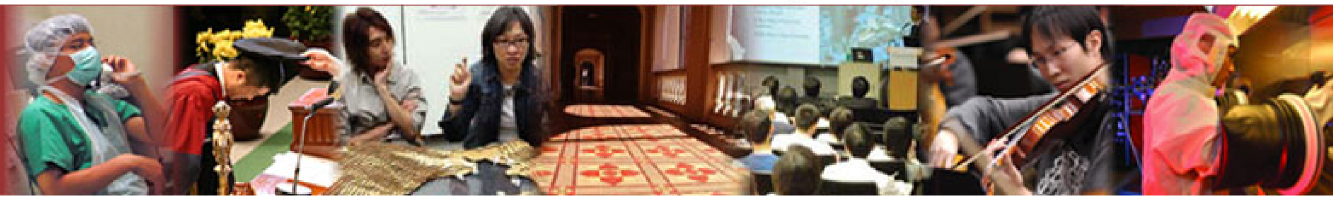

THE ROLES OF SUSTAINABILITY ASSESSMENT SYSTEMS IN DELIVERING SUSTAINABLE CONSTRUCTION

Cheng Siew Goh[1] and Steve Rowlinson[2]

Department of Real Estate and Construction, Faculty of Architecture, The University of Hong Kong, Hong Kong.

Sustainable development in construction has increasingly gained momentum over the years due to a growing public concern and enforcement of government policy. A variety of sustainability standards and systems have therefore emerged in the current construction industry to provide a means for assessment, ranging from Leadership in Energy and Environmental Design (LEED), Building Research Establishment Environmental Assessment Method (BREEAM), National Australian Building Environmental Rating System (NABERS) to ISO14001. In Hong Kong, LEED and Building Environmental Assessment Method (BEAM Plus) are the mechanism preferred by practitioners for their sustainable buildings certification. This paper will review and examine the roles of the sustainability performance assessment standards in delivering sustainability in construction. Interviews were conducted to explore various viewpoints on sustainability rating systems from different stakeholders. Apart from serving as a guideline for practitioners, sustainability systems can help to gauge the sustainable performance of individual buildings by using transparent and objectively comprehensible metrics. Nevertheless, there is a lack of focus on the post occupancy evaluation and soft issues in the current sustainability assessment systems. By taking into consideration soft issues and those performance goals in operational management, a more holistic and comprehensive assessment approach can be provided for evaluating sustainable construction performance. The potential of the green building rating systems being abused for marketing purpose can also be reduced with a series of periodic assessments during the operational life cycle. These improved sustainability assessment systems can therefore help to reframe the expectations and the strategies of construction stakeholders in pursuing the true goals of sustainable development in construction.

Keywords: sustainability assessment system, sustainable development, construction.

INTRODUCTION

Sustainable development has gained increasing momentum in the past decades due to a growing public concern on the environmental and social development (Robichaud and Anantatmula 2011). Global phenomena such as the depletion of natural resources, carbon emission, climate change, and ecological development have triggered the alarm on the importance of pursuing sustainable development. United Nations Environmental Program (UNEP) (2007) indicated that although primary energy use will increase by almost 50% from 2005 to 2030, the share of different energy sources

[1] gohkeanu@yahoo.com

Goh CS and Rowlinson S (2013) The roles of sustainability assessment systems in delivering sustainable construction *In:* Smith, S.D and Ahiaga-Dagbui, D.D (Eds) *Procs 29th Annual ARCOM Conference*, 2-4 September 2013, Reading, UK, Association of Researchers in Construction Management, 1363-1371.

are not expected to change significantly in the near future. The necessity for immediate action has therefore been increased to prevent any unexpected catastrophic consequences on the future generations (Alyami and Rezgui 2012).

