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Evaluating the Efficacy of BREEAM Code for Sustainable Homes (CSH): A Cross-Sectional Study

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Abstract

There is now a substantial body of evidence suggesting that climate change is occurring as a result of human activities. Bottom-up approaches have been encouraged to enhance sustainability agenda. Assessment methods have been developed to ensure an incessant decrease in carbon footprint of buildings. It has long been discussed that many of such assessment methods systematically lack dedicated criteria to assess building beyond its physical boundaries. This paper focuses on Code for Sustainable Homes (CSH) and attempts to map it against LEED and CASBEE with an aim to encourage assessment beyond physical boundaries of a building and into its immediate context and surrounding environment. A critical review of the latest literature was conducted to establish the general concepts and principles behind the CSH's method of assessment in comparison with CASBEE and LEED. Following this, differences, positive and negative aspects of the three assessment method were established through in-depth review of their official documents and by cross-referencing the different components, methodologies and assessment criteria of each. This led to a comparative analysis using a critical evaluation of findings of The Building Environmental Quality Evaluation for Sustainability through Time (BEQUEST), The European Sustainable Development Strategy (ESDS) and The Freiburg Charter (FC). Expert interviews were conducted to consolidate the findings of this study. This added technical in-depth expert opinions to the preliminary findings of this research and helped pave the way for providing practical suggestions for possible areas of improvement for the CSH.

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1. Introduction

There is now a substantial body of evidence suggesting that climate change is occurring as a result of human activities and is posing a threat on the existence of humankind [1]. Efforts have been made to drive sustainable development using a top-down approach through directives, initiatives, mandates, codes and legislations as well as guidelines and incentives. In addition to top-down approaches, bottom-up approaches have also been taken forward and encouraged by governments to enhance sustainability agenda. One typical example of such approaches is assessment methods which have been developed to ensure an incessant decrease in carbon footprint of present and future buildings. This paper focuses on CSH and attempts to map it against its most important international competitors to investigate if and how it can be improved to include environmental impacts of a building beyond its envelopes. For this purpose LEED and CASBEE have been selected for further investigation, through mixed methods of critical review of literature, in-depth cross-comparative content analyses of the formal documents and in-depth expert interviews.

2. Review of literature

2.1. *The frame of reference*

The Building Environmental Quality Evaluation for Sustainability through Time (BEQUEST) provides foundations of a common European Union (EU) understanding of sustainable urban development through a multi-disciplinary network of representatives of all actors involved in the production, use and maintenance of the built environment [2]. BEQUEST has driven many different policies, actions and legislations which links together socio-economic and technical dimensions in urban communities [2], adopted by the European Green Building Forum (EGBF). The European Sustainable Development Strategy (ESDS) has also been established to drive sustainable development in Europe with its key objectives i.e. environmental protection, social equity and cohesion, economic prosperity, and developments meeting international responsibilities [3]. Moreover some individual cities and towns have taken those initiatives onto the next stage, developing their own detailed agenda to comply with international commitments and responsibilities for the environment. Freiburg, south-west Germany, which received the Academy of Urbanism's "European City of the Year 2010" award in London, developed The Freiburg Charter (FC) which consists of a framework to outline viable, sustainable urban planning policy based on 12 principles. These principles cover factors such as; spatial principles for a city of neighborhoods developed along public transport lines; content principles covering economy, employment, education, design quality and culture; principles of procedure allowing for a long-term sustainable vision, communication and participation from all stakeholders [4].

2.2. *Efficacy of building environmental assessment tools*

Lee [5] suggests that since Building Research Establishment Environmental Assessment Method (BREEAM) was first launched in 1990, there has been a significant rise in the number of building environmental assessment schemes. The more widely known methods include the Leadership in Energy and Environmental Design (LEED) in the United States, the Green Star in Australia, Building Environmental Performance Assessment Criteria (BEPAC) in Canada, the Evaluation Standard for Green Building (ESGB) in China, the Eco-Management and Auditing Scheme (EMAS) in the European Union, Building Environmental Assessment Method Plus (BEAM Plus) in Hong Kong, Comprehensive Assessment Scheme for Built Environment Efficiency (CASBEE) in Japan, Green Building Certification Criteria (GBCC) in Korea, Sustainable Building Assessment Tool (SBAT) in South Africa, the Green Building Labelling System in Taiwan, the Green Mark in Singapore, the Green Building Index (GBI) in Malaysia, and the Estidama environmental assessment method in the UAE which adopts the Pearl Rating System. There is also an international collaboration framework, the Sustainable Building Tool (SBTool).

