Sustainable Cities and Society 18 (2015) 32–43

Contents lists available at ScienceDirect

Sustainable Cities and Society

journal homepage: www.elsevier.com/locate/scs

A need for balanced approach to neighborhood sustainability assessments: A critical review and analysis

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ARTICLE INFO

Article history:
Available online 28 May 2015

Keywords:
Neighborhood sustainability assessment
Pillars of sustainability
Livable city

ABSTRACT

With over 70% of the world population projected to live in urban areas by 2030, the role of cities in sustainable development is gaining greater momentum. Creating healthy and livable communities have become a priority in many regions, giving birth to several neighborhood sustainability assessment tools. Yet, these tools largely fail to consider and integrate the four pillars of sustainability namely, environmental, social, economic, and institutional dimensions in a balanced, equitable manner. Without a detailed analysis of the most recent versions of widely used NSA tools, the impact of these tools toward sustainability may be inaccurately measured and reported. Besides, it is crucial to understand the various credits implemented and/or ignored by stakeholders using such tools. With a balanced approach in mind, this paper examines five NSA tools and addresses four objectives namely, (1) to fill the gap in current literature by using the most up-to-date versions of NSA tools in the analysis; (2) to examine the current rating systems' ability to define the goals of sustainability and to measure their progress; (3) to identify which sustainability criteria are applied most frequently by stakeholders and which ones are ignored; and (4) to offer timely and imminent issues relevant to current NSA tools. The first three objectives listed above are dealt with using actual projects implemented, i.e., data from 115 projects, one of the largest dataset used in any study at this time. Using the results from the analysis, this paper concludes with a series of recommendations for a balanced approach to NSA.

1. Introduction

The concept of sustainability dates back to 1970s. Since the publication of the Brundtland (1987) report "*Our common future*", the terms "sustainability" and "sustainable development" have been widely embraced by public and private sectors of our society. Since then, there has been much debate about the definition of these terms (Gibson, 2006) with the emergence of a plethora of competing definitions for sustainability (Hopwood, Mellor, & O'Brien, 2005; Robinson, 2004). New definitions are introduced endlessly, sometimes obscuring the concept altogether (Berardi, 2013). This lack of consensus on the definition of sustainability has been attributed to its ambiguous and complex meaning (Doughty & Hammond, 2004; Evans & Jones, 2008), as it may mean different things to different organizations or stakeholders. Although this vagueness might seem negative, Robinson (2004) noted this is a constructive ambiguity as leaving this key definition undefined and open would be beneficial in reaching the best result. In essence, if the definition of sustainability is vague, so will be its assessment (Berardi, 2013). The significance of the definition of sustainability cannot be understated especially as they directly impact the indicators of sustainability and, therefore, the projects themselves.

Nevertheless, there is a broad consensus on the concept of sustainability with "environmental," "social," and "economic" dimensions, which are referred to as the three pillars of sustainability (Elkington, 1997). Whereas environmental sustainability relates to making decisions with the intent of protecting the natural environment, social sustainability is about actively supporting the capacity of current and future generations to create healthy and livable community by promoting equity, diversity, livability, democracy, etc. Economic sustainability refers to using resources wisely, efficiently, and responsibly for long-term benefits. Needless to say, there is a growing desire to consider "institutional" dimension, i.e., those that

Abbreviations: LEED, leadership in energy and environmental design; BREEAM, building research establishment environmental assessment methodology; DGNB, Deutsche Gesellschaft für Nachhaltiges Bauen (German Sustainable Building Council); CASBEE, comprehensive assessment system for built environment efficiency; USGBC, U.S. Green Building Council; NSA, neighborhood sustainability assessment.

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http://dx.doi.org/10.1016/j.scs.2015.05.004
2210-6707/

relates to the policies, governing principles and structures, and regulations as the fourth pillar of sustainability (Spangenberg, Pfahl, & Deller, 2002; Valentin & Spangenberg, 2000; Wijngaarden, 2001).

At the outset, the role of cities in sustainable development has become much more prominent for several reasons particularly, with more than half of the world population living in urban areas, and expecting to have this number increased to 72% by 2030 (United Nations Population Fund, 2007), as well as urban sprawl and its detrimental effect on the environment (Jaeger, Bertiller, Schwick, & Kienast, 2010). This recognition is the result of the growing awareness that cities are the pioneering actors in addressing sustainability performance of its buildings and other infrastructure. The concept of sustainable city has gained significant political momentum worldwide (Dempsey, Bramley, Power, & Brown, 2011). As Choguill (2008) noted, cities cannot contribute to overall sustainability unless its built environments are sustainable. It is not a surprise that both planners and policymakers have increasingly come to understand the importance of neighborhoods as the building blocks of cities (Searfoss, 2011) and also recognizing them as nearest environmental, social, and economic level to the citizens in which sustainability can be meaningfully assessed (Berardi, 2013).

1.1. Neighborhood sustainability assessment tools

Having a significant share of total energy consumption and related emissions, buildings and their environment are, among others, the primary focus of sustainability assessment. This has resulted in a variety of building assessments such as building rating systems, certificates, Life Cycle Assessment (LCA) based tools, technical guidelines, assessment frameworks, and checklists (Haapio, 2012). Such assessments are essential to stimulate dynamic and open dialogs and encourage deeper understanding of design and practice (Conte & Monno, 2012). Some of the well-known examples are BREEAM (United Kingdom), LEED (United States), Green Globes (United States), CASBEE (Japan), and DGNB (Germany). There are numerous building-level tools developed by various organizations including government entities worldwide.