Significant effort should go to the construction sector for improving sustainable development since the construction industry has accounted for a large amount of natural resources exploitation, land use, waste production, energy use, and carbon emission (Alyami and Rezgui 2012; Robichaud and Anantatmula 2011; UNEP 2007). The building sector takes a large share of the world's energy consumption and it accounts for about 30 - 40% of the worldwide primary energy (UNEP 2007). The construction sector hence offers the largest single potential for improving the performance of sustainable development significantly.

The revolution of sustainable development has also evolved in the construction industry for decades (Lee and Yik 2004). Numerous national and international initiatives have also emerged to address sustainable development issues in the built environment and one of the mechanisms is the extensive development of sustainability rating standards and systems. The emergence of a variety of sustainability systems in the current construction industry provides a means for assessment, ranging from Leadership in Energy and Environmental Design (LEED), Building Research Establishment Environmental Assessment Method (BREEAM), National Australian Building Environmental Rating System (NABERS), Green Mark, Three Star to Hong Kong Building Environmental Assessment Method (BEAM Plus). In parallel to the sustainable revolution, the standardization issues pertaining to environmental buildings have also improved where International Organisation for Standardisation (ISO) and The European Committee of Standardisation (CEN) have actively provided definitions for the standardized requirements for the environmental assessment of buildings (Alyami and Rezgui 2012).

SUSTAINABILITY ASSESSMENT SYSTEMS

Various assessment tools and methods have focused on different perspectives of sustainability and different targeted projects. Project performance is benchmarked against a set of prescribed qualitative and quantitative criteria and a single score will subsequently be used after balancing all achieved criteria in a designed weighting scheme. Table 1 summarises the use of various existing sustainability performance tools that are commonly used in the construction industry. BREEAM, which was developed in the United Kingdom in 1990, was the first environmental building performance measurement tool (Larsson 1998). Scores are awarded for each criterion met in the assessment and the collected scores determine the rating of "Pass", "Good", "Very Good" or "Excellent" in the overall building performance (Fowler and Rauch 2006). Nine categories are used in the rating: management, heath and well being, energy, transport, water, materials, land use, ecology and pollution and innovation (Kajikawa et al. 2011).

In the United States, rating systems include LEED, BREEAM and Green Globes. LEED is currently the principal building evaluation system, after its formulation in 1994 under the efforts of the American Society for Testing and Materials (ASTM) and U.S. Green Building Council (USGBC) (Kibert, 2008). Instead of a single rating system, LEED is compounded by a suite of building rating systems which including LEED – EB (Existing Building Operations), LEED – CI (Commercial Interiors Projects), LEED – CS (Core and Shell Projects), LEED – H (Homes), and LEED - ND (Neighborhood Development). Similarly, LEED standard also adopted single number rating system of "Platinum", "Gold", "Silver" and "Certified" based on accumulation of pointes scored in various impact categories, which are subsequently totaled to produce an overall score (Kibert, 2008). Six main categories are used for evaluation: sustainable sites, water efficiency, energy and atmosphere, materials and resources, indoor environmental quality and innovation in design.

Table 1: A summary for existing sustainability rating tools in construction

Regions	Rating Systems Used
U.S.	Leadership in Energy and Environmental Design (LEED); Green Globes; DOE's Energy Star; ASHRAE Green Guide
U.K.	Building Research Establishment's Environmental Assessment Method (BREEAM)
Europe	Eco-labeling
The Netherlands	GreenCalc
Canada	Canada's Green Globes (GBI); Sustainable Building Tool (SBTool)
China	China's Green Olympic Building Assessment System (GOBAS); LEED; Three Star
India	TERI-GRIHA
Australia	Green Star; Australia's Building Greenhouse Rating (ABGR)
Japan	Comprehensive Assessment System for Building Environmental Efficiency (CASBEE 2006)
Korea	Green Building Rating System (GBRS)
Hong Kong	Building Environmental Assessment Method (BEAM Plus); LEED
Singapore	Green Mark

