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Building Sustainability Assessment Methods: current update

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Abstract. The major reason that promoted the development of systems to support environmental performance assessment of buildings was the effective realisation, in some countries, that they were unable to say how sustainable a building was. Later researchers and government agencies understood that assessment tools are the best method to demonstrate the level of sustainability of all types of constructions. These can improve the education for a sustainable society, because it can promote understanding between the principles of sustainable construction and the user. Within this, several countries have developed their own methods for sustainability assessment adapted to their reality and presenting them as capable of guiding the overall performance of this sector. Most of these methods are based on local rules and legislation, in locally conventional construction technologies, with the default weight of each indicator set according to the actual local socio-cultural, economic and environmental contexts. Through the years, these methods have contributed to the growth of the awareness about criteria and objectives of sustainability, and they have been improved to a more holistic approach. They become a reference to assess the sustainability of buildings in particular and construction in general.

This paper proposes to present the evolution of these methods after twenty-five years, comparing and critical analysing the most recognised ones. It will expose the results of comparison, regarding criteria, weights and final scores, and presented the new path these methods are now tracing. A new trend for method to support design rather than certifying an erected building is also presented. In conclusions it will be discussed the pros and cons of the appearance of them and their improvements.

1. Path of assessment methods

How sustainable a building was, is the issue that triggered the initiative of several countries to promote the development of systems to support environmental performance assessment of buildings, including countries and design teams, which believed that they were experts in this field [1].

According to these, since the ninetens, several countries have developed their own systems for sustainability assessment, adapted to their local situation and presenting them as capable of guiding the overall performance of this sector. Most of these systems are based on local rules and legislation, in locally conventional construction technologies, with the default weight of each indicator set according to the actual local socio-cultural, economic and environmental contexts [2].

So, it started to appear in the market different systems and assessment tools, whereas the following are acknowledged for their accuracy and increased market penetration: BREEAM (Building Research Establishment Environmental Assessment Method); CASBEE (Comprehensive Assessment System for Building Environmental Efficiency); DGNB (*Deutsche Gesellschaft für Nachhaltiges Bauen*); Green



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Star; HQE (*Association pour la Haute Qualité Environnementale*); LEED (Leadership in Energy & Environmental Design); NABERS (National Environmental Australian Building Rating System); and SBTool (Sustainable Building Tool).

1.1. Initial proposes and objectives

The majority of existing methods are oriented to the evaluation of environmental sustainability of buildings, but now they present a more holistic structures and sustainability assessment characteristics, such as:

- Emphasize more than the assessment of resources use, ecological loadings, health and comfort;
- Assess more than the design intentions and potential as determined actual real-world performance;
- Structure performance scoring using criteria, benchmarks and weightings systems to balance and encourage initiatives;
- Offer a performance summary, certificate or label that can be part of leasing documents to share all the results and potential improvements with different stakeholders;
- Try to develop a simpler and more succinct guide to be more easily used by all stakeholders;
- Start to incorporate Life Cycle Analysis (LCA) approaches to refine the constituent measures;
- Each method as different guides/manuals developed for a specific reality (namely a country) and to assessment specific types of buildings.

1.2. New emphasis

Several emerging issues increasingly frame the use of building assessment method [3]. According to this, the main objectives and proposes of them are:

- Assessment methods have moved beyond voluntary marketplace mechanisms and start to have a place in the commercial market field;
- Building Sustainability Assessment (BSA) methods starting to be recognised by financial and insurance companies as a basis for risk and mortgage appraisals and real estate valuations;
- Some industries begin to use this as an opportunity to re-evaluate production processes, and to improve principal and design/construction methods;
- The increase in the number of buildings evaluated began to arouse the need to create universal methods capable of comparing the assessments made;
- The need to permit easy access to tools and methods, and to enable assessments to be made quickly and cheaply, is spurring the increased deployment of web-based methods and tools;
- The most recognised BSA methods as now an International toll capable to evaluate different types of buildings, designed/constructed in any reality/country (e.g. BREEAM International New Construction and LEED for BD + C).

2. New method to support early-stage building design

2.1. Propose and objectives

Although most building assessment methods were developed to evaluate buildings already built or in later design stages, research and practice show that it is easier, cheaper, and more effective to implement sustainable concerns during early design stages, because most decisions that impact a building's sustainable performance take place during these stages [4]. In this sense, the most relevant goals should be established at the start of the project, with the definition of objectives and thresholds, against which design solutions' performance should be compared. Nevertheless, these stages are characterised by fuzzy and scarce data [5].

One proof of such impact and relevance was the Royal Institute of British Architects developing a Green Overlay to Outline Plan of Work focusing in sustainability concerns at all design phases [6]. Such

raising awareness, paved the way to the development of new methods to support and assess buildings' sustainability from its conception.

With this in mind, a new method was developed to support designers (project teams and building owners/promoters in an integrated work) decision making process towards building sustainability since early design. This new method intends to aware designers to sustainability concerns by helping them setting sustainable targets and to compare design alternatives against such targets. By enabling solutions performance comparison, it allows both, quantifying each solution performance and aiding selecting the most sustainable solution at the indicator level.

While enabling considering and evaluating sustainability early in the design, the method is underpinned by the following premises:

- Be simple and easy to use;
- Be in line with international standards for sustainable construction;
- Comprise the three sustainability dimensions;
- Allow simultaneity of quantitative and qualitative criteria;
- Give required guidance to understand the implications of sustainability in the design;
- Allow further verification and development of preliminary results with specific tools and certification with any existing certification tool.