However, existing building assessment tools are unable to meaningfully capture the interaction between buildings and their infrastructure. Moreover, they fail to consider and integrate the multiple dimensions of sustainability, particularly social and economic dimensions and may induce the idea that sustainability is achievable "by working at the margins" rather than considering the complex building-urban relationships (Conte & Monno, 2012; Richardson & Cashmore, 2011). These deficiencies emerged as an encouragement for reconsidering the spatial boundary of sustainability assessment, by introducing neighborhoods as a viable scale of assessment within which all pillars of sustainability can be assessed. As a result, NSA tools are increasingly gaining momentum universally. Appendix A lists some of these NSA tools. NSA tools are also referred as urban community assessment tools, district sustainability assessment tools, neighborhood sustainability rating tools, and sustainable community rating tools. In the past few years, as the number of NSA tools started to grow, the number of research publications contrasting the development of such tools and their comparison with actual implementation grew as well.

1.1.1. NSA tool development study

Several studies have investigated the categories and evaluation criteria in NSA tools through comparison, highlighting their strengths and weaknesses, and/or providing recommendations for future improvements. Haapio (2012) analyzed three NSA tools (LEED-ND, BREEAM Communities, and CASBEE-UD) to discuss the current situation of assessment for urban communities. In this study, Haapio emphasized strong linkages between tools and their region and the importance of sharing knowledge and experiences in tool developments. Sharifi and Murayama (2013) conducted a comprehensive review on seven NSA tools (LEED-ND, CASBEE-UD, BREEAM Communities, HQE2R, Ecocity, SCR, and ECC) providing additional insights by introducing a framework for examination of NSA tools. In this study, they criticized the tools for underperforming in the social, economic, and institutional aspects of sustainability. In other words, the environmental aspects were adequately taken care while there is still a lack of an adequate mechanism for local adaptability and participation. Berardi (2013) compared three NSA tools (BREEAM Communities, CASBEE-UD, and LEED-ND) and concluded it is necessary to consider evolution of communities in assessment.

The feasibility of developing global standards for NSA tools was assessed by Sharifi and Murayama (2014b), particularly investigating how NSA tools performed in different contexts. Results showed that identical projects could be rated differently under different NSA tools, which reflects the diversity of opinions about suitable way of addressing sustainability at the neighborhood level. Their study concluded that the use of a global standard is undesirable and suggested creating a database of all relevant criteria and indicators and contextualizing them based on the project.

1.1.2. NSA tools' project implementation study

Garde (2009) surveyed seventy three LEED-ND registered pilot projects in the U.S. to examine the extent to which sustainability criteria were incorporated in different projects and also to understand if there are trends in the planning and design of the projects. Garde tabulated the criteria that were used identifying the most and least used to evaluate the rating systems. Based on the study, Garde recommended planners to consider local and regional conditions as basically complying with LEED-ND alone cannot guarantee a sustainable neighborhood development. As part of their study, Sharifi and Murayama (2014a) analyzed the scorecards of 97 LEED-ND pilot projects and showed the frequency of the criteria used in those projects; it is to be noted that the study results were in sync with those of Garde.

Yet, with the periodic updates to rating systems, both in terms the credits and the requirements for evaluation, the studies discussed previously in this paper may not be applicable for current and future neighborhood progression. Without a detailed analysis of the most-recent versions of widely used NSA tools, the impact of these tools toward sustainability may be inaccurately measured and reported. Besides, it is crucial to understand the various credits implemented and/or ignored by stakeholders using such tools. From the stakeholders' and NSA tool developers' point-of-view, it is crucial to evaluate the tools' adoption of the *four* pillars of sustainability i.e., if they are balanced with equitable weights. It is to be noted that the authors do not suggest equal weights for the balanced approach, i.e., in terms of quantity as a measure, rather an equitable one for sustained neighborhood growth.

Balanced approach toward sustainability must be an inseparable part of sustainability assessment. Balanced approach means to have a balanced structure such a way that the resultant implements the four pillars of sustainability in an equitable manner. Consequently, the sustainability assessment becomes deeper than just simple evaluation. Factors such as time dimension, i.e., performance over time, etc., come into play as well.

With a balanced approach in mind, this paper examines five NSA tools and addresses four objectives namely, (1) to fill the gap in current literature by using the most up-to-date versions of NSA tools in the analysis; (2) to examine the current rating systems' ability to define the goals of sustainability and to measure their progress; (3) to identify which sustainability criteria are applied most frequently by stakeholders and which ones are ignored; and (4) to offer timely and imminent issues relevant to current NSA tools. The first three objectives listed above are dealt with using actual projects implemented, i.e., data from 115 projects, one of the largest dataset used in any study at this time. Since mechanisms for sharing experiences gained from each practice for refining and improving the indicators and procedure among different NSA tools are limited, this analysis can be a means for knowledge sharing and be taken into consideration for future revisions of such tools. Using the results from the analysis, this paper concludes with a series of recommendations for a balanced approach to NSA.

This paper is organized as follows: Section 1 introduces the importance of considering sustainability assessment in neighborhood-scale and previous studies on NSA tools. Section 2 defines sustainability assessment concepts, the importance of indicators in achieving sustainability and the necessary qualities of indicators for a comprehensive and sustainable neighborhood assessment. It furthermore focuses on NSA tools and discusses five widely used assessment tools followed by an in depth analysis. Section 3 discusses the findings of this study on the limitations of NSA tools and recommendations.