In Hong Kong, a localized sustainable building assessment system - BEAM was developed in 1996 based on the United Kingdom Building Research Establishment Environmental Assessment Method (BREEAM). It sets criteria and serves as a measurement system by adopting local climate and industry needs. BEAM has undergone a number of revisions from BEAM 4/04 and BEAM 5/05 to BEAM Plus version 1.1 and version 1.2 for the refinement and improvement to adjust to the market needs. BEAM Plus provides a guidance for local practitioners in fulfilling their sustainable tasks. It is currently a voluntary scheme and adopts four categories of "Bronze", "Silver", "Gold" and "Platinum" in rating the building performance. Similar to LEED, BEAM Plus also uses six areas in assessing the building performance: site aspects, material aspects, energy use, water use, indoor environmental quality, and innovation and additions.

Most sustainable rating tools have taken into consideration eight main goals of sustainable construction, i.e. reducing carbon footprints, ecology and environmental protection, healthy indoor and outdoor environment, water use reduction, energy efficiency, eliminating environmentally harmful materials, improve resource efficiency, and conserve resources (Chong et al. 2009). Nevertheless relatively few of the comprehensive sustainability performance assessment tools incorporate the features of triple bottom line – environment, economy and society, in the system. An overly emphasis on environmental protection would ultimately lose the balance of triple bottom line and hence fail to pursue the real goals of sustainable development.

THE ROLES OF SUSTAINABILITY ASSESSMENT SYSTEMS

Sustainability assessment systems facilitate the certification process by a third party eg. UK Building Research Establishment (BRE), US Green Building Council (USGBC) and HK Green Building Council (HKGBC) that buildings satisfy specified sustainable criteria pertaining to the building types and functions. The assessment systems set the standards and help to evaluate the extent to which buildings advance the goals of sustainable development.

Ding (2008) believes sustainability assessment systems have enhanced the awareness of sustainability building practices and provided a structured and objective way to measure progress towards sustainability. In addition, the systems also lay down a fundamental direction for the construction industry to move towards sustainable development (Ding 2008). The market for sustainable construction can be stimulated and promoted by applying the systems in the construction practices. Besides, sustainability assessment systems have also furthered the promotion of higher sustainable expectations and are directly or indirectly influencing the sustainable performance of buildings (Cole 2005).

METHODOLOGY

Interviews can help to obtain firsthand knowledge about people's perceptions while the data's reliability can be improved by gathering supplemental information through observations. Interviews were therefore employed to explore various viewpoints on sustainability rating systems from different stakeholders. The interviews were semi-structured interviews that contain open ended questions to allow more flexibility for interviewees in expressing their views without external restrictions. Interview questions were sent to interviewees prior to the conduct of interview for the interviewees' reference.

Ten face-to-face interviews and one email administered interview were collected in the study. Purposive sampling was used where all interviewees must possess related exposures to sustainable practices in construction. In purposive sampling, the informants are intensively informative and richer in experiences who can offer large information on subjects or phenomena. A spectrum of construction stakeholders is included comprising of academics, architect, contractor, engineer and developer. The profile of interviewees is shown in Table 2. All interviewees possess more than 10 years working experience in the construction field. Interviewees were asked about their views and impressions on the sustainability rating systems, which include but are not limited to the roles, scope coverage, clarity, and comprehensiveness. In the research, the rating systems are studied and analysed as a group rather as individual tools.

Discourse analysis was conducted to analyse the data. Discourse analysis can uncover the way in which the reality is produced by capturing recurrent patterns in the organisation and context of texts (Herrera and Braumouller 2004; Sarantakos 2005). The perceptions of construction stakeholders towards assessment systems and the associated interactions underlying systems can hence be identified.

