A systematic review of the International Assessment Systems for urban sustainability

Authors: Joana Pedro | Anabela Reis | Carlos Silva | Manuel Pinheiro
AGENDA

I. Introduction

II. Review Methodology

III. Results & Discussion
  • Overview of the Systems
  • Key criteria and metrics
  • Common shortcomings
Introduction

“The growth of cities will be the single largest influence on development in the 21st century.” UNFPA’s 1996 State of World Population Report

![Graph showing urban and rural population growth from 1500 to 2050.](Image)
Introduction

The construction sector has an increasing impact on the demand for scarce resources

- Building sector accounts for 40% energy consumption (WEC, 2016) and 30% construction and demolition waste (EUROSTAT, 2014)
- Accounts for 15% potable water demand (WRG, 2009).

Need to develop planning and decision support tools for cities sustainable development.
Introduction

Approaching sustainability in the construction sector

Buildings

ISO 21929:2011 | CEN/TC 350 | EN 15643

Provide the general framework for the evaluation of sustainability for the construction sector

Urban areas

ISO 37120: Sustainable Development of Communities

Themes (17)
City Services & Quality of Life

- Economy
- Education
- Energy
- Environment
- Finance
- Fire/Emergency
- Governance
- Health
- Recreation
- Safety
- Shelter
- Solid Waste
- Telecom
- Transportation
- Urban Planning
- Wastewater
- Water/Sanitation
Introduction

What are the International Sustainability Assessment systems and why do they matter?

International Sustainability Assessment systems

are Multicriteria based tools that can be used to measure and document sustainability performance of a construction project, which can support and guide an integrated and interdisciplinary collaboration in the design of the buildings and built environments.

This study focus on the Urban Scale

By analyzing in detail the following selected tools
Review Methodology

1 part: comparison the system (timeline, spatial spread, scoring).

2 part: review of the main indicators and metric

3 part: Identification of the common shortcoming

*methodological approach for literature search and selection according to the Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines
## Overview of the Systems

### Sustainability levels

<table>
<thead>
<tr>
<th>Scoring points</th>
<th>Number of projects achieving each level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outstanding (&gt;80p)</td>
<td>BREEAM-CM (50 projects)</td>
</tr>
<tr>
<td>Excellent (70p)</td>
<td>LEED-ND (188 projects)</td>
</tr>
<tr>
<td>Very Good (55-70p)</td>
<td>DGNB-UD (34 projects)</td>
</tr>
<tr>
<td>Good (45-55p)</td>
<td>GREEN STAR</td>
</tr>
<tr>
<td>Pass (30-45p)</td>
<td>CASBEE</td>
</tr>
<tr>
<td>Not certified</td>
<td>Not certified</td>
</tr>
</tbody>
</table>

### Statistics

<table>
<thead>
<tr>
<th>System</th>
<th>Platinum (7%)</th>
<th>Gold (40%)</th>
<th>Very Good (18%)</th>
<th>Good (8%)</th>
<th>Silver (24%)</th>
<th>Certified (28%)</th>
<th>Pass (52%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BREEAM-CM</td>
<td>3 projects</td>
<td>20 projects</td>
<td>9 projects</td>
<td>4 projects</td>
<td>4 projects</td>
<td>11 projects</td>
<td>26 projects</td>
</tr>
<tr>
<td>LEED-ND</td>
<td>13 projects</td>
<td>74 projects</td>
<td>35 projects</td>
<td>14 projects</td>
<td>14 projects</td>
<td>31 projects</td>
<td>74 projects</td>
</tr>
<tr>
<td>DGNB-UD</td>
<td>2 projects</td>
<td>13 projects</td>
<td>9 projects</td>
<td>4 projects</td>
<td>4 projects</td>
<td>13 projects</td>
<td>26 projects</td>
</tr>
</tbody>
</table>

* Insufficient statistical info for CASBEE and Green Star
### Key Sustainability criteria and weights: Environmental criteria