2. Assessment of NSA tools' approach toward sustainability

2.1. Indicators versus criteria

Sustainability indicators can lead to better decisions and more effective actions by simplifying, clarifying, and making aggregated information available to stakeholders and policy makers. Indicators help in implementing physical and social science knowledge into the decision-making process, as well as in setting targets, and measuring and calibrating progress toward such targets. They are useful tools to communicate ideas, thoughts and values (Verbruggen & Kuik, 1991). On the other hand, a sustainability criterion is the touchstone by which a sustainability indicator is evaluated (Sahely, Kennedy, & Adams, 2005).

However, a few concerns related to indicators and criteria need further discussion. The first is the manner in which sustainability indicators have been developed and applied in the past (Berardi, 2013). The lack of consensus on neighborhood sustainability indicators among different practices has caused confusion during the process of selecting and relating these indicators to targeted objectives (Legrand, Planche, & Rabia, 2007; Planque & Lazzeri, 2006). Practical challenges in applying these indicators have led to mixed results in different environments and sometimes brought little gain in sustainability performance (Alshuwaikhat & Nkwenti, 2002; Seabrooke, Yeung, Ma, & Li, 2004; Selman, 1999) often obscuring the original intent.

The other concern is related to what the developed indicators measure in relation to actual sustainability. The complex nature of sustainability and complex interrelationships of criteria mandate to avoid considering an indicator in isolation, but rather to consider them based on relative changes in the state of the environment. Several studies have put together extensive lists of sustainability indicators (Foxon et al., 2000; Hellström, Jeppsson, & Kärrman, 2000; Maclaren, 1996).

Moreover, existing literature does not always differentiate between indicators and criteria; these terms are used interchangeably. In the context of neighborhood sustainability, currently available indicators can be identified using a broad brush on the environmental, social, economic, and institutional aspects as,

a) integrating, i.e., reveals and considers linkages among multiple issues;
b) forward-looking, i.e., inter-generational equity;
c) distributional, i.e., intra-generational equity;
d) developed with input from multiple stakeholders, i.e., procedural equity;
e) context-specific, i.e., local contextualization;
f) asset-based, i.e., focusing the analysis on existing assets; and
g) considerate to local values, i.e., progress toward local values.

The multiplicity and complexity of existing NSA tools makes it difficult to critically analyze each tool. For the purpose of this paper, five widely used NSA tools were studied based on two selection criteria: (a) the prominence and successful diffusion of the tool in order to ensure that these NSA tools have been implemented and tested; and (b) the region of origin of the tool so as to be able to use the result of analysis with the regional context in mind. Moreover, ease of access to their manuals has been an effective factor. The selected NSA tools are: LEED-ND used in North America (US); BREEAM Communities, Europe (UK); DGNB-NSQ, Europe (Germany); CASBEE-UD, East Asia (Japan); and Pearl Community for Estidama, West Asia (UAE). Appendix B lists the characteristics of these selected tools.

2.2. In-depth analysis of NSA tools development

Among others, the purpose of a performing an in-depth analysis of the most recent versions of selected NSA tools is to answer lingering questions related to this paper in two phases:

- Tool development phase
  - Who are the stakeholders that were involved in tool development?
  - What categories and criteria were used in each tool?
  - What are the weights assigned to each criterion?
  - How balanced is each tool, i.e., if all pillars of sustainability including institutional dimension were considered for assessment?
  - What are the scoring and certification levels in each NSA tool?
  - What solutions have these tools devised to guarantee the achievement of a certain level of performance in a certified project?
- Tool implementation phase
  - What are the characteristics of certified projects?
  - What criteria have been widely used in these projects?

In this respect, this paper focuses on the analysis in two fronts, namely (a) the development procedure, content, and methodology of NSA tools, i.e., how effective these NSA tools are in aiding developers and other stakeholders to make informed decisions to achieve a balanced approach to sustainability in neighborhoods; and (b) the results of certified projects and how well they match the original goals of NSA tools.

2.2.1. Assessment and discussion #1: NSA tool development

For this analysis, content analysis was used on the manuals of the selected NSA tools. The first question to be answered in NSA tools analysis is about the participating stakeholders in development of each tool. As previously noted, the "procedural equity" in developing neighborhood sustainability indicators necessitates involvement of different stakeholders. NSA tools can be developed from the top (expert-led) or from the bottom (citizen-led) in which citizens are significantly involved in development process. However, to achieve better results in order to secure a comprehensive analysis, an integrative approach may be necessary (Reed, Fraser, & Dougill, 2006). A successful evaluation consists of a discourse between all the stakeholders who are affected by evaluation (Khakee, 1998) such as citizens of the community who can play a key role in helping to convey local values into assessment indicators. Turcu (2013) developed an integrative set of

Table 1
Parties involved in NSA development.

Rating system	Gov	Non-gov	Industry	Academia	Citizens
LEED-ND	–	√	–	–	–
BREEAM Communities	–	√	–	–	–
DGNB-NSQ	–	√	√	–	–
CASBEE-UD	√	–	√	√	–
Pearl Community for Estidama	√	–	–	–	–

indicators for urban sustainability but concluded people tend to assign unequal importance for individual indicates and sustainability indicators are not isolated information. Through literature, Sharifi and Murayama (2013) identified three stages in which citizens can be involved: (i) defining sustainability goals and core criteria which can facilitate mutual understanding (Seltzer, Smith, Cortright, Bassett, & Shandas, 2010); (ii) assigning weights to different criteria to have a consensus-based weighting process which can help improving the assessment process (Alwaer, Sibley, & Lewis, 2008; Bauler et al., 2012; Koellner, Weber, Fenchel, & Scholz, 2005); and (iii) giving feedback for revisions for future improvements.

