Introducing the Portuguese Sustainability Assessment Tool for Urban Areas: SBTool PT – Urban Planning

Luis Bragança, Erika Guimarães

University of Minho, School of Engineering, Civil Engineering Department, Guimarães, Portugal

corresponding author: braganca@civil.uminho.pt

Abstract. Given the accelerated urbanization process throughout the twentieth century, many of today's cities reflect a fast and disordered growth, which influences directly the demand for natural resources. For an indispensable change in the current urban infrastructure management models, it is necessary to quantify the sustainability level of actual practices and proposals. In this context, based on widespread methods, SBTool_PT Urban Planning represents an adaptation of the SBTool international method to the Portuguese context. This tool assesses the sustainability level of the practices promoted in urban projects with no size restrictions and is applicable to new urban development and/or urban renovation. The process is conducted by a rigorous analysis of requisites specifically developed to stimulate improvements on energy consumption, management of potable water, solid waste, urban soil and territory and air quality. Aiming at a full introduction of the tool, this article contextualizes its development and characterizes its assessment methodology. Additional application to a case study shows how the assessment of a proposed project is performed. It is intended to demonstrate in which way sustainability assessment methodologies allow the promotion of innovation and urban sustainability through the environmental preservation and the improvement of the quality of life in urban areas.

1. Introduction

Cities are subjected to constant physic, social and economic changes, driven by various needs of societies and cause severe and irreversible disturbs on urban environment. Currently, given the accelerated population growth rates, the rhythm of imposed alterations is increasingly frenetic [1]. The raise of urban population expands the existing urban networks and transforms rural areas, conducing sequential alterations in the environment. Beyond the immediate impacts, constant changes in urban environment deeply imbalance the quality of life of its inhabitants in the long term [2].

Given the rapid urbanization process of the latest twentieth century, today's cities reflect a fast and disordered development, which influences directly the need for resources and energy. Inevitably coincident with higher population densities, the increase of urbanization rates comes along with substantial raise in the demand of materials, water and energy sources and also affects the waste and effluent generation [3]. Many urban infrastructure management models, internationally consolidated in industrialized countries, are strongly depended on non-renewable sources. Several studies demonstrate that the use of fossil fuel tends to enlarge in the short term, mainly in emergent countries, where economic development matches the increase of urbanization rates and population concentration [3].

It is thereby urgent to reassess the existing policies and regulation mechanisms through the establishment of social economic and environmental principles. To produce new, sustainable oriented, urban management models, it is necessary to quantify the sustainability level of proposed solutions. Sustainability assessment in urban areas must be made through the evaluation of priority criteria, which should base certification tools. This is an essential initiative to promote sustainable urban planning and governance.

The concept of urban morphology embraces everything that composes the urban network, such as the built heritage, the roads infrastructure, landscapes and open spaces. The shape of an urban community is the result of the interaction between those elements, through interventions of the inhabitants, local climate and other systems. In addition to stationary elements, movements and socioeconomic dynamics are implicit within the urban network. Thereby, an urban scenario scope is much more complex when compared to the assessment of a single building.

Based among others on the SBTool international method, a proposal to apply the SBTool methodology on urban areas was developed inside the scope of SBTool PT-STP project [4]. The tool, called SBTool_PT Urban Planning (UP), presents a structure conceived towards the assessment of urban planning operations. Because of this specific scope, mainly at scale level, the tool has little similarities with the analogue tool designed for buildings (SBTool_PT Residential Buildings). However, its guidelines maintain the approach of several categories previously defined in accordance with existing international methodologies.

Hereinafter, this article presents the SBTool_PT-UP as an effective methodology for the assessment of urban communities. After a brief introduction on the basis for its development, an overall definition regarding the tool's overall aspects is made, regarding the main objectives, structure and calculation process. To achieve the purposes of a throughout presentation, the evaluation of a proposed project is followed in the form of a case study. The subsequent discussion of results acknowledges the main conclusions retrieved from the sustainability assessment performed by the tool.