<table>
<thead>
<tr>
<th>Criteria</th>
<th>BREEAM-CM</th>
<th>LEED-ND</th>
<th>DGNB-UD</th>
<th>CASBEE-UD</th>
<th>G.STAR-CM</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Energy &amp; Emissions</strong></td>
<td>energy strategy*; transport carbon emissions 7%</td>
<td>minimum building energy performance*; solar orientation; optimize building energy; renewable energy; district heating &amp; cooling; infrastructure energy efficiency 9%</td>
<td>energy infrastructure; LCA -emissions 9%</td>
<td>possibility demand/supply ...; adaptability and expandability 6%</td>
<td>greenhouse gas strategy; peak electricity demand 8%</td>
</tr>
<tr>
<td><strong>Water</strong></td>
<td>water strategy*; water pollution; rainwater harvesting 5%</td>
<td>indoor water use reduction*; outdoor water use reduction; wastewater management 5%</td>
<td>water cycle 3%</td>
<td>water resource – waterworks; sewerage 6%</td>
<td>integrated water cycle 7%</td>
</tr>
<tr>
<td><strong>Waste</strong></td>
<td>low impact materials; resource efficiency; existing buildings*; sustainable buildings 12%</td>
<td>construction activity pollution prev.<em>; solid waste management; building reuse; certified green building</em>; recycled and reused infrastructure 8%</td>
<td>lca-resource cons; resilience and adaptability; resource management 10%</td>
<td>resources recycling-construction; operation; environmentally considerate buildings 17%</td>
<td>materials; waste management; sustainable buildings 11%</td>
</tr>
<tr>
<td><strong>Land use</strong></td>
<td>ecology strategy*; enhancement of ecological value; green infrastructure; land use*; landscape 12%</td>
<td>smart location*; imperiled species*; wetland &amp; water body conservation*; agricultural land conservation*; site design for habitat or wetland*; restoration of habitat or wetlands; long-term conservation management; minimized site disturbance 4%</td>
<td>biodiversity; land use; smart infrastructure; land use efficiency (Wst 15%)</td>
<td>greenery - ground greening; building top greening; biodiversity – preservation; regeneration &amp; creation; consistency with upper level; planning; land use 17%</td>
<td>sustainable sites*; ecological value 4%</td>
</tr>
</tbody>
</table>
### Key Sustainability criteria and weights: Social criteria

<table>
<thead>
<tr>
<th>Criteria</th>
<th>BREEAM-CM</th>
<th>LEED-ND</th>
<th>DGNB-UD</th>
<th>CASBEE-UD</th>
<th>G.STAR-CM</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Well-being</strong></td>
<td>noise pollution*; light pollution 3%</td>
<td>light pollution reduction 1%</td>
<td>thermal comfort open spaces; open space; noise, exhaust &amp; light emiss 10%</td>
<td>View; inhabitant population; staying population 8%</td>
<td>healthy and active living*; light pollution 6%</td>
</tr>
<tr>
<td><strong>Climate adapt &amp; resilience</strong></td>
<td>adapting to climate change; flood risk assessment*; flood risk management; microclimate 8%</td>
<td>rainwater management; floodplain avoidance*; steep slope protection; brownfield remediation; heat island red 8%</td>
<td>urban climate; environmental risks; groundwater and soil protection 7%</td>
<td>basic disaster prevention; disaster response ability; traffic safety; crime prevent 11%</td>
<td>adaptation and resilience; safe places*; heat island effect 7%</td>
</tr>
<tr>
<td><strong>Access to services</strong></td>
<td>access to public transport; public transport facilities; transport assessment*; cycling network; cycling facilities; local parking; demographic needs*; delivery of services, facilities; public realm; utilities; inclusive design; safe and appealing streets 26%</td>
<td>preferred locations; access to quality transit; transit facilities; transportation demand...; bicycle facilities; reduced parking ...; compact development*; connected &amp; open community*; mixed-use neighbor.; access to civic &amp; public space; access to recreation facilities; neighbor. schools; walkable streets; local food prod.; visibility &amp; universal design; tree-lined &amp; shaded streets ~51%</td>
<td>motorized transportation; pedestrian and cyclists; robust social and functional mix; social &amp; commercial industry; barrier-free design 21%</td>
<td>convenience; health and sustainable transport &amp; movement; walkable access to amenities; access to fresh food; digital infrastructure 9%</td>
<td></td>
</tr>
<tr>
<td><strong>Heritage</strong></td>
<td>local vernacular 1%</td>
<td>historic resource preservation 2%</td>
<td>urban design 3%</td>
<td>history and culture 3%</td>
<td>culture, heritage and identity 3%</td>
</tr>
<tr>
<td><strong>Participation</strong></td>
<td>consultation plan*; consul. &amp; engagement*; design review; training and skills; community management of facilities 15%</td>
<td>community outreach and involvement 2%</td>
<td>integrated design; consultation; project management; governance; monitoring 10%</td>
<td>compliance; area management; information service performance; information system - block management 17%</td>
<td>Gstar professional; design review; engagement; corporate responsibility; sustainability awareness; community participation; environmental management; community develop* 28%</td>
</tr>
</tbody>
</table>
### Key Sustainability criteria and weights: Economic criteria