The method does not intend certification by itself, meaning that it does not produces a sustainability performance certificate, but it supports the design of sustainable buildings, regardless if they are indented to have a final label or not. Nevertheless, any existing BSA method that certifies can be used to certify a building designed with this method.

2.2. *Criteria and assessment framework*

As in any other sustainability assessment method, this new method relies on indications to carry out its evaluation. The sustainability matrix- the pool of sustainability indicators included – was established considering the following:

- Be internationally recognised for for building sustainability assessment (ISO and CEN);
- Consider the whole building life cycle;
- Be frequently addressed in existing BSA methods;
- Cover all sustainability dimensions.

The method then follows a decision-tree structure with four levels with four levels: areas aggregate the main topics; categories establish the general and strategic objectives; indicators represent the main issues addressed; and, whenever needed, sub-indicators address more accurate measures (Figure 1).

The method then has a total of nineteen indicators, divided into thirty-five sub-indicators. A complete list of the indicators can be found in [7]. The order whether to assess and evaluate each indicator, is decided by the project team. There is no mandatory sequence nor pre-requisite indicators.

The method develops in the following steps:

- Define main broad sustainability goals to attain for during design;
- Select the indicators and relate to those objectives;
- For each indicator: (i) Set the performance level to attain and retrieve what needs to be accomplished to reach such level or; (ii) Define a design solution and retrieve the performance level it relates to; (iii) Add additional solutions to compare results as desired.

The method uses a mid-point approach, meaning it does not aggregate the indicators' outcomes into a single sustainability score. Also, and for that reason, there is no weighting system to aggregate results. In each indicator a three-level scale is used to quantify and compare the performances of the design solutions, using best-practices, legal requirements, and/or common practices to set the thresholds.

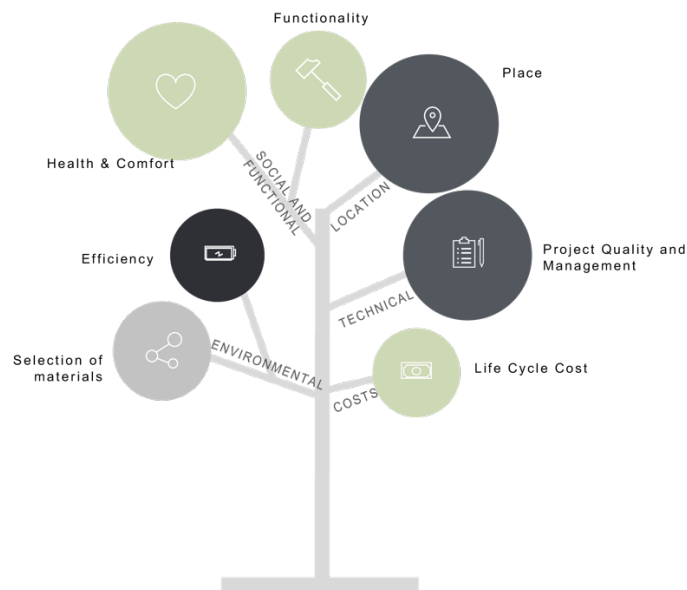


Figure 1. Decision-tree structure

2.3. Relation with existing certification methods

This new method distinguishes from existing certification methods as it: (i) was designed and thought to address early design phases, dealing with the lack of data; (ii) does not aggregates results into a single overall score; (iii) does not intend to certify but rather to support design; (iv) enables comparison of design solutions' performance. It does not entail comprehensive calculations, contrarily to existing certification methods. In this sense, this method and existing systems can complement each other, regardless the type of building, country, or label (brand) associated with the certification system.

3. Conclusions

Although there are aspects to overcome in all BSA methods, hindering their adoption, they still have an important role to play, not only in evaluating the impacts of an actual building, but also, and even more importantly, in guiding the appropriate design for the attainment of performance objectives.

The new method presented supports designers comparing design alternatives prior to their execution, rather than assessing its final performance. By considering sustainability concerns early in the project, it not just aids resources optimisation as the impact of such changes have lower or zero cost.

References

- [1] Castro, M. F., Mateus, R., Bragança, L., 2015. A critical analysis of building sustainability assessment methods for healthcare buildings. *Environ. Dev. Sustain.* 17 (6), 1381–1412.
- [2] Crawley, D., Aho, I., 1999. Building environmental assessment methods: applications and development trends. *Build. Res. Inform.* 27 (4–5), 300–308.
- [3] Cole, R. J., 2005. Building environmental assessment methods: redefining intentions and roles. *Building Research & Information*, 33 (5), 455–467.
- [4] Kohler, N., & Moffatt, S. 2003. Life-cycle analysis of the built environment. *UNEP Industry and Environment*, 26, 17-21.
- [5] Bragança, L., Vieira, S. M., & Andrade, J. B. 2014. Early Stage Design Decisions: The Way to Achieve Sustainable Buildings at Lower Costs. *The Scientific World Journal*, 2014, 8.
- [6] RIBA. 2011. Green Overlay to the Outline Plan of Work. London, United Kingdom: RIBA
- [7] Andrade, J. 2017. Early stage design methodology to ensure life cycle sustainability of residential buildings (PhD Thesis), University of Minho, Portugal.