It has long been discussed that many of the assessment methods systematically lack dedicated criteria to assess a building beyond its physical boundaries [5, 6, 7, 8, 9, 10]. As a result serious questions have been raised about the efficacy of environmental assessment tools. BREEAM (with its newer CSH) as the oldest assessment tool, has a

widespread popularity for many benefits it offers first and foremost for its ease of use. On the other hand LEED, primarily originated from BREEAM has shown an unprecedented growth in popularity across the world. It has been chosen for its international recognition, usage and its widespread audience to gauge is and what can be learned from it to improve CSH. On the other hand CASBEE, the BREEAM's Japanese counterpart is reportedly formulated with a much broader scope of assessment, including factors above and beyond the building envelope. To close the comparative analysis loop CASBEE was selected for its uniqueness and comprehensiveness of methodology permitting equal values for sustainable performance both inside the building envelope and out [11]. This is further backed up by a comparative analysis of 5 sustainable rating system conducted by Nguyen and Altan [12] indicated the highest score of 75 for BREEAM and LEED, closely followed by CASBEE (69.5), HK BEAM (66) and Green Star (65). To carry out the analyses BEQUEST, ESDS and FC were used to benchmark the criteria of CSH, LEED and CASBEE, beyond buildings' physical boundaries, against sustainable urban development measures at EU and an Academy of Urbanism's sustainability champion city of the year.

2.3. CSH and LEED: similarities and differences

The CSH and LEED for Homes have been in use since 2006 and 2007 and many buildings are now being rated under each assessment method worldwide [5, 12]. LEED was originally developed based on BREEAM [13] and therefore the two have similar assessment parameters aiming at increased energy efficiency [6, 13] and reducing GHG emissions [5]. Both assessment methods also consist of a linear checklist format upon which performance targets are set and to which credits are attributed. The key difference between the two is the process of certification. The CSH has trained assessors who work for BRE, check evidence provided against the criteria requirements and then provide a report to BRE, who then award the certificate to the developer. With regards to LEED for Homes it is not compulsory to include an assessor. However using an assessor will add an extra credit. There are also minor differences in terms of assessment criteria, for example the CSH includes an exclusive criterion on 'Ecology' while LEED does not. On the other hand, LEED has an assessment parameter specifically for improving indoor environmental quality while CSH lacks such similar parameter.

2.4. CSH and CASBEE: similarities and differences

The two assessment methods do share some similarities in terms of assessment parameters. This includes CASBEE's 'Conserving Energy and Water' and CSH's 'Energy and CO₂ Emissions' and 'Water'. However CASBEE and the CSH have been designed for different climates, within distinct cultural and industrial contexts. Therefore the two have many differences in assessment parameters and methodology. The CSH consists of a linear check list format while CASBEE adopts an 'arborescent' structure. There is no relation between the two in terms of the formula used. The CASBEE's Building Environmental Efficiency (BEE) is a self-assessment online software application while the CSH's checklist format, although prescriptive, is based on the discretion of the assessor. Finally the CSH's assessment criteria primarily assesses the building's level of sustainability from within the building envelope targeting energy and CO₂ reduction while CASBEE lays equal weighting for quantifying indoor and outdoor environmental loadings. As a result, CASBEE for Homes creates a more holistic analysis of the sustainability of a building [14] because it does not focus specifically on certain criteria but will rate a building highly if it is well balanced across several sustainable factors. This is in line with what some researchers such as Bentivegna *et al.* [2] have put forward and also complies with some others who have suggested accommodating more flexibility into assessment methodologies [15].

3. Research methodology

The aim of this research is to assess the CSH in order to evaluate its level of efficacy in comparison with two leading international competitors, CASBEE and LEED, and to identify ways in which it can be enhanced given the complex nature of sustainability. To achieve this aim the following objectives were pursued:

- To investigate the three assessment methods in their construction industry contexts.
- To identify their similarities and differences, strengths and weaknesses, opportunities and threats.
- To identify any areas of improvement within the CSH assessment method.