None of the five NSA tools selected for this study included a comprehensive set of stakeholders in their development procedure. As shown in Table 1, CASBEE-UD is a consensus-based tool that included members from government, industry, and academia (CASBEE Manual). In case of other four tools, development is limited to only expert committees. However, NSA tools try to collect the feedback and consider them for the revision of their tool. For example, LEED-ND received feedback on early drafts of the LEED-ND 2009 through two public comment periods (Lambert, 2010).

Categories and criteria are one the most debated parts of NSA tools. The performance of NSA tools against principles of "integrity" and "intra-generational equity" is investigated through their categories and criteria they used for assessment. The lack of consensus on definition of sustainability causes a variety of options leading toward achieving sustainability. For NSA tools, this translates into different sustainability coverage by different tools. Sustainability coverage relates to how comprehensive sustainability is assessed from all aspects. This difference in coverage can be studied through the categories and their criteria in each tool. Although it is difficult to categorize sustainability issues definitively, as they frequently impact all dimensions of sustainability, all of the studied rating systems have divided their assessment based on number of categories. By assigning categories, the NSA tools seek to provide some clarity about the intention of each issue. In other tools, there are similarities and significant differences in categories (Sharifi & Murayama, 2014a). Since the objective of this study is to assess different tools, with categories of different coverage and scope, it was decided to define new categories or a "re-categorization" process. Re-categorizing is crucial for preforming an effective comparative analysis between these tools. Table 2 shows previous studies that have used re-categorization for comparing different NSA tools.

Through re-categorization, the content analysis was used to attribute criteria in each NSA tool to one of the new categories. Considering each criterion may only be assigned to one category, grouping criteria into new categories proved to be challenging particularly in cases where the tool criteria may belong to multiple categories. For example, LEED-ND v4 manual demonstrates all of its criteria are attributed to multiple categories. Studying each criteria description, the authors did their best effort to ensure each criterion is attributed to its most significantly relevant category. Table 3 shows the percentage of maximum points after applying weighting factors available for each category in the five selected NSA tools. It is evident that different tools have dissimilar emphases. Figs. 1 and 2 show the distribution of credits/points in various categories for all five NSA tools. Per Table 3 and Figs. 1 and 2, all tools are inclined toward the following categories: "Environment, Ecology and Resource Efficiency" and "Infrastructure, Design and Innovation." Institutional category is the least emphasized category. Institutional sustainability includes not only organizations, but also mechanisms and orientations; it refers to human interaction and the rules by which they are guided (Valentin & Spangenberg, 2000).

Comparing with the results of previous studies, some positive trends regarding inclusion of institutional criteria is noticeable. The latest versions of BREEAM-Community and DGNB-NSQ have both included criteria which primarily fall into institutional sustainability. However, LEED-ND has not assigned any points for assessing projects based on institutional sustainability. Table 4 sheds more light on areas of emphasis in each tool and helps better understand their possible linkage to national priorities and regional challenges. As Haapio (2012) noted, NSA tools depend on national bibliography, recommendations, and standards with strong connection to national regulations, building codes, cultural heritage, way of living, and building culture.

2.2.1.1. Location and site selection. All tools except CASBEE have included certain criteria to the *Location and Site Selection.* However, the weight assigned to this category is very different. Location has high priority in LEED-ND (18%) while other tools dedicated much fewer points for it (4% or less). This can be explained by the fact that concerns over sprawl is more severe in the U.S. than other countries. However, it is argued that this makes certification relatively easy for well-located projects (Garde, 2009).

2.2.1.2. Water efficiency. Water efficiency is another criterion which helps demonstrating national and regional challenges are strong factors in distribution of points among the NSA tools. Water-related credits are fairly similar among all tools (2% to 4%) except for Pearl Community (23%). The reason for this significant emphasis can be explained by scarcity of potable water resources in U.A.E. and the Middle East region.

Table 2
Categorization in different studies.

Categories	Haapio (2012)	Sharifi and Murayama (2013)	Berardi (2013)
Location and site selection	√	√	√
Transportation	√	√	√
Infrastructure, design & innovation	*	*	–
Environment, ecology and resource efficiency	√	√	√
Sociocultural quality	–	√	–
Economic quality	√	√	√
Institutional	–	–	–
Categories excluded from this study or considered within another category	Well-being	Pattern & design	1) Sustainable land 2) Well-being

√: category included; *: category partially included; –: category not included.

Table 3
Percentage of each category in different tools.