2. Methodology Basis

Prior to the presentation of the SBTool_PT for Urban Planning operations, it is necessary to analyse the different international methodologies in which the tool's development is based. Each methodology presents a proper structure, organized according to sustainability's dimensions. Also, the tool's assessment structure comes after the acknowledgement of different political strategies at national, European and international scale, and internationally accepted lists of sustainability indicators.

Thereby, the SBTool methodology for urban planning presents crosscut aspects with methods and practices recognized worldwide. In particular, BREEAM Communities, LEED for Neighbourhood Development and SBTool International Method must be highlighted.

2.1. BREEAM Communities

BREEAM Communities is an independent certification and assessment system that approaches sustainable concepts at social, economic and environmental levels, as well as the design requisites that impact practices within the built environment [5]. The system provides credits according to the project's performance on sustainable objectives and planning policies. The summation of credits gives a final global score that varies from Pass, God, Very Good, Excellent and Outstanding.

Certification is regulated by a "sustainability council", which represents a wide range of stakeholders of construction industry in the UK. BREEAM Communities certification standard embraces eight categories of assessment, described in table 1.

Table 1. Summary of BREEAM Communities Structure [6].

Category	Number of Indicators	Main objective
Climate and Energy	9	Reduce climate alterations
Community	4	Encourage community participation
Place Shaping	11	Conceive a local identify respecting local heritage
Ecology and Diversity	3	Protect site's ecological value
Transport	11	Provide sustainable transportation options
Resources	6	Ensure the efficient use and disposal of resources
Business	5	Supply site's economic needs and create local jobs offers
Buildings	2	Guide sustainable design of buildings

2.2. LEED for Neighbourhood Development

The objective of LEED for Neighbourhood Development is the promotion of healthy, lasting economic and environmentally rational practices on projects and construction of buildings. Based on the principles of the "New Urbanism" and on the theories of "Smart Growth" and "Sustainable Construction", this tool focuses on the local selection, the association with existing buildings and infrastructure and the relation with the landscape [7]. As shown in table 2, LEED for Neighbourhood Development is structured in three mandatory groups and two additional punctuation groups.

Table 2. Summary of LEED for Neighbourhood Development Structure [8].

Category	Number of Indicators	Main objective
Smart Location and Linkage	5 (mandatory + 9 (credits)	Selection of the best location for the development concerning environmental and social priorities
Neighbourhood Pattern and Design	3 (mandatory) + 15(credits)	Emphasize social needs in the urban design process
Green Infrastructure and Building	4 (mandatory) + 17 (credits)	Highlights priority environmental and social aspects for the buildings' design
Innovation and Design Process (optional)	3 (credits)	Valorize higher performance practices
Regional Priority Credit (optional)	6 (credits)	Stimulate concern with site's specific environmental issues

2.3. SBTool International Method

The SBTool (Sustainable Building Tool) International Method is an initiative of the non for profit association iiSBE (International Initiative for the Sustainable Built Environment), developed in cooperation with teams from over 20 countries. The method establishes an overall frame to assess sustainable performance of buildings and developments and is a useful tool to help local organizations to develop SBTool-based sustainability evaluation systems.

The SBTool International Methodology is divided in two phases [9]. The first, Evaluation of Project's Implantation Site, concerns the planning phase and supports macro issues related to local context. The second, Evaluation of Project and Building's Performance, refers to design, construction and operation phases and analyses parameters essentially related to local renovation/ regeneration, urban design and infrastructures and other built environment specific issues.

Likewise other assessment tools developed within the scope of the Portuguese context, SBTool_PT-UP is based in the structure of the SBTool international method, which is summarized in table 3.

Table 3. Structure of SBTool International Methodology regarding relevance for Urban Planning Operations (UPO) [10].

