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Effectiveness of ‘Green’ Building Rating Tools: A Review of Performance

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Abstract: In the context of the built environment this paper presents an approach using a series of nine criteria for investigating the effectiveness of building rating tools. The ability to measure a building's performance using rating tools is one way of looking at the integration of sustainability objectives into the built form. The term effectiveness, as defined in this paper, is not limited to demonstrating improved environmentally performance but also the long term effectiveness of the rating tools application and usability. Further, it covers the ability for the rating systems to provide the outcomes expected by those using the tools. It was found that though rating tools tend to look primarily at environmental sustainability, reports covered broader outcomes such as social sustainability, productivity improvements, comfort gains and costs savings. Effectiveness therefore also encompasses these other issues particularly as these are often used as arguments for the design and construction of ‘green’ buildings, and the use of rating tools as a support for the process. The research method uses existing publicly available reports on the performance of buildings which have been rated over the last 10 years. This data is then used to discuss effectiveness based on the criteria identified by the research. It shows that the rated buildings do seem to have significant reductions in energy and water consumption; there is evidence that employees are more comfortable and there is increased productivity. Their effectiveness does not seem as high in other areas though, as the tools do seem to be both costly and bureaucratic in their implementation, and seem to be less geared to supporting the dynamic nature of building design and development, needing to be more proactive in support of innovation. The paper closes with a brief discussion of the future developments occurring internationally, particularly how these are addressing some of the less effective parts of the tools. The paper closed by posing the question whether rating tools can lead to a sustainable built environment when the tools are predicated on increasing efficiency and efficiency is limited and only part of the solution.

Keywords: Building Rating Tools

Introduction

SUSTAINABILITY, OR THE sustenance of the life and its quality, is central to many research and development projects. The built environment, in which an increasing percentage of the world’s population lives, should be central to the discussion of sustainability. This is particularly pertinent given the well know negative impacts of the built environment: consuming 32% of the world’s resources, including 12% of the world’s fresh water and up to 40% of the world’s energy, producing 40% of waste going to landfill and 40% of air emissions (OECD, 2003). Therefore, it is curtail to be able to design and build buildings that aim to achieve a more sustainable outcome. Being able to measure a building's sustainability is one way of being able to begin this discussion; rating tools propose to be an approach to carry out this measurement. The question this paper poses using publicly available data on the integration of some of these tools is: how effective have they been in reducing this impact and moving the built environment towards sustainability?

The term effectiveness here is not only limited to improved environmentally performing buildings, but also the long term effectiveness of the rating tools application and usability; and the ability for the tools to provide the outcomes expected by those using the tools. Further, reports on rated buildings not only presented results on performance improvements in the areas of energy, waste, water and so forth, but also costs savings, improvements in productivity, comfort, and other less tangible benefits. Effectiveness therefore also encompasses these elements which are often used as arguments for the design and construction of ‘green’ buildings, and the use of rating tools as a support for the process.

Stakeholder Definition of Sustainability

Firstly, what do some of the main stakeholders understand by a sustainable or ‘green’ building? The Organisation for Economic Co-operation and Development (OECD) definition is given in Madew (2005) as: *“[t]hose buildings that have minimum adverse impacts on the built and natural environment*.” More specifically the Green Building Council of Australia (GBCAus) defines it as one that incorporates design, construction and operational practices that significantly reduce or eliminate the negative impact of development on the environment

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and occupants with strategies for addressing (GBCAust, 2006):

- energy efficiency;
- greenhouse gas emission abatement;
- water conservation;
- waste avoidance, reuse and recycling;
- pollution prevention - noise, water, air, soil & light;
- enhanced biodiversity;
- reduced natural resource consumption;
- productive and healthier environments; and
- flexible and adaptable spaces.

The above shows that though sustainability is a very complex issue, encompassing social, cultural and economic aspects, the stakeholders have concentrated on environmental sustainability objectives with a component referring to human health. The ability to measure what this means is useful both for communication and implementation of these objectives. Tools attempt to do this by providing a simplified universal framework while simultaneously addressing the complexity of sustainability and the various building contexts to which they are applied[1]. They do this by providing a series of categories with requirements that are given a series of scores, credits or points, the higher the score the more environmentally responsible or 'green' the building.