A critical review of the latest literature was conducted to establish the general concepts and principles behind the CSH's method of assessment in comparison with CASBEE and LEED. Following this, differences, positive and negative aspects of the three assessment method were established through in-depth review of CSH, LEED, and CASBEE official documents and by cross-referencing the different components, methodologies and assessment criteria of each. This led to a critical evaluation for a comparative analysis of findings using the principles of BEQUEST, ESDS and FC. BEQUEST, ESDS and FC were used to benchmark the potentialities and limitations of CSH, LEED and CASBEE, beyond buildings' physical boundaries. To consolidate the findings of this study, purposive sampling method was used to select experts for specialized semi-structured interviews. This added technical in-depth expert opinions to the preliminary findings of this research and helped pave the way for providing practical suggestions for possible areas of improvement for the CSH.

4. CSH, CASBEE and LEED: cross-comparative analysis of potentialities and limitations

Policies, mechanisms, application, and methodologies underlying the environmental assessment tools have been widely and generally criticized for many shortcomings including but not limited to: failure to address all dimensions of sustainability [16], voluntary nature of existing assessment methods which defeats their immediate purpose [16], lack of clarity regarding new emerging role [15], the need for the sustainability agenda to go above and beyond energy efficiency and combating the climate change [9, 10, 16], to go beyond the building envelope [9] and the need to refer more broadly to environmental, social and economic sustainability of houses, households and communities [10] where 'sustainable communities' are expected to 'meet the diverse needs of existing and future residents. They achieve this in ways that make effective use of natural resources, enhance the environment, promote social cohesion and strengthen economic prosperity' [17] and CSH, LEED and CASBEE all to some extent fail to address these strands of sustainability. This, however, is not all initiated internally as for instance the lack of awareness by many professionals regarding a broad range of techniques which will facilitate sustainable development is contributing to failure in integration of efforts to drive sustainability beyond simple economic and environmental protection criteria [2].

Akin to LEED, CSH includes in-built sustainable features which have shown effective in the enhancement of sustainable behavioral patterns [18]. This further complies with what Pilkington *et al.* [7] suggest as people's behavior having a significant effect on the environmental load of a building. Therefore CSH indirectly induces sustainable behavioral patterns for inhabitants although this does hardly extend beyond the building envelope. Although some suggest that CASBEE is more adaptable to changing views of sustainability and has successfully adapted to the urban scale; what others have failed to do [8], both BREEAM (outside the scope of CSH, though) and LEED include some elements of community level assessment. The CSH also offers a recognizable structure for environmental issues and provides a focus for the debate on building environmental performance; which has rightly been portrayed by Cole [15] as 'furthered environmental expectations and performance of buildings'. Furthermore the CSH allows for benchmarking of current sustainable construction practice which is necessary for further improvements to be made [2] and has provided considerable theoretical and practical experience for furthering sustainable development [16]. A large percentage of credits available within the CSH are dedicated to the reduction of energy use and GHG emissions which was also highlighted by The European Sustainable Development Strategy [3].

With eight out of nine assessment criteria evaluating the sustainability of a building within its envelope, the CSH has a limited environmental assessment scope. This creates an immediate concern about how other sustainable aspects are going to be addressed. The 'Ecology' assessment criterion is the only parameter to address sustainability outside the building envelop. However, research identifies the 'phenomenon of the illusion of ecological benefit'

provided by the CSH [19]. This allows for projects to score highly under the ecology section with no or very little enhancement regarding ecology and biodiversity. The CSH only assesses a buildings environmental performance at the 'design stage' and at the 'post-completion' stage. Although the CSH is based on Ecohomes in which 80% of assessment criteria is associated with the operational phase [20], the CSH has no criteria to measure the sustainability of a building during its occupancy stages, where 'actual' performance values have been shown as critical in assessing progress towards sustainability [16]. Hall and Garbutt [21] and Cole [16] also state that the CSH creates 'green' and not 'sustainable' buildings because it only attempts to measure improvements in environmental performance of a building. Self-assessment format of CASBEE improves engagement of end-users by providing opportunity for the general public to easily rate their own efforts towards a more sustainable lifestyle. In CASBEE, the methodology has a higher efficiency than in LEED and BREEAM as it benefits from a higher degree of complexity hence more capable of accounting for the level of intricacy present within environment assessment [12, 22]. This however, has a reverse effect on its popularity and user friendliness by general users.