Scope	Theme	Number of Categories / Indicators	Relevant Indicators for UPO
Evaluation of Project's Implantation Site	Location, Services and site's characteristics	3/26	6
Evaluation of Project and Building's Performance	Site's Development and Regeneration, Urban Project and Infrastructures	3/35	6
	Resources and Energy Consume	4/16	7
	Environmental Loads	5/25	17
	Indoor Environment Quality	5/19	16
	Service Quality	5/35	29
	Social and Cultural Aspects	3/15	9
	Economic Aspects	1/8	4

3. Methodology Description

3.1. Overview and Objectives

SBTool_PT-UP is applicable to urban planning projects that are not covered inside Urbanization Plans nor Detailed Plans scopes, and may eventually be framed as National Interest Plans (PIN). According to Portuguese laws, Urbanization Plans (PU) define the planning and urbanization policies for a large-scale urban territory [11] Detailed Plans (PP) constitute specific parts of PU's, being subjected to municipal approval and promoted either by private or governmental initiatives [11]. PIN's are projects that, among other objectives, promote positive impacts regarding the local development strategies or contribution to economic dynamics of economically disadvantaged regions [12].

The assessment made by the methodology focuses equally the development of new areas and interventions in existing urban communities, namely urban renovation or regeneration. Certification regards exclusively the project, where two phases are identifiable preliminary projects and detailed projects. The importance of a preliminary evaluation is given by the possibility of establishing the guidelines of sustainable urban areas.

The overall objectives of the sustainability assessment and certification methodology for urban planning concern [4]:

- Improvement of space organization for urban network consolidation;
- Assurance of environment preservation and enhancement of environmental quality of urban entourage;
- Safeguard of the quality of life of urban communities' habitants;
- Fomentation of regional economic competition;
- Promotion of sustainability assessment of the built environment.

3.2. Structure

The general structure of SBTool_PT-UP is based on the hierarchy Dimension > Category > Indicator, as shown in table 5. The methodology presents 41 indicators, distributed among 14 categories within 3 main dimensions. The dimensions, related to the basis of sustainability, divide the categories in a macro scale. Categories, in turn, group indicators according to common issues and may also attend a life cycle analysis. Each one identifies the corresponding stage of life cycle (construction, operation and dismantlement), according to EN 15942. At last, indicators refer to impacts associated to specific aspects inside the respective category scope.

Each indicator assesses the impact of the urban area according to proper calculation methods, associated to individual functional units. The provided score represents an individual performance of the project. Posterior stage consists in comparing the score to the performance of reference urban areas. Such areas apply excellence, recognized practices inside sustainability precepts, and thereby are acknowledged as benchmarks. The comparison is made using figures normalized through the Diaz-Balteiro equation [9], [13], shown in equation (1).

$$\bar{P}_i = \frac{P_i - P_{*i}}{P_i^{*} - P_{*i}} \qquad (1)$$

Where: P_i is the score on the indicator i; P_{*i} and P_i^{*} correspond respectively to results of conventional and best practices for indicator i; $\bar{P}_i$ the normalized result.

Normalization method converts the parameters into a dimensionless scale, ranging from 0 (worst value) to 1 (best value). At last, the normalized result for each parameter is classified from A+ to E, according to the final score

To determine the score correspondent to the total performance, the individual values are summed up through a weighted system, which attributes different importance levels for indicators, categories and dimensions. The assigned weights are shown in table 4.

Table 4. General Assessment Structure of SBTool_PT-UP [4], [10].