Tools and their Assessment Approaches

This paper will look at the following tools: BREEAM developed in 1990-2 (UK): LEED in 1999 (US), CASBEE in 2003 (Japan), Green Star in 2003 (Australia), GBTool in 2000 (international), Green Globes in 2002 (North America), and HK-BEAM in 1996 (Hong Kong).

Of the above tools there are some significant differences in approach which need to be understood (for more comprehensive discussions see Larsson 2004, Brunz *et al* 2006 and Bordass 2006). One of the main differences between rating tools is whether they measure potential or actual performance. Potential performance rates the intent of the building design, how the design team have put the building together to perform under a series of specific assumptions. Actual performance attempts to demonstrate the performance of a building after occupation, in actual use. Examples of tools that advocate potential performance are LEED and Green Star. These tools recognise that the greatest potential to influence a building's performance is at the design stage. However, this has led to a disparity between expected and actual performance because aspects of the project will change, for numerous reasons, between initial design and final completion.

There is also a difference between tools that provide an objective assessment versus those that advocate value-changing systems. This represents the difference between a system that tries to measure performance objectively through measurement using approaches such as Life Cycle Assessment (LCA) and a system that tries to encourage highest possible levels of performance. For example it is not currently possible to objectively prioritise between saving energy, water or using certified timbers without a carrying out a full LCA; therefore the aim becomes to do the best possible in each area. Most of the rating tools are of the latter variety, you receive points for each area (water, energy, waste, etc.) and try to optimise within each.

Rating tools can also be either mandatory or voluntary. The mandatory ones tend to be narrowly focused looking at one area only – such as energy or water – and used by government to set regulations. Tools which have a more broad focus tend to be voluntary as they aim to provide guidance and direction over a wide selection of environmental criteria. However, some governments, such as the US and Australia, are starting to use these voluntary tools to set levels for their own projects.

Finally, tools can be used and verified through external assessments or self-assessments. Green Globes is a self-assessment tool; others such as BREEAM are based on expert independent assessment. The main choice between the two is driven by cost and time. Third party assessment is more costly and time consuming; buildings are complex systems and the time and cost to assess them is considerable. Meanwhile, self-assessments are seen as being less rigorous and less defendable.

What is meant by Effectiveness?

In looking at the effectiveness of rating tools several criterion and their key aspects were distilled from the literature, previous research by the author and various conversations with tool users. These criteria will be used as a framework within which to discuss the various tools on which there is publicly available information.

Effectiveness criteria 1: reduction in environmental impact – using this category the research tries to determine the actual reduction in environmental impact that is achieved by buildings through use of the various tools.

Effectiveness criterion 2: positive social impacts – using this category evidence was sought as to whether buildings that rated highly achieved positive social impacts for the community and the staff, for

[1] See Bordass (2006:4) for a review of the various categories and weightings used by many of the tools reviewed here.

example by providing support for public art, day care, education, etc.

Effectiveness criterion 3: positive effect on occupant comfort – using this category evidence of improved comfort was looked for. It must be remembered though that comfort and wellbeing are difficult to link exclusively to building design; the moral of the company, attitude of senior staff etc. also have a large impact.

Effectiveness criterion 4: positive affect on employee productivity – evidence for improved productivity was looked for under this category. Productivity and reduction in absenteeism is linked to the above effectiveness criteria though it is often reported separately using different research methodologies. For this reason it is looked at in isolation in this paper. Like comfort, productivity is difficult to link exclusively to building design. It is also very difficult to measure, which is why absenteeism is often used as the main indicator.

Effectiveness criterion 5: cost savings – this looks at the actual savings accrued through the building supported by the use of tool. It is mainly measured in terms of energy savings, increased productivity and reduced absenteeism with their associated limitations as discussed above. For those using the tools this is often a key criterion because the use of arguments of pay back and return of investment which are often used to justify the cost of using the rating tools and investment required to produce a high scoring building.

Effectiveness criterion 6: ease of use, cost effectiveness and process – this looks at the ability for the tool to be integrated into every day activities of designing and constructing a building.