<table>
<thead>
<tr>
<th>Criteria</th>
<th>BREEAM-CM</th>
<th>LEED-ND</th>
<th>DGNB-UD</th>
<th>CASBEE-UD</th>
<th>G.STAR-CM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economic prosperity</td>
<td>Economic impact*; Housing provision 12%</td>
<td>Housing and jobs proximity; Housing types and affordability 10%</td>
<td>Local economic impact; Value stability 6%</td>
<td>Economic development revitalization activity 6%</td>
<td>Community investment; Affordability; Employment&amp; economic resilience; Education &amp; skills 13%</td>
</tr>
<tr>
<td>Life cycle costs</td>
<td>Not found any exclusively dedicated criteria, although costs calculation is included in the energy-related criteria 0%</td>
<td>Not found any exclusively dedicated criteria, although costs calculation is included in building reuse and energy criteria 0%</td>
<td>Life cycle cost; partially included in resilience and adaptability 6%</td>
<td>0%</td>
<td>Return on investment; Incentive programs 4%</td>
</tr>
</tbody>
</table>
Shortcomings and pathways for improvement

Identified Gaps

G1 Lack of consensus on sustainability definition and concepts
10%

G2 Overlapping and incoherent distribution of criteria and weighting
18%

G3 Need for widening the scope
26%

G4 Need for widening the scale
9%

G5 Regulatory bodies involvement and participation
18%

G6 Little flexibility for local adaptation
28%

G7 Need to adapt the assessment systems for urban regeneration projects
11%

G8 Integration of the NSA with computer-based models
6%

Pathways for improvement

*from the total of 124 publications
Shortcomings and pathways for improvement

**G1** Lack of consensus on sustainability definition and concepts

Sustainability is not a fixed term yet. They providing a practical pathway to measure sustainability, but they often group and use different metrics and weights to each sustainability issue.

**G2** Overlapping and incoherent distribution of criteria and weighting

Because of this lack of consensus on the definition of sustainability, they often face the problem of completeness, and overlapping criteria which raises the question about what exactly do they measure “Do green neighborhood ratings cover sustainability?” Reith & Orova, 2015
G3 Need for widening the scope
To include socioeconomic factors, mobility and walkability, disaster resilience and climate change, cultural factors

G4 Need for widening the scale
New opportunities - improved efficiency and better management of local resources & New challenges - increased complexity and interconnectivity

G5 Regulatory bodies involvement and participation
Is a key factor for the successful adoption of green communities. Also, the improvement of the obligatory minimum standards may push forward the current voluntary standards by establishing a more demanding baseline that incentivizes competitiveness in the market.
Shortcomings and pathways for improvement

**G6** Little flexibility for local adaptation
Most of the systems are developed within a certain country but are often used internationally. This opens the debate on the viability of using global standards and the pertinence of their use in actual local conditions. This particularly noticed and needed for developing countries.

**G7** Need to adapt the assessment systems for urban regeneration projects
are mostly designed to guide the development of new urban areas, but cities are already built environments, therefore, there is a need to adapt these systems to serve built environments as well.

**G8** Integration with computer-based models
These systems are typically expert-based rather than computer-based models. Yet, as scale is enlarged and complexity increases, there is a need to couple it with computer-based models (e.g., GIS, BIM)
Thank you for your attention

Any Questions?

Joana Pedro