Dimension	Weight	Category	Weight		Indicator	Life Cycle Stage [a]	Weight
Environmental	50%	Urban Design	20%	I.1	Passive Solar Planning	U	34%
				I.2	Ventilation Potential	U	33%
				I.3	Urban Network	U	33%
		Use of Land and Infrastructures	15%	I.4	Land Natural aptitude	C; U	26%
				I.5	Flexible uses	C; U	14%
				I.6	Urban soil reutilization	C	23%
				I.7	Built heritage revitalization	C	17%
				I.8	Technical Infrastructure Network	C; U	20%
		Ecology and Biodiversity	20%	I.9	Green Spaces Distribution	U	26%
				I.10	Green Spaces Connectivity	U	29%
				I.11	Autochthone Vegetation	C; U	29%
				I.12	Environmental Governance	U	16%
		Energy	15%	I.13	Energy Efficiency	U	41%
				I.14	Renewable Energy	U	36%
				I.15	Centralized Energy Management	U	23%
		Water	15%	I.16	Potable Water Consume	U	40%
				I.17	Centralized Water Management	U	40%
				I.18	Effluent Management	U	20%
		Materials and Waste	15%	I.19	Material's Impact	C; D	39%
				I.20	Construction and Demolition Waste	C; D	22%
				I.21	Urban Solid Waste Management	U	39%
Social	30%	Exterior Comfort	20%	I.22	Air Quality	U	23%
				I.23	Exterior Thermal Comfort	U	32%
				I.24	Noise Pollution	U	18%
				I.25	Light Pollution	U	27%
		Safety	10%	I.26	Safety in the Streets	U	50%
				I.27	Technological and Natural Risks	U	50%
		Amenities	25%	I.28	Service Proximity	U	37%
				I.29	Leisure Equipment	U	37%
				I.30	Local food production	U	26%
		Mobility	25%	I.31	Public Transportation	U	35%
				I.32	Pedestrian Accessibility	U	30%
				I.33	Cycling Network	U	35%
		Local and Cultural Identity	20%	I.34	Public Spaces	U	42%
				I.35	Heritage Enhancement	C; U	26%
				I.36	Social Inclusion and integration	U	32%
Economic	20%	Employment and Economic Development	100%	I.37	Economic Viability	U	35%
				I.38	Local Economy	U	35%
				I.39	Employment	C; U	30%
Extra Points	5%	Buildings	44%	I.40	Sustainable Buildings	C; U	100%
		Environment	56%	I.41	Environmental Management	C; U; D	100%

[a] C – Construction; U – Use; D – Dismantlement

4. Case Study

To characterize a practical application of the methodology and also demonstrate its performance as assessment tool, the analysis of an urban planning development is proposed as case study. The selected plan is Vila Lago Monsaraz Golf & Nautic Resort, which involves a land transformation for the purposes of touristic development.

Vila Lago Monsaraz Golf & Nautic Resort is a Detailed Plan (PP), also characterized as a National Interest Plan, located at the margins of Alqueva Dam, within Gagos and Xerez homesteads, at the Portuguese district of Monsaraz. Total investments involve about 170 million euros in a 15- year horizon, an area of 371,5 ha, 623 units related to hotel, touristic and commerce facilities and the creation of 700 job positions [14].

Placed inside a well-marked cultural landscape, the Alentejo region, the plan establishes the pre-requisites for a touristic intervention that aims natural, cultural and landscaped enhancement coupled with enjoyment of future users. These are important aspects to environmental and territorial valorization and the remarkable presence of water bodies improves the site's scenery features. The project has been positively distinguished by third-parties Portuguese entities as the promoted sustainable practices overcome the standard practice in the country. Strategies related to local water management, use of local and recycled materials, solar orientation of the buildings (majorly North/South), vegetation as passive-shading components, and safe pedestrian pathways are the principal responsible for the good environmental performance.

Construction works had started in 2009 and when this analysis was made (2014) only technical infrastructure networks where completed. Thereby, the evaluation is focused exclusively on the project proposal. Table 5 presents the detailed scores and results.

Table 5. Final results for case study assessment [14].

	Indicator	Score	Classification
I-1	Passive Solar Planning	0,45	B
I-2	Ventilation Potential	1,00	A
I-3	Urban Network	-0,74	E
I-4	Land Natural aptitude	1,00	A
I-5	Flexible uses	0,24	C
I-6	Urban soil reutilization	0,00	D
I-7	Built heritage revitalization	0,00	D
I-8	Technical Infrastructure Network	0,00	D
I-9	Green Spaces Distribution	0,32	C
I-10	Green Spaces Connectivity	1,00	A
I-11	Autochthone Vegetation	1,00	A
I-12	Environmental Governance	0,00	D
I-13	Energy Efficiency	1,00	A
I-14	Renewable Energy	0,20	C
I-15	Centralized Energy Management	0,53	B
I-16	Potable Water Consume	0,30	C
I-17	Centralized Water Management	0,96	A
I-18	Effluent Management	0,00	D
I-19	Material's Impact	1,00	A
I-20	Construction and Demolition Waste	0,58	B
I-21	Urban Solid Waste Management	0,00	D
I-22	Air Quality	1,00	A
I-23	Exterior Thermal Comfort	0,37	C