Effectiveness criterion 7: rating and modelling accuracy – evidence is collated here on the accuracy of the tools. To be credible rating tools need to demonstrate accuracy in their predictions of the performance of a building. A tool's effectiveness in the market and their uptake by industry is linked to the ability for tools to give accurate estimates and demonstrated benefits.

Effectiveness criterion 8: ability to be dynamic and support continuous improvement – linked to effectiveness criterion 6, this is about a tools ability to be flexible and appropriate while being able to promote stakeholder awareness of sustainability objectives within system boundaries (Augenbroe & Pearce 1998).

Effectiveness criterion 9: ability to support innovation in design – innovation is crucial as progress is made towards a more sustainable future. It is not probable that practice can continue to do things the way it has always done them, tools need to have the capacity to support and encourage innovation.

Performance of Tools

This section of the paper briefly discusses the demonstrated performance of the tools as they have been reported in the literature using the above defined effectiveness criteria.

Effectiveness Criterion 1 – Reduction in Environmental Impact

Aggregated information could only be found in the area of energy, and to a lesser extent water. Waste figures are reported for individual buildings but it is difficult to find reliable data on emissions, material use and other areas associated with environmental impacts. This section will summarize some of the information and then look at one case study to see the impact of the tool on the project.

A study on 60 LEED rated buildings showed that there was a decrease in energy consumption of 25-30% (Kats 2003:4). The only fully completed and utilised building that has achieved the Australian Green Star rating reports a 30% reduction in energy use, while others that have not been fully occupied expect reductions over 60%. In the UK energy savings of 40-80%[2] have been reported, though a recent Masters project has shown that there is a substantial discrepancy between predicted and actual performance (Cobb 2005:44).

In Japan one government report shows a reduction of 70% and 92% in CO_2 emissions over a series of buildings compared to a base building of the same type and function (Ministry of Land, Infrastructure and Transport 2006).

The Green Building Council of Australia reports 60% or more savings for water consumption of those buildings that are Green Star rated (GBCAust 2006). Some LEED certified buildings show water reduction of 30-50% (City of Austin, nd). Water is not considered in the Japanese CASBEE rating tool.

Case Study Cascadia (US) Study 11 LEED Certified Buildings

A 2006, post occupancy report carried out in Cascadia, US, of 11 LEED certified buildings showed that in the area of energy all but two of the buildings showed savings. The savings over 25 years were between $2 and $26 per square foot, this related to various amounts of energy reflecting the regional utility cost differences (Turner 2006:9). When reviewing water performance all but one of the buildings (only 7 buildings provided adequate date) used more

[2] Estimated from figure 1, Bordass B. et al 2004:2

water than predicted, though four buildings saved 8% when compared to a base line (Turner 2006:12). The report does caution that it is difficult to generalize to this level due to the absence of good base line data for water consumption. Finally looking at occupant survey results, in general people were very satisfied with their building, though less so with their workspace. In particular, noise levels and acoustic privacy scored poorly. Light levels and air-quality were perceived to be 'somewhat helpful' in effectively supporting daily activities. Finally, there were slightly positive thermal comfort figures (Turner 2006:13-14).

Waste is predominantly regarded as a site specific issue and significant reductions have been reported by individual projects such as 87% materials savings through building structure reuse at 40 Albert Road (DEHa 2006:54) and a 50% solid waste savings at the Johnson Diversey Head Quarters (USGBC 2004:5) in the United States (US). Though site specific, a tool that fosters an understanding of materials, their impact in use, production and wastage is important. Improving resource efficiency onsite also improves building industry awareness of links between ecological, social and economic factors of resources.

While the tools have resulted in better performing buildings the question remains whether this is really enough? Taking energy as an example, is an average of 30% saving on energy, shown by the Kats 2003 report, leading to a sustainable outcome? This is not even reaching a 50% or factor two improvement in performance[3].