Provided that the CSH and LEED for Homes are not capable of offering a comprehensive concept of sustainable building, they will still be a good starting point. The standards and aim of CSH are laudable, since improving the energy performance of housing has the potential to contribute to environmental, social, and economic sustainability [23]. The CSH has the opportunity to learn from CASBEE and thus form the forefront of sustainable construction in the UK and internationally if it adapts its assessment criteria to evaluate a building's external environmental load. The unique structure and format of CASBEE allows internal and external assessment, which might suggest that the checklist format is not the best option when looking for an assessment method to construct fully sustainable buildings. Instead, an assessment method should be adopted by CSH which is easily adaptable to an ever-changing concept of sustainability to enable CSH demonstrate continuous improvement. This further reaffirms Cole's [16] assertion that the individual building is a too constraining level to define 'sustainable' practice and the next significant advances in environmental assessment methods will invariably have to explicitly extend its boundaries of analysis.

If CSH is proved unable to pave the way towards sustainable practices while claiming to do so, this would have devastating effects on its reputation spreading a false impression of sustainability. This can build towards losing faith in the concept of sustainability altogether. Another threat to the CSH would be the loss of its international leadership in the event that it is proven as an ineffective assessment methodology. This could be the case if BRE were not willing to adapt the CSH assessment criteria and methodology at the rate, and to the extent that meets the current and future demands and targets. On the other hand changing CSH at a very quick pace has its own drawbacks. The need for continued professional development (CPD) for those who are already using it, and the cost implications both for the BRE and for the individuals/organizations using CSH, and the administration and formalities are amongst the reasons which might force the BRE to hold back if they were thinking of introducing substantial changes to CSH. The BRE needs to strike a delicate balance between the two.

5. Primary data collection and review of results

Utilizing the literature, a semi-structured interview was designed to consolidate the findings from the literature and official documents' cross-sectional comparative analysis, to ensure that what theoretical studies suggest have enough and proper ground in practice and also to investigate the practical applicability of CSH assessment criteria and methodology and the practicalities of possible ways to improve it. This was designed to help develop a better frame of reference and to highlight the areas of improvement for CSH and to corroborate the lessons which could potentially be learned from other assessment methods for a successful transfer to CSH. A preliminary list of accredited CSH assessors was initially composed using www.thecodestore.co.uk. Although at the start it was tried to cover a reasonable geographical spread in the UK, this did not prove to significantly enrich primary data enquiry because the quality of work and experience of the assessors varies dramatically. For this reason simple random sampling strategy was abandoned and a purposeful sampling method was taken instead as suggested by [24]. This strategy combined with availability, access to and willingness of participants was used for the selection of 7 CSH assessors for detailed expert interviews. In selecting the interviewees, following criteria were used:

- Include a wide range of backgrounds.
- Provide as varied a spectrum of previous experience as possible.
- Select experienced assessors with critical strategic views.
- Include assessors involved or active in executive, public, academic or research roles.

These assessors were mainly based in London metropolitan area, South of England and West Sussex. The interviews were conducted in spring of 2011. Table 1 shows the qualifications and the experiences of the selected participant. Interviewee's were given opportunity to discuss their opinions of the CSH freely but were also asked specific questions such as:

- Would the Code benefit from a 'post occupancy evaluation stage' to assess level of retention of awarded sustainability rating? [20]
- The CSH focuses on energy and CO2 reduction and water efficiency; should assessment criteria be expanded to include more aspects of sustainability? [21]
- The 'Passive House Planning Package' (PHPP) has achieved great success for construction of zero carbon homes. Would the CSH benefit from the inclusion of PHPP design principles? [25]
- The link between ecology and any sustainable entity has been realised. Ecology criteria within the Code for Sustainable Homes are not mandatory, should they be? [19]

Table.1 Qualifications and the experience of the interviewees

Participant	Qualifications and Experience
Interviewee 1	Accredited CSH assessor working for a construction company for ecological building in Hayward's Heath in west Sussex.
Interviewee 2	Accredited CSH assessor working for a construction company for ecological building in Brighton, he/she has also has experience using the BREEAM pilot scheme for retrofit. He/she also worked previously in the USA in the state of Oregon and has experience of LEED or homes although he/she is not an accredited assessor.
Interviewee 3	Accredited CSH assessor working for a construction company based in London but undertakes projects throughout the UK, Europe, middle east and Asia. They have been involved with many award winning construction schemes. He/she also used to work for the BRE.
Interviewee 4	Accredited CSH assessor working for a construction company based in London. He/she is also a BREEAM accredited professional (AP) and is licensed under the education, higher education and offices BREEAM schemes. Having achieved a BSc in environmental science at the university of Southampton, he/she then went on to complete an MSc in environmental management for business at Cranfield university.
Interviewee 5	Accredited CSH assessor and an architect running his/her own sustainable domestic construction company in Brighton. He/she also carries out sap assessments and has previously worked as an executive director for Morgan Stanley.
Interviewee 6	Accredited CSH assessor and also works with BREEAM and Ecohomes. He/she is also a zoologist by training and in recent years has been leading a team of sustainability consultants for design teams.
Interviewee 7	Accredited CSH assessor and currently works for the BRE in the area of low carbon futures and refurbishment. In the past he/she has been a BREEAM multi-residential manager at BRE global. He/she also graduated from the university of Brighton with a 1st class honours degree in architectural technology.