I-24	Noise Pollution	1,00	A
I-25	Light Pollution	0,42	B
I-26	Safety in the Streets	0,57	B
I-27	Technological and Natural Risks	0,33	C
I-28	Service Proximity	0,01	D
I-29	Passive Solar Planning	0,02	D
I-30	Ventilation Potential	0,08	D
I-31	Urban Network	-0,20	E
I-32	Land Natural aptitude	0,53	B
I-33	Flexible uses	0,29	C
I-34	Urban soil reutilization	28,69	A+
I-35	Built heritage revitalization	0,78	A
I-36	Technical Infrastructure Network	0,09	D
I-37	Green Spaces Distribution	0,22	C
I-38	Green Spaces Connectivity	0,15	C
I-39	Autochthone Vegetation	0,45	B
I-40	Environmental Governance	0,63	B
I-41	Energy Efficiency	0,00	D
Total			B

5. Final Remarks

In the face of contemporary cities' needs, adopting sustainable guidelines in the development of urban management models is a verified new international trend. Nevertheless, many project designers are still unaware of this reality, which justifies investments on instruments for assessing and guiding urban areas towards sustainable performances.

In this ambit, assessment and certification tools stand out as suitable mechanisms for comparing practices adopted by existing proposals. SBTool Portuguese methodology for urban planning is pointed out as an adaptation of SBTool international method, as it modifies both the scale and scope of assessments. This conceptual change boosts its application and improves sustainability features for the built environment by defining sustainable parameters and comparing different solutions.

The results of a case study assessment showed that, although still under development and subjected to validation by iiSBE Portugal association, SBTool_PT-UP is a suitable method for evaluation of urban planning developments. The tool demonstrated a holistic approach in the sustainability assessment and allowed a good perception of project's performance at impact categories level.

References

[1] Bragança, L., Araújo, C., Castanheira, G., Barbosa, J.A., Oliveira, P., "Approaching sustainability in the built environment" in *International Conference SB13 Seoul - Sustainable Building Telegram Toward Global Society*, 2013, pp. 17–25.

[2] J. A. Barbosa, L. Bragança and R. Mateus, "Assessment of Land Use Efficiency Using BSA Tools: Development of a New Index" *J. Urban Plan. Dev.*, vol. 141, no. 2, 2014.

[3] R. Mateus and L. Bragança, "Sustainability assessment and rating of buildings: Developing the methodology SBToolPT-H" *Build. Environ.*, vol. 46, no. 10, pp. 1962–1971, 2011.

[4] Ecochoice & LFTC UMinho, "SBTool PT: Metodologia para Planeamento Urbano - Relatório de desenvolvimento" 2013.

[5] BRE, "The Case for BREEAM Communities. BREEAM-UK" 2014.

[6] BRE, "Breeam Communities Technical Manual SD202 -1.0:2012" 2014. [Online]. Available: http://www.breeam.com/communitiesmanual/#_frontmatter/breeam_communities.htm%3FTocPath%3D_____1. [Accessed: 16-Nov-2015].

[7] USGB, “Getting to know LEED: Neighborhood Development,” 2014. [Online]. Available: http://www.usgbc.org/articles/getting-know-leed-neighborhood-development. [Accessed: 13-Nov-2015].
[8] USGB, “LEED v 4 for NEIGHBORHOOD DEVELOPMENT” 2014.
[9] L. Bragança and R. Mateus, “Guia de Avaliação SBTool PT H v2009/1” 2009.
[10] iiSBE, “SB Method and SBTool for 2015 - Overview” 2015.
[11] Portugal, *Decreto-Lei nº 316/2007*. 2007.
[12] Portugal, *Decreto-Lei nº 76/2011*. 2011.
[13] iiSBE, “International Initiative for a Sustainable Built Environment” 2009. [Online]. Available: http://www.iisbe.org/. [Accessed: 13-Nov-2015].
[14] Ecochoice & LFTC UMinho, “Relatório Técnico Científico Final - SBTool PT-STP – Ferramenta para a avaliação e certificação da sustentabilidade da construção” 2014.