Effectiveness Criterion 2 – Positive Social Impacts

There have been no reports or case studies found that deal specifically with the effectiveness of rating tools that support the improvement of social impacts of a building. The lack of information about positive social impacts is indicative of the complexity of understanding qualitative social outputs of a building. A contemporary office building holds people from all walks of life, from many cultures, with a variety of responsibilities and ways of dealing with their jobs, superiors and their environment. Can rating tools deal with these complex issues? Should they? If they cannot is it wise to include them as requirements, but if positive social actions are not part of the rating tools how are they included in building conception?

Effectiveness Criterion 3 – Positive Effect on Occupant Comfort

A team of researchers at Berkeley in the US, investigated the Indoor Environment Quality (IEQ) in 215 buildings using a web-based invite based survey. The web-based survey was collated in a database, which as of September 2005 contained 181 buildings and 33,285 respondents. The average response rate was 46%. Fifteen buildings were LEED rated and six deemed to be 'green' though they had no rating, these were compared to 160 'non-green' building. The results showed a higher level of overall satisfaction for the users of the 21 green building specifically concerning thermal comfort and air quality. Interestingly, they found that lighting and acoustic quality rates were comparable to the non-green buildings (Abbaszadeh *et al* 2006).

Effectiveness Criterion 4 – Positive Effect on Productivity

The table below summarises some of the productivity studies that have been carried out on green buildings. Of these projects they are all certified by a rating tool, except the ING bank in the Netherlands which was opened before rating tools were in use.

Table 1 – Overview of Productivity Studies (Adapted from DEHa 2006:15)

Project	Productivity impact	Reason
ING Bank (Netherlands)	15% improvement	IEQ improvement
San Fran Sustainable Development Committee studies (US)	3-15% improvement	IEQ improvement
Nevada Post Office (US)	6% improvement	Better lighting and use of natural light
Verifone Corporation (US)	45% decrease in absenteeism	Daylighting, air filtration and low toxic material specification

[3] Different authors (Weaver and Schmidt-Bleek 2000 and Weizsäcker *et al* 1995) advocate that a 4 to 10 factor reduction in impact is needed to move towards more sustainable consumption.

These figures need, and generally are, to be taken cautiously as improvements in productivity are related to much broader issues than just a building's design. Particularly company moral, attitude, staff, management and factors outside of work (e.g. family) can have significant impacts on productivity.

Effectiveness Criterion 5 – Cost Savings

Many of the publicly available reports on the performance of LEED and Green Star discuss the cost-benefits and savings associated with implementation of their rating tools. A recent report by the GBCAus estimates, based on 10 referenced reports and studies, savings from well being, productivity and reduced staff turn over at between $A35 and $A41 per square meter (GBCAus 2006:5). They also present a number of other benefits:

- Ethical investment opportunities
- Higher tenant retention
- Lower risks and relative insurance costs
- Reduced capital costs, including reduced construction time and variations

Issues to consider in using these measures to show effectiveness are that an investment in staff through a new building might create these impacts irrespective of whether it is a green building. There are many variables that can cause costs savings, those directly associated with reductions of inputs are easily associated with the improved design (though even that could just be a matter of technological advancement) others such as the reasons for reduced absenteeism and increases in productivity are more elusive and require more research.

Effectiveness Criterion 6 – Ease of Use, Cost Effectiveness and Process

For a tool to be effective in the market it needs to be user friendly, cost effective and work within the existing activity pattern of the design and construction processes. This is very difficult when trying to standardise a building rating for the 'greenness' of a building because it is such a complex concept that encompasses such divergent and often conflicting categories. For example lowering energy consumption by using heavy construction for thermal mass will mean the building has a higher materiality and higher embodied energy. It is not surprising then that tools such as LEED and Green Star, which have attempted to simplify this into a single tool using credits or points allocated to specific areas, find that they are criticised for making the credits the main focus of the discussion, often losing sight of the reasons for the credit: saving energy, water, etc. (Schendle and Udall 2005: paragraph 8 and Larsson 2004:20-21).

The 2004 review of LEED implementation over 5 years shows that the process is currently overly-rigorous, inconsistent and takes too long to be implemented (Larsson 2004:9). Schendler and Udall also report on this as well as commenting on the tools being too expensive, bureaucratic and unresponsive to a dynamic design environment (2005:paragraph 8). Other reports also comment on the bureaucracy (Solomon 2005:4) and cost of the LEED process (Solomon 2005:4 and Greenspirit Strategies 2004).