Category	LEED-ND	BREEAM-Communities	DGNB-NSQ	CASBEE-UD	Pearl Community
Infrastructure, design & innovation	39%	14%	31%	30%	26%
Transportation	6%	11%	9%	7%	4%
Location and site selection	18%	4%	3%	0%	2%
Environment, ecology and resource efficiency	15%	31%	24%	42%	61%
Sociocultural quality	17%	16%	12%	19%	6%
Economic quality	5%	15%	15%	1%	0%
Institutional	0%	9%	6%	1%	1%
	100%	100%	100%	100%	100%

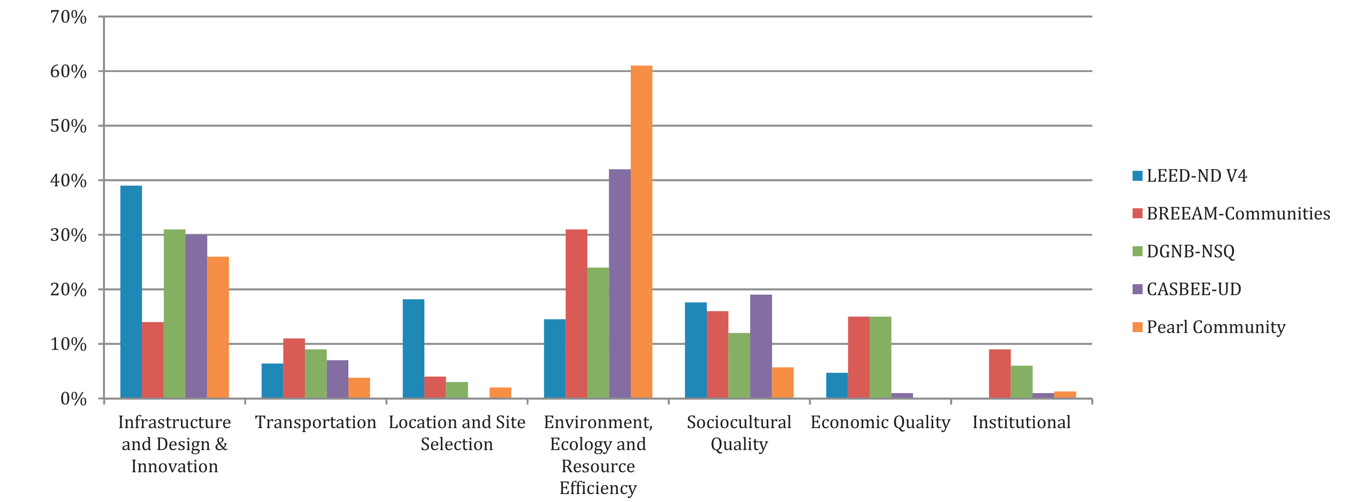

Fig. 1. The distribution of weighted points in different NSA tools.

More importantly, Figs. 1 and 2, without doubt, illustrate the lack of a balanced approach in the studied NSA tools. This may be partially due to the fact that many criteria could be related to multiple categories. But in this study, each criterion is attributed exclusively to the primary category to which it belongs. Take the example of bike lanes that is considered in Transportation, yet can also be attributed to Social Quality (health and wellbeing of the residents) and Environment, Ecology and Resource Efficiency.

2.2.1.3. Scoring and certification levels. Table 5 demonstrates certification levels and process in each tool. Although the studied rating systems use hierarchy to award superior recognition to developments which achieve more credit points, each tool uses a different method of scoring and different threshold for certification levels. The subjectivity in scoring and certification levels makes it hard for comparison of certified projects from different tools.

2.2.1.4. Mandatory requirements. For NSA tools, it is important to ensure a project meets certain minimum performance to get certified. Although there is no consensus among NSA tools for achieving this goal, inclusion of mandatory (or prerequisite) criteria is the most common mechanism among NSA tools to ensure the project

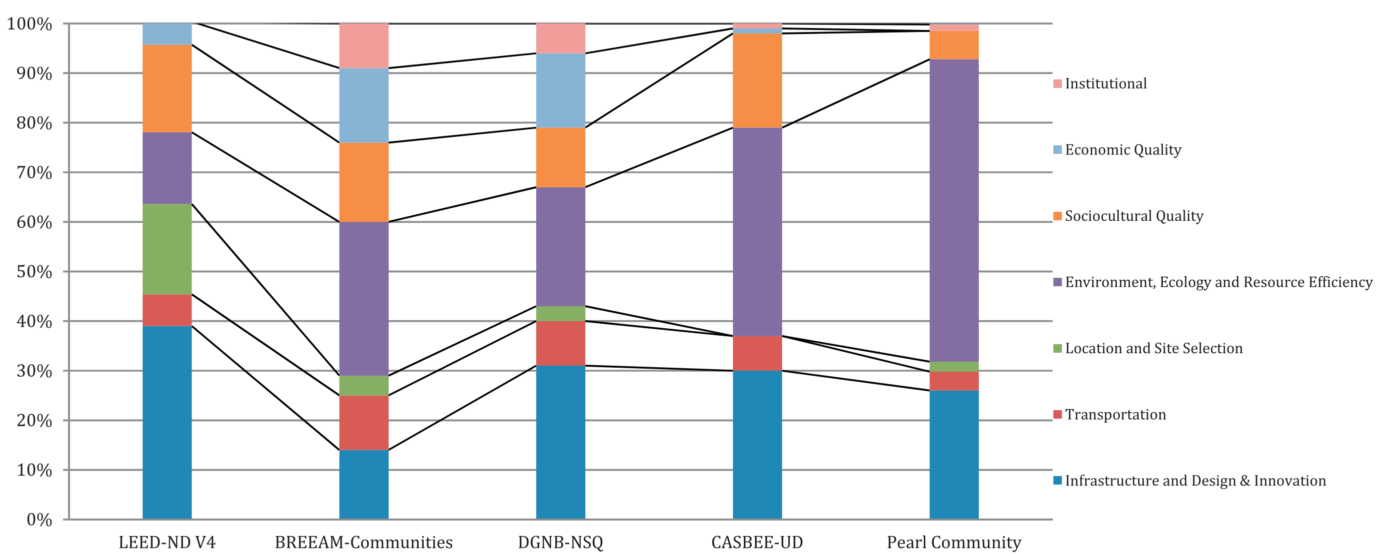

Fig. 2. Comparison of NSA tools' categories.