Table 2 The profile of interviewees

No.	Code	Background	Work Experience
1	A01	Academic & Engineer	23
2	A02	Academic & Landscape Architect	25
3	C01	Contractor	35
4	A03	Academic & Architect	18.5
5	E01	Engineer Consultant	22
6	D01	Developer	40
7	C02	Contractor	12
8	C03	Contractor	15
9	U01	Urban Planner	30
10	C04	Contractor	35
11	E02	Engineer Consultant	16

RESULTS AND DISCUSSIONS

In Hong Kong, BEAM Plus and LEED are the most popular certification tools employed by local practitioners for their pursuit of sustainable buildings. The adoption of BEAM Plus in Hong Kong buildings has increased drastically recently since it has gained extensive supports from the industry and government bodies. Notwithstanding different climate and local needs, the LEED certificate is sometimes preferred by local stakeholders to gain more international recognition as well as to attract more international investors for the project. No specific focus has been directed on a particular assessment system. Nevertheless, the results are mostly confined to BEAM Plus and LEED due to the higher exposure and familiarity of interviewees towards these two systems.

Although all interviewees have an exposure to sustainable construction projects, the sustainability assessment tools are sometimes complicated, particularly in understanding the content and credits to be achieved. As revealed by most interviewees, training is always required to understand the content of rating tools thoroughly and accurately. Interviewee E01 suggested organisations responsible for the assessment system develop simplified checklists to allow practitioners to get a quick snapshot on the overall pictures on building sustainability.

Mixed responses are found on the sufficiency of scope coverage as well as the comprehensiveness of the rating systems in delivering sustainable building. Nonetheless, a high satisfaction is still found on the overall performance of sustainability assessment systems. Interviewees believed that the understanding and knowledge of construction stakeholders on sustainability issues have been increased in the process of applying sustainability rating systems.

The results also show no reluctance from practitioners in relying on sustainability assessment systems even if there is sometimes a lack of detailed knowledge or consensus on the systems credits. All interviewees agreed that construction stakeholders always tend to use the sustainability assessment systems as major principles in guiding them to design and construct a sustainable building. In the interviewee E02's opinion, the systems offer clients a strong indication in setting the right priority and goals by providing a sustainable development vision and strategy. The systems hence help to align the construction supply chain and all related efforts towards sustainability. As a result, these assessment tools impose remarkable influences in shaping the development and smoothening the transition of sustainable practices in the construction industry.

Apart from serving as a guideline for practitioners, interviewees also held that sustainability systems can help to gauge the sustainable performance of individual buildings by using transparent and objectively comprehensible metrics. From the interviewees' perspectives, the systems have definitely established a basis for benchmarking and comparison. As described by Alyami and Rezgui (2012), most assessment systems play a significant role in reflecting sustainable development in building performance. By employing the systems, the implementation of building sustainability can be improved by reflecting the performance and diagnosing the problems encountered. The findings are in line with the study of Shen and Tam (2002) which showed the most significant benefits of implementing environmental management systems is the contribution to environmental protection. In addition to offering a methodological framework for measuring and monitoring environmental performance of buildings, the assessment tools also alert building professions on the importance of pursuing sustainable development in the construction process (Ding 2008).

On one hand, most interviewees agreed that sustainability assessment systems are marketing tools. Projects can often gain more people's attention of being "the first sustainable residential building" or "the first sustainable tallest building". By gaining the market recognition on sustainable development, the certification systems can help the buildings to attract more potential investors or tenants into the buildings. In addition, gaining accreditation can also help to build up a good corporate social image and hence improve the competitiveness for the organization (Shen and Tam 2002).

Interviewees also pointed out that sustainability rating systems are self serving and have a focus on the short term view by measuring the technical criteria only. The systems do not determine the real need of builders and clients. As a result, construction stakeholders have a tendency to focus on achieving the sustainability standard and not on fulfilling their needs. Interviewee E02 expressed that it is significant to have a good decision over sustainable practices, rather than merely focusing on the systems' content. Interviewee C04 even felt that the systems are fallible in nature since people can manipulate the credits in order to achieve the higher grading in the certification.