Excerpts from the interview, both positive and negative, have been used to highlight different viewpoints of CSH assessors. The positive views mainly supported the idea that the CSH is fit for the purpose it have been devised for, implying that overloading it with new expectations may make the entire process defunct:

'The CSH is a reliable and useful assessment method for building sustainable homes' Interviewee 4

And also sustainability can be achieved by other means than CSH:

'You shouldn't stick within the parameters of the CSH, there is so much more you can do when designing a sustainable home. If the target is a completely sustainable home then the CSH should not be used because there is a whole world of other things that can be looked at.' Interviewee 4

Or more succinctly shielding the existing approach by extrapolating to the mindset behind it:

'Ecology credits are not mandatory because the CLG [Department for Communities and Local Government] want the focus to be on the building and that they didn't even want ecology included in the first place.' Interviewee 7

The suggestions for improvement, by contrast, were more elaborate and ranged from mild comments to very sharp criticism concerning different aspects including: the focus of sustainable design which has been shifted as a result of introduction of the CSH (and BREEAM and most of the other assessment methods):

'The CSH draws focus away from classic sustainable design principles like orientation/solar gain and towards add-on features like bike storage.' Interviewee 1

The underlying epistemology of all assessment methods:

'A lot of the current assessment schemes around the world that are comparable to BREEAM and therefore the CSH, e.g. LEED, Hong Kong BEAM, Green Star were all based on BREEAM to start with. Therefore all the flaws in BREEAM are replicated to the others so that their foundations are tainted.' Interviewee 6

The philosophy behind the CSH:

'CSH's philosophy is to 'look at the building' then 'everything else'. This approach is completely wrong; the environment should be looked at first and then the building. This shows fundamental flaws in CSH's approach to sustainable housing construction. Japan has a far better approach/philosophy than the UK. They look at the assessment method almost completely holistically with building and its environment equally.' Interviewee 6

To specific allegation of creating delusional fallacy:

'The ecology section within the CSH does not actually have any ecology in it. That with BREEAM and therefore the CSH, there is the illusion of ecological benefit, apparently the CSH's credits add up to a fantastic ecological environment, however if an ecologist looks at it could be very poor.' Interviewee 6

More moderate comments also shared similar viewpoints:

'Ecology is essential for true sustainability to be achieved and therefore should have more dominant position in the CSH.' Interviewee 2

Some other interviewees had more empirical opinions for further improvements including suggestions to facilitate integration of the post-occupancy assessment and possible developments into social and economic sustainability:

'What would be the point? The home buyers are not making a binding agreement to use the house with a

home office, with certain levels of efficiency or in any other manner. Therefore there is no reason to include a post-occupancy evaluation stage assessment.
Interviewee 5

'... 'EN4 Drying Space', 'EN8 Cycle Storage' and 'EN9 Home Office'; These credits help the CSH branch out into the areas of sustainability [both] social and economic'
Interviewee 3