Table 4
Breaking down categories based on indicators.

Category	Criteria	LEED-ND	BREEAM-Communities	DGNB-NSQ	CASBEE-UD	Pearl Community
Location and site selection		18%	4%	3%	0%	1%
Transportation	Connectivity to public transportation, Connectivity to bike lane, Pedestrian-friendliness, Private car, Parking, etc.	6%	11%	9%	7%	4%
Infrastructure and design	Design principles, mixed use, compact development, green infrastructures, heat island	34%	14%	31%	30%	25%
	Innovation	5%	0%	0%	0%	1%
Environment, ecology and resource efficiency	Water	3%	4%	2%	4%	23%
	Energy	5%	4%	6%	11%	15%
	Materials, resource conservation, waste management,	2%	8%	5%	6%	14%
	Biodiversity, nature and microclimates	5%	15%	11%	21%	9%
Sociocultural quality	Safety, well-being, quality of life, sound emission, affordable housing, inclusive communities, social networks and infrastructure, heritage	17%	16%	12%	19%	6%
Economic quality	Local economy, employment and local jobs, business, investments	5%	15%	15%	1%	0%
Institutional		0%	9%	6%	1%	1%

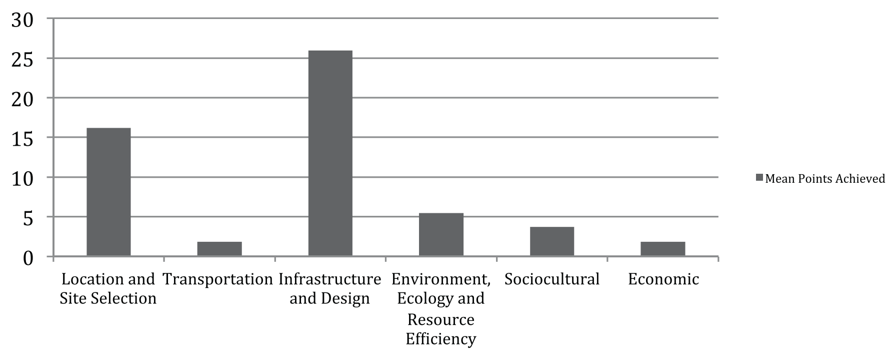

Fig. 3. The average of points achieved by LEED-ND 2009 certified projects in defined categories.

Table 5
Scoring and certification levels of NSA tools.

NSA Tool	LEED-ND	BREEAM Communities	DGNB-NSQ	CASBEE-UD	PEARL Community
Minimum level for certification	Certified: meeting all pre-requisites + achieving 40 points	Pass: achieving 30% of points	Bronze: total performance index >50% and minimum performance index >35%	Poor (C): BEE <0.5	1 Pearl: meeting all mandatory criteria
Certification levels	(40–49) Certified, (50–59) Silver, (60–79) Gold, (80+) Platinum	Score %: (<30) unclassified (30–45): Pass (45–55): Good (55–70): Very Good (70–85): Excellent (85<): Outstanding	Certified: total performance index >35% Bronze: total >50% & minimum 35% Silver: total >65 & minimum >50% Gold: total >80% & minimum >65%	S: Excellent BEE => 3.0, A: Very Good BEE 1.5–3.0, B+: Good BEE 1.0–1.5, B– Fairly Poor BEE 0.5–1.0, C Poor BEE <0.5	1 Pearl: all mandatory credits, 2 Pearl: 55+ credit points, 3 Pearl: 75+ credit points, 4 Pearl: 100+ credit points, 5 Pearl: 125+ credit points

Table 6
Inclusion of mandatory credits in percentage.

<table>
<tr><th>NSA Tool</th><th>LEED-ND</th><th>BREEAM Communities</th><th>DGNB-NSQ</th><th>CASBEE-UD</th><th>PEARL Community</th></tr>
<tr><td></td><td></td><td></td><td><table><tr><td>Total Performance Index</td><td>Minimum Performance Index</td><td>Awards</td></tr><tr><td>From 35%</td><td>-%</td><td>Certified</td></tr><tr><td>From 50%</td><td>From 35%</td><td>Bronze</td></tr><tr><td>From 65%</td><td>From 50%</td><td>Silver</td></tr><tr><td>From 80%</td><td>From 65%</td><td>Gold</td></tr></table></td><td></td><td></td></tr>
<tr><td>Mandatory</td><td>21%</td><td>23%</td><td>0%</td><td>0%</td><td>30%</td></tr>
<tr><td>Optional</td><td>79%</td><td>77%</td><td>100%</td><td>100%</td><td>69%</td></tr>
</table>

achieves a certain minimum in each category. In this case, the project will not be certified unless it meets all the mandatory criteria. Table 6 presents the inclusion of mandatory criteria in each rating system. LEED-ND, Pearl Community, and BREEAM Communities have adopted to include mandatory criteria. Contrary to LEED-ND and Pearl Community, BREEAM Communities allocate points to mandatory criteria. CASBEE-UD does not have any mandatory criteria. Not having any mechanism for ensuring certain minimum performance can be a point of concern since a development might acquire sustainability brand without adequately addressing all the dimensions of sustainability. DGNB-NSQ uses a different approach to assure minimum performance. As discussed earlier, DGNB-NSQ aims to promote a uniform quality standard by mandating a certain minimum points in each category for achieving certification. DGNB's approach is unique among all rating systems considered in this study.