The findings also suggest a lack of focus on the post occupancy evaluation and "soft issues" in the current sustainability assessment systems. According to interviewee A01, more room for improvement exists in the aspects of life cycle costing and material durability. Extra measures need to be taken during the occupancy stage to avoid the abuse of the sustainability assessment systems. As suggested by interviewee C03, the exact building performance should be monitored by frequent review of documents and site visits. Meanwhile interviewee E02 stressed the importance of right data in order to manage sustainability goals appropriately. Data management is critical to visualise the energy consumption, waste production, indoor environment quality as well as carbon emission within the building. A right level of measuring data can hence help end users or operators to make necessary adjustments in achieving building sustainability performance.

The significance of integrating post occupancy evaluation of sustainability assessment systems is supported by Meir et al. (2009) by indicating contributions in terms of (i) bringing conceptions and aspirations closer to the actual practices and performances; (ii) bridging the static performance conceived for the building versus the dynamic functioning when real users interact with and modify the static features; (iii) integrating subjective and objective dimensions of building use and experience, and their measurement; (iv) integrating various tools with the suites of qualitative and quantitative research traditions; (v) merging practice with research; (vi) integrating various building disciplines with one another; (vii) integrating various stakeholders in building process; and (viii) integrating pre- and post-handover phases in building life cycle.

Life cycle assessment is an important aspect that should be integrated into all sustainability assessment tools to realize the real pursuit of long term development. It is important to take future cost and needs into the consideration when constructing a sustainable building. As described by interviewee U01, the application of rating systems is mainly confined to the building design, especially for new buildings. He further added that there is a limited flexibility in changing the building use in future. The findings are in consistent with UNEP (2007) which opined most assessment tools and policy fail to take a life cycle approach, and often target conditions during a specific point only such as in design or construction, or only apply to the building owners or investors but not the end users. Interviewees D01 also felt that the sustainability systems need to learn and improve from past projects and always reflect necessary changes on the systems from time to time.

Lee and Burnett (2008) advocated that HK BEAM always emphasizes environmental issues while neglecting the development of other elements such as social, cultural, economical and life cycle aspects. “Soft issues” such as culture, leadership, communication, attitudes, learning and human issues often have a huge influence in determining the success of sustainable practices. Interviewee E02 experienced a project where the end user opting out the use of advanced sustainable technology, even though the facilities and equipments are all in place. Negligence on soft issues development could therefore impact the ultimate outcomes of sustainable construction to a great extent. As a result, all interviewees stressed the importance of education and trainings of sustainable construction, not only to increase sustainable knowledge of stakeholders but also to cultivate a right attitude in reforming the community towards sustainable development.

By taking into consideration soft issues and the performance goals in the operational management, a more holistic audit and monitoring assessment approach can be provided for evaluating sustainable construction performance. The potential of the green building rating systems being abused for mere marketing purpose can also be reduced with a series of periodic assessments during the operational life cycle. BEAM (2012) has also acknowledged the need of a dynamic assessment system which is able to incorporate periodic changes and updates in responding the continual development of sustainable building practices and it therefore plans for the integration of dynamic assessment systems in the future revisions of BEAM Plus.

Apart from the cost of the sustainability features incorporated in the project, the cost associated with the certification fees are raised as one of the inhibitors for sustainable implementation in construction. As described by interviewee A03 and C03, additional fees are always required for certification documentation and appointing consultants such as LEED AP or BEAM Pro. Shen and Tam (2002) also showed that an increase in management cost was the top barrier to implementing environmental management in construction in Hong Kong and the contractors are often concerned with short term results in terms of cost and benefits. To increase the momentum of adopting sustainable practice, a simplified setting of assessment systems with an acceptable administration cost should therefore be administered by the monitoring bodies such as HKGBC to avoid heavy financial burdens incurred on sustainable building projects.