Similar criticisms have also been heard of the Australian Green Star tool though no official reports or research projects have yet been carried out on this relatively young tool.

> "… at one of the design meetings water issues were discussed. A new option was put forward to save additional water. Once of the team commented 'but we already have all the points in that category', there was agreement around the table and the decision was made not to look further into that area." (City of Melbourne 2006: 5)

The BREEAM tool, on the other hand, approaches the process of certification differently putting it in charge of a BRE certified assessor who carries out all of the work. No studies looking at the ease of use of BREEAM have been found.

On the cost side, Larsson reports that "[o]ne of the independent assessors used by applicants for LEED certification in the USA reported two years ago that the work of gathering and preparing the information necessary to submit an application for certification costs anywhere from $US20,000 to $US60,000…" (2004: 17). This has also been found in Australia where the CH_2 project reports a cost of $A20,000 to $A70,000 for the application of Green Star (City of Melbourne 2006:1). Larsson also reports that the GBTool assessment costs have been in the same order of magnitude. In many projects these costs are justified by the savings achieved through better building and happier employees.

There are simpler, less costly systems available such as Green Globes that have sacrificed some of the impartiality and rigour by developing a self-assessment tool that runs on the internet at a minimal cost. This has seen the tool gain rapid uptake in some industries such as tourism, though they are being used for other building types also.

Effectiveness Criterion 7 – Rating and Modelling Accuracy

Several of the reports cited in this paper discuss the disparity between the rated ideal and reality. This is particularly true for energy modelling as there is often a discrepancy between the modelled value and the actual performance. Some of the reasons for this are occupant behaviour, use of model based assumptions while reality is much more complex, changes post modelling, error in installation and poor maintenance (Johnson 2003). This creates what is called a credibility gap. An excellent study that addresses this is presented in the Bordass *et al* (2004) paper given at the Buildings Performance Congress, where he shows that while the estimated BREEAM annual CO_2 emissions per square meter of floor area was just over 40kg the actual emissions two years after completion of the projects studied were just under 140kg (Bordass 2004:2). That is over three times the initial BREEAM estimate!

Another criticism is that, in their simplification, tools have lost the ability to compare like-with-like. For example an initiative costing $US1,300,000 and an initiative costing $US395 could score the same points under LEED (Green Building Alliance 2004:4). This is often where the argument for the use of a more seemingly scientific approach such as LCA is put forward[4]. A recent study found many discrepancies (for example a threshold not representing a significant enough advance, lack of relationship between measured cost and environmental effectiveness, comparability of building over regions - 5 star in one area having more impact than 5 star in another, etc.) they conclude:

> "The lack of comparability between LEED ratings and LCA results indicated that when considered in a life cycle perspective LEED does not provide consistent, organise structure for achievement of environmental goals. Further, the disaggregation into individual credits may stimulate specific solutions, but overall building integration may be less than ideal. Finally that lack of balanced results may lead to so much variation in total building environmental performance that a building's rating may not align with its actual performance." (Scheuer, 2002: 93)

Yet, though it would be ideal to link rating tools with LCA this is currently unrealistic as its use is limited by its complexity, time requirements, costs, lack of data and its current inability to give meaningful assessments on local, context specific environmental impacts. But the question again needs to be asked if this level of complexity is necessary.

Effectiveness Criterion 8 – Ability to be Dynamic and Support Continuous Improvement

Tools need to be able to change and reflect what is occurring on a project drawing board or construction process – that is to be dynamic. Yet, to keep tools simple in such a complex activity it is almost impossible. For this reason some tools, such as Green Star, have split their certification to ratings for various stages of the process. For example in Green Star subdivisions are: Office Design, Office As Built and Office Interiors. While this allows for great reflection of the actual building performance it does add further layers of complexity, requiring the application for a rating, the demonstration of credits, and the following of the rating tool process at each stage.