Although NSA tools may seem to have a rigorous procedure for project evaluation on paper, yet it is to be noted that these tools are purely voluntary and their implementation has no legal basis, i.e., the results from completed project may not be as what it was originally accepted during certification. Moreover, there is a concern over use of these tools as marketing tools by developers who want to their project secure market recognition through these "green" certifications. Since achieving certification helps market recognitions, obtaining certification can become a sole marketing-driven decision and developers might embark into a "point-chasing" game. Ignoring the original intent of these tools, developers may target and implement easy and inexpensive criteria or those with large number of points.

In order to study how these challenges might affect the certified projects and how frequent they are implemented, the scorecards of 115 LEED-ND projects were used for further investigation. To the best of the knowledge of the authors, to-date, this is by far the largest dataset of project implementation and the most current versions of NSA tools assessed. These projects are then grouped into two datasets: dataset #1 consists of 95 LEED-ND pilot certified projects and dataset #2 includes 20 LEED-ND 2009 certified projects. LEED-ND was chosen because among all NSA tools, LEED-ND has been more successful in gaining better recognition among developers and authorities, resulting significantly higher number of projects, which utilized it. This success can be directly related to the collaborative effort of LEED-ND's developing organizations, Department of Housing and Urban Development (HUD) and U.S. Environmental Protection Agency (EPA) to help the utilization of the tool.

2.2.2. Assessment and discussion #2: NSA tool implementation results

This section discusses the result of implemented projects, that is, those projects which have received certification. Tables 7 and 8 show the percentage of projects that received points in any criterion, the mean and standard deviation of the points for each criterion (Fig. 3).

The results corroborate the fact that heavier weighted criteria are generally more appealing for developers to achieve; the same result was concluded in previous studies (Garde, 2009; Sharifi & Murayama, 2014a). In case of dataset #1, preferred locations, reduced automobile dependence, walkable street and compact development have respectively 10, 8, 8, 7 points and 98%, 91%, 71% and 95% of projects have collected points from them. In case of dataset #2, walkable streets, preferred locations, locations with reduced automobile dependence and mixed-income diverse communities have respectively 12, 10, 7, 7 points and 100%, 100%, 94% and 72% of projects have received points from them. Out of 115 studied certified projects, 17 projects (%15 of total) just achieved 40 or 41 points (the lowest minimum points for certification), which can be the case for using certification only for market-driven intentions.

Analysis showed several certified projects met only few criteria in green construction and technology (which corresponds to green infrastructure and building in dataset #2) category while achieved certification through location-based criteria. Although location is important in sustainability assessment but NSA tools should not let projects receive certification by collecting solely location-based points (or any other category) as this would not actualize the stated goal of NSA tools (Garde, 2009). The table also revealed the lack of attention to important criteria such as on-site energy generation, solar orientation and district heating a cooling; out of 19 criteria in this category only seven criteria have been met by 50% of the certified projects which suggests lack of rigorous consideration of this category.

3. Toward a balanced approach to NSA tools

As we analyzed five widely used NSA tools in this study, it became clear that they generally follow similar goals but use different approaches. They have similar categories; however, distribution of criteria addressed in each category varies. The purpose of this study is not to solely focus on the weaknesses of these tools, but to identify their strengths and to identify the need for a balanced approach to NSA tool development. NSA tools have contributed to increasing the environmental awareness among the actors involved. They also help sharing criteria and objectives of sustainability among professionals, for which these tools are a method and framework of reference for evaluating their projects. Moreover, they guide toward better practices, if not the best practice, and can facilitate legal and political agenda in some cases; and improve the market demand and supply (Reed, Wilkinson, Bilos, & Schulte, 2011). In this sense, it is clear these tools are increasingly promoting sustainable design (Mateus & Bragança, 2011) and practices (Conte & Monno, 2012). However, it is also important to consistently attempt to improve theses assessment tools based on previous experiences and results. Based on this study, the following are some of the suggested features of a balanced NSA tool.

3.1. Unwavering focus on four pillars of sustainability

Although the criteria to reduce environmental impact of the project are necessary in contributing to overall sustainability, it is essential to consider all aspects of sustainability in an equitable manner. Fig. 2 demonstrated that the NSA tools analyzed for this study, like their parent building-level assessment tools, focus more on the environmental aspect by assigning a greater percentage of points, thus raising concern over adoption of a physical/material-based approach to sustainability. A sustainable neighborhood should promote healthy social life and relationships as well as bolstering local economy, production and economic power, i.e.,. from household level to community and city level. Criteria such as affordable housing, safe and inclusive community, integral policies, and local economy and job are still not adequately considered; achieving intra-generational equity necessitates addressing socio-economic criteria. This unbalanced focus has been attributed to lack of equal knowledge on how to measure social, economic, and institutional sustainability (compared to environmental sustainability), and limited knowledge on conceptualization of both sustainability (Pope, Annandale, & Morrison-Saunders, 2004) and sustainable assessment (Lawrence, 1997).

Beyond the common goal of measuring sustainability of projects, these NSA tools and their performance indicators are an assertion of a certain interpretation of sustainability, and hence, the

Table 7
Result of LEED-ND pilot projects.