6. Discussion of findings

The CSH and LEED for homes have many similarities such as the assessment parameters adopted, the methodology of accreditation and each having a checklist format. This is not unexpected since LEED for Homes was actually based on BREEAM in the first place and therefore flaws present in BREEAM would also be present in LEED for Homes. In terms of means by which the CSH could benefit from LEED for Homes there is limited opportunity. However despite this, LEED for Homes does appear to assess a building's level of sustainability from a wider spectrum than the CSH, e.g. using assessment parameters such as 'Sustainable Sites' and 'Awareness and Education' which goes way beyond the building's external envelope. Perhaps the CSH would benefit from the integration of these assessment parameters into its current assessment process. Further research is required to establish this. Regarding checklist formats, they help provide a simple assessment method however may risk achieving the overall sustainable target as a result of focusing on the guideline system. Also adopting a checklist approach can result in a system which designs around the checklist and not with the aim of constructing the most sustainable building possible. In comparison, CASBEE's comprehensive and holistic approach has allowed for its adoption beyond the building envelope so that the sustainability of a building's surroundings is given equal weighting. What inspires CASBEE's method is to view a building as a living entity which is in constant interaction (and in an ideal scenario, in harmony) with its immediate and distant contextual environment as a whole. Also the current titles of the CSH's assessment criteria would lead one to believe that it assesses a buildings level of sustainability from a variety of different viewpoints (i.e. the Ecology assessment criterion combined with the others), hence a thorough assessment. However, the findings of this research have shown that the CSH's approach to sustainable construction is flawed because its current approach to sustainable construction starts from within the 'building' first and then moves onto the 'environment' surrounding it. This needs to be changed so that the 'environment' is accounted for simultaneously with, if not before, the 'building'. If this is to help:

- Stop the misconception of ecological benefits achieved through CSH's ecology credits.
- Take account of both fauna and flora.
- Ensure consistency of rating across projects.
- Involve an ecologist early on during the conception stage and along every stage of the project.

The findings of this research have also demonstrated that all of the CSH assessment parameters are set within the building envelope and therefore it is impossible for the CSH to fully achieve a sustainable building construction in its broadest meaning. This would then suggest that the CSH's current name is not suitable when considering the type of building it advocates. A more suitable name would perhaps be 'The Code for Energy Efficient Homes'. Despite the points that have been stated because of the ever-changing view of sustainability, the CSH still has the opportunity to develop its current assessment criteria and methodology to allow for internal and external assessment. The comparison conducted with CASBEE and the results of the research project have found that there are many differences both fundamentally in approach/philosophy to sustainable construction and on a smaller scale in terms of assessment criteria. CASBEE looks to improve a buildings base environmental performance, assessing it equally internally and externally. One significant way for the CSH to improve its current assessment method would be to adapt its assessment criteria to that used by CASBEE. It would then be assessing in a multi-dimensional manner and therefore resulting in a more sustainable building.

7. Conclusion

Nearly quarter of a century after BREEAM was initially conceived as the first environmental assessment tool, there is an undisputable need for a comprehensive review of how effective it is in delivering the built environment up to today's mandates, standards and expectations. CSH as a revised progeny of BREEAM was chosen to perform a cross-sectional qualitative comparative analysis of its criteria against two other internationally influential assessment methods, namely LEED and CASBEE. In addition BEQUEST, ESDS and FC were also deployed as frames of reference to triangulate CSH criteria with their underlying and encompassing principles. It was shown that despite attempts in accommodating sustainability measures beyond the building's envelope, such attempts have not shown very successful. Therefore, if CSH and BREEAM are to keep their credibility and global leadership in driving the environmental and green agenda worldwide, they need to take a more effective account of the buildings' immediate and distant environments to different degrees. The mechanisms of such inclusion are manifold and need a separate study to work out. However, as findings of this study showed, there are immediate lessons to be learnt and knowledge/experience to be transferred from LEED and more specifically from CASBEE to CSH. As sustainability is now more rightly comprehended beyond energy efficiency, non-energy-related factors and criteria need to be included in CSH. Those include new or revised credits for ecology in a way that the actual and factual effects of buildings on their context can be measured and accounted for. More specifically the impacts of both existing and new buildings on flora and fauna need to be factored in. Post-occupancy evaluation and assessment need to be carried out and results need to be included in the assessment process to be able to update the rating system based on actual performance of a building as opposed to predicted, perceived, simulated or expected performance. The CSH rating system needs to be reviewed and revised to guarantee a more consistent rating across different categories. A multi-tier, multi-dimensional assessment structure seems to be of significant use in improving the existing assessment structure of CSH so that more effective, properly weighted yet balanced credits can be given to buildings contribution – positively and negatively – to sustainability both from inside and out, not only regarding energy and carbon footprint but also about other aspects of environment. Ideally an overall triangular (environment, economy, society) or quadrangular (environment, economy, society, technology) assessment structure for CSH is ideal. However, it should be carefully noted that over-complication of CSH may have detrimental effects on its popularity, ease of use and broad adoption. If and when any attempt on making CSH is to be taken on, complexity should be alleviated via automation of the process using ICT, reinforced and supported by education, training and development strategies endorsed by campaigns for raising political, professional and public awareness.

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