CONCLUSION

The construction industry needs a comprehensive and transparent sustainability model with systematic and clear guidance in the path towards sustainable development. However existing sustainability rating systems are found to have flaws in aspects of their use in a marketing role, credits manipulation, self serving attributes, short term technical focus, a lack of post occupancy assessment and soft issues, a lack of life cycle assessment and the imposition of additional costs. A failure to address the identified issues will affect the performance of sustainable buildings and eventually distort real goals of pursuing sustainable development in the construction industry.

Although the existing sustainability assessment systems have limitations which may reduce the effectiveness and full benefits of going sustainable, they have undeniably increased the understanding of construction stakeholders of sustainability issues. They also can offer better interactions between various project parties by laying out a measureable sustainable development framework and requirements. The systems have also provided a vision and strategy to building professions to align the construction supply chains and all related efforts towards sustainability goals. Additionally, the general implementation of sustainability in construction can also be improved by sustainable performance of individual buildings using transparent and objectively comprehensible metrics in the systems.

No matter how well a sustainability assessment tool has been designed, the performance at the end very much depends on how the people behave and apply the provisions. More effort needs to be made to address the holistic needs for sustainable development in the built environment. Improved sustainability assessment systems can therefore help to reframe the expectations and the strategies of construction players in pursuing the true goals of sustainable development in construction.

REFERENCES

Alyami, S H and Rezgui, Y (2012) Sustainable building assessment tool development approach. Sustainable Cities and Society, 5(0), 52-62.

BEAM (2012) BEAM Plus New Buildings Version 1.2. Hong Kong: BEAM Society Limited.

Chong, W K, Kumar, S, Haas, C T, Beheiry, S M A, Coplen, L and Oey, M (2009) Understanding and Interpreting Baseline Perceptions of Sustainability in Construction among Civil Engineers in the United States. Journal of Management in Engineering, 25(3), 143-154.

Cole, R J (2005) Building environmental assessment methods: redefining intentions and roles. Building Research & Information, 33(5), 455-467.

Ding, G K C (2008) Sustainable construction—The role of environmental assessment tools. Journal of Environmental Management, 86(3), 451-464.

Fowler, K M, and Rauch, E M (2006) Sustainable Building Rating Systems Summary: Pacific Northwest National Laboratory.

Herrera, Y M, and Braumoeller, B F (2004) Symposium: Discourse and content analysis. Qualitative Methods, 2(1), 15-19.

Kajikawa, Y, Inoue, T, and Goh, T (2011) Analysis of building environment assessment frameworks and their implications for sustainability indicators. Sustainability Science, 6(2), 233-246.

Kibert, C J (2008) Sustainable Construction: Green Building Design and Delivery (2nd ed.). New Jersey: John Wiley & Sons, Inc.

Larsson, N (1998) Research Information: Green Building Challenge '98 – International strategic considerations. Building Research & Information, 26(2), 118-121.

Lee, W. L., & Burnett, J. (2008). Benchmarking energy use assessment of HK-BEAM, BREEAM and LEED. Building and Environment, 43(11), 1882-1891.

Lee, W L, and Yik, F W H (2004). Regulatory and voluntary approaches for enhancing building energy efficiency. Progress in Energy and Combustion Science, 30(5), 477-499.

Meir, I A, Garb, Y, Jiao, D and Cicelsky, A (2009) Post-Occupancy Evaluation: An Inevitable Step Toward Sustainability. Advances in Building Energy Research, 3(1), 189-219.

Robichaud, L B and Anantatmula, V S (2011). Greening Project Management Practices for Sustainable Construction. Journal of Management in Engineering, 27(1), 48-57.

Sarantakos, S (2005) Social Research: Palgrave Macmillan.

Shen, L Y and Tam, V W Y (2002) Implementation of environmental management in the Hong Kong construction industry. International Journal of Project Management, 20(7), 535-543.

United Nations Environmental Program (2007) Building and climate change: Status, Challenges and Opportunities. United Nations Environmental Program.