The need for the tool and assessment process to be dynamic highlights the importance of the human element in procuring high performance and green buildings. Continually depending on, and aspiring to, the targets and framework of tools can limit potential thinking beyond current practice. The limitations could potentially stagnate the natural evolution of ideas. It could be argued that the targets of current best practice represented by tools will not guarantee the standard and rate of change the world wide building industry needs to take in order to mitigate building industry impacts on the environment. Enhancing the dynamic element of tool and assessment processes is thus vital. However, the rapid uptake of environmental awareness and efforts across building industries towards raising lifecycle awareness has entered mainstream debate and is in part due to the encouraged use of rating systems.

Case Study of one Tools Approach to being Dynamic

> The Japanese CASBEE family of tools has approached this usability, cost and integration within current practice by lowering standards, thereby increasing uptake and getting the system onboard normal building practice. "*The reduced number of assessment criteria in the CASBEE system compared to the GBTool, does mean that a less rigorous assessment result will be achieved. Benefits of the smaller subsystems will make building assessment more viable as a part of common building practice*" (Syndercombe 2003:91). Their intention is that they will increase the depth and rigour of the standards once the tool has been taken up. Considering the number of stakeholders

[4] LCA is often seen as more objective as it takes the actual emissions from products used in a building over life including production, consumption and disposal and aggregates these. This allows trading off of one option against another.

potentially affected by national regulatory building environmental assessment, the CASBEE family of tools is an easier place to start for national building assessment. Gaining public acceptance, the building industries and stakeholder acceptance of a relatively new system may be more important to the implementation of a tougher future system, than beginning with difficulty in uptake – especially given political and pragmatic concerns. Therefore gaining acceptance of a system may at first be more important than the degree of the tool's effectiveness. Tool effectiveness can gradually be increased as industry and stakeholders accept the system and high performance buildings as standard practice (Syndercombe 2003:84).

Figure 1 below shows the family of CASBEE assessment tools in relation to the pre-design, design and post design phases of a building life cycle. The tools are small and limited to specific procurement phases making them practical and cost effective to implement for everyday use.

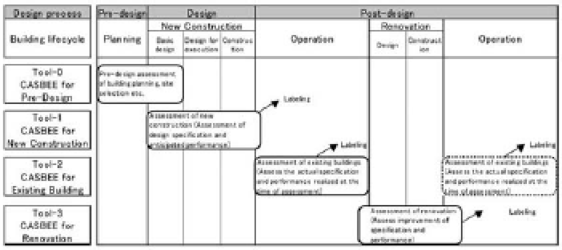

Figure 1: Building Lifecycle and Four Assessment Tools (Japan Sustainable Building Consortium 2005: Figure 2 Paragraph 6)

As seen above developers of the rating tools admit that the tools are not as rigorous as they could be giving no constraints on time and money and also that tools need further development. Given this it is not surprising that as shown by a recent Japanese research project different tools give different scores on various aspects.

Effectiveness Criteria 9 – Ability to Support Innovation in Design

One of the areas that can be limited by the tools simplification of the complex world into a distinct set of points is innovation. This is linked directly to the ability to be dynamic as discussed above. There are cases where innovative solutions may not be part of the standard building solutions covered by a rating tool.

> "If you always do what you've always done, you will always get what you've always gotten." ~ Anonymous

Green Star is one tool which tries to address this by making 5 innovation points available for initiatives showing advances in approach or technology. Yet this is still placing a limit, as was experienced by the author in one project that she participated in, when the credits where completely allocated, there was a sense of disappointment as further innovation could have occurred.

Future Trends for Rating Tools – Thoughts and Reflections

Having looked at the effectiveness of the tools: what are the expected developments in the future? This section briefly discusses how the criticisms shown above are starting to be worked through into a next generation of tools which look at performance at a global, regional and local scale.

On a global scale, international unification of rating tools and approaches to reporting is likely to take place. Tools are likely to converge in criteria and focus on critical international issues such as water, energy, and global warming and resource consumption. These globally generic parts of the assessment will likely be linked to regulatory frameworks and international agreements. While at regional levels, tools will be implemented voluntarily, be locally applicable, and more variable. This will respond to shifting requirements as local knowledge and pressures change over time.

