and the perception of these methodologies within industry professionals, policy and government. It is not so much a question of what is achievable, but what is acceptable and ultimately how these barriers can be addressed to achieve the most 'realistic' sustainability possible.

As SAMs become more streamlined with clearly defined benchmarks their popularity will almost certainly continue to increase along with their ability to influence the market and subsequently policy. It is important that lessons are learnt from novel articulations developed through natural and cultural practice in order to achieve further 'realistic' sustainability. The evidence of pressure on environment and resources and subsequently culture, communities and economies is now too overwhelming to be ignored. While market, money, image and technology are inarguably important in the building industry, it should not overwhelm the need for a 'common sense' approach to incorporate at least all of the TBL and at least two 'images' of sustainability.

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