There are already forums which discuss standardisation (for example the International Standards Organization (ISO) working group TC59/SC17 Construction and Sustainability and TC205 on Building environmental design – specifically looking at Indoor Air Quality) and it is expected that this will gain in strength, particularly in the globally significant generic rating criteria. It is expected that these will be enforced by governments and supported by local rating criteria that evolve with local community knowledge and long term goals. The awareness of the interdependence of local and global systems may be an appropriate means to move the rating process to a wider level where there is also scope for international consensus about the responsibilities for nationally built environments and the global ecology from which resources are drawn.

While consensus on the role of rating tools internationally is being reached it is expected that an objective approach of rating tools will increase as systems are developed that can deal with conflicting criteria more quantitatively, for example by the use of LCA. The Australian project aiming to integrate LCA and Computer Aided Design (CAD) software is one such initiative (CRC Construction innovation, 2005). Linked to this will be the continual development of better benchmarks. Again taking an example from Australia, the national water intensity benchmarks for commercial buildings have been developed, as indicated in the Table 2 below. A score of 2.5 stars is Australian average practice, with a score of 5 stars representing possible best practice (DEHb 2006).

	Sydney	Melbourne	Canberra	Adelaide	Brisbane	Perth
1 star	1.73	1.03	0.99	1.08	2.53	1.41
2 stars	1.39	0.86	0.83	0.9	1.99	1.14
2.5 stars	1.21	0.77	0.75	0.8	1.72	1.01
3 stars	1.04	0.69	0.67	0.71	1.44	0.88
3.5 stars	0.87	0.6	0.59	0.62	1.17	0.75
4 stars	0.7	0.53	0.51	0.53	0.9	0.61
4.5 stars	0.52	0.43	0.43	0.44	0.62	0.48
5 stars	0.35	0.35	0.35	0.35	0.35	0.35

Table 2: Australian Water Consumption Benchmarks - kl/m^2 Annum (DEHb 2006:2)

There is also work being carried out to reduce the time and cost devoted to the undertaking of an assessment through the development of high-level indicators that can "explain 80% of the performance with 20% of the effort" (Larsson 2004:16). This will increase the rate and viability of ratings, increasing uptake and market demand.

Also, it is expected that there will be a move to provide tools that do not result in a final rating until the actual outcomes are measured when the building is in operation.

> "A focus on outcomes could therefore be the most effective way of assuring rapid, effective and cost-effective improvements to the sustainability of our buildings and reward the organizations, buildings and management systems that actually work well, and not just look as if they should*." (Larsson 2004:2)*

Assessment criteria for rating tools will reflect the state of the environment and attempt to redress imbalances to parts of environmental (ecological), social, economic and resource systems. Some of the most recent literature on the relationship between the built environment, people and nature suggests a move towards "*restorative environmental design*" (Kellert 2005). Buildings will be judged more on their effect on "*people's emotional and intellectual well-being*" and will "*promote positive interactions between people and nature in the built environment*" (Kellert 2005:124 and 123). These are potential future building performance criteria. The question now is: what will the nature of the assessment criteria be and what form will the rating tools take? Will some of the above mentioned developments feed into this?

Conclusions

It is clear from the uptake of rating tools, and the increase in demand for rated buildings that rating tools have contributed to raising awareness and creating a language and market for green rated buildings. On every other level the tools examined seem to be only partly effective, getting various levels of improvements in energy use, water use and waste reduction while addressing only some social and indoor environment issues and providing unpredictable performance and financial benefits.

It is difficult to include in this discussion the less public tools such as BREEAM, but given the results from tools such as Green Star and LEED it seems that the least effective element of rating tools is the cost and bureaucracy associated with their implementation. These seem out of proportion with the flexible creative stage in which they are used. Having concluded this, it is worth adding that the tool developers contacted as part of this study have said that they are looking at these issues and implementing strategies to address these criticisms.

In conclusion, the central question is whether rating tools the most effective way of moving towards a more sustainable built environment? Are tools aimed at limiting use and increasing efficiency able to support the design and construction of sustainable buildings or just more efficient ones? Will this ensure that our future generations have the same benefits and opportunities we have today? Or will this approach only mean we can build a few more buildings before we are in the same position as we would have been without the efficiency measures?

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