LEED-ND Pilot	Criteria	Possible available points	Percent of projects received any points	Mean	SD
Smart location and linkages	Preferred location	10	97.89%	7.65	1.80
	Reduced automobile dependence	8	90.53%	4.63	2.50
	Housing and jobs proximity	3	85.26%	2.54	1.08
	School proximity	1	73.68%	0.74	0.44
	Steep slope protection	1	65.26%	0.65	0.48
	Brownfield redevelopment	2	58.95%	1.18	0.99
	Bicycle network	1	47.37%	0.47	0.50
	Site design for habitat or wetland conservation	1	31.58%	0.32	0.47
	High priority brownfields redevelopment	1	28.42%	0.28	0.45
	Conservation management of habitat or wetlands	1	14.74%	0.15	0.36
	Restoration of habitat or wetlands	1	9.47%	0.09	0.29
Neighborhood pattern and design	Compact development	7	94.74%	4.11	2.38
	Diversity of uses	4	93.68%	3.37	1.20
	Street network	2	85.26%	1.44	0.74
	Diversity of housing types	3	73.68%	1.88	1.26
	Reduced parking footprint	2	71.58%	1.43	0.91
	Access to active spaces	1	71.58%	0.72	0.45
	Walkable streets	8	70.53%	3.97	2.79
	Community outreach and involvement	1	69.47%	0.69	0.46
	Access to public spaces	1	67.37%	0.67	0.47
	Access to surrounding vicinity	1	64.21%	0.64	0.48
	Transit facilities	1	48.42%	0.48	0.50
	Affordable rental housing	2	40.00%	0.63	0.84
	Universal accessibility	1	32.63%	0.33	0.47
	Affordable for-sale housing	2	31.58%	0.47	0.76
	Transportation demand management	2	26.32%	0.29	0.52
	Local food production	1	12.63%	0.13	0.33
Green construction and technology	Minimize site disturbance during construction	1	90.53%	0.91	0.29
	Minimize site disturbance thru site design	1	88.42%	0.88	0.32
	Construction waste management	1	77.89%	0.78	0.42
	Reduced water use	3	70.53%	1.51	1.17
	Comprehensive waste management	1	70.53%	0.71	0.46
	Heat island	1	68.42%	0.68	0.47
	Stormwater management	5	58.95%	1.99	2.04
	Energy efficiency in buildings	3	47.37%	1.20	1.35
	LEED certified green buildings	3	43.16%	1.08	1.36
	Infrastructure energy efficiency	1	42.11%	0.42	0.50
	Recycled content in infrastructure	1	41.05%	0.41	0.49
	Building reuse and adaptive reuse	2	34.74%	0.56	0.82
	Light pollution	1	31.58%	0.32	0.47
	Reuse of historic buildings	1	22.11%	0.22	0.42
	Contaminant reduction in brownfields remediation	1	18.95%	0.23	0.63
	On-site energy generation	1	16.84%	0.17	0.38
	On-site renewable energy sources	1	15.79%	0.16	0.37
	Solar orientation	1	8.42%	0.08	0.28
	Wastewater management	1	7.37%	0.07	0.26
	District heating and cooling	1	6.32%	0.06	0.24

results of evaluation of project sustainability is affected depending on the vision implicit in the tool (Reed, Bilos, Wilkinson, & Schulte, 2009). The difference in vision causes consideration of different indicators and area of evaluation, and assigning different weightings to the same indicator. This is due to the subjective nature of sustainability; NSA tools are facing ambiguity in indicator selection and weighting. Using fuzzy techniques (Sharifi & Murayama, 2013) in assigning points may potentially help mitigating the effect of sustainability subjectivity.

Moreover, NSA tools do not include a wide array of stakeholders in developing the tools. A more balanced approach toward different aspects of sustainability in some NSA tools can be attributed to their comprehensive array of stakeholders. Including the parties that are affected by the evaluation can help unraveling human relationships within the community and facilitate entwining objective and subjective factors (Scerri & James, 2010). The results of this study indicated current NSA tools are mostly expert-led, i.e., top-heavy, and have failed to include all stakeholders, which might have different priorities and concerns both in criteria selection and their weightages. Specially, inclusion of citizens' opinion in assessment process is another field for improvement in current NSA tools. According to Berardi (2013), research studies have shown citizen-based systems are more successful in measuring community activity, individual happiness, satisfaction with local area and perception of community spirit (Hardi & Zdan, 1997; Morse & Fraser, 2005).

3.2. *Focus on local context*

By definition, sustainability calls for applying an integrative approach by taking into account various factors, their relationships, and interdependencies. As Conte and Monno (2012) noted "context is the most influential element of the assessment, and it must be intended in a large, comprehensive way, by disaggregating physical aspects – like geography, climate, etc. – and non-physical aspects – like legislation, local habits, etc., all in one culture – of a place." Local adaptability, sensitivity to the context, development type, and regional priorities are necessary for achieving an "asset-based", and "considerate to local values" assessment. Currently, NSA tools have considered regional context in a limited fashion and it is necessary

Table 8
LEED-ND 2009 projects results.

LEED-ND 2009	Criteria	Possible available points	Percent of projects received any points	Mean	SD
Smart location and linkages	Preferred locations	10	100.00%	7.94	2.18
	Locations with reduced automobile dependence	7	94.44%	6.50	1.65
	Site design for habitat or wetland and water body conservation	1	88.89%	0.89	0.32
	Housing and jobs proximity	3	77.78%	1.89	1.23
	Steep slope protection	1	77.78%	0.78	0.43
	Brownfields redevelopment	2	55.56%	1.00	0.97
	Bicycle network and storage	1	33.33%	0.33	0.49
	Long-term conservation management of habitat or wetlands and water bodies	1	22.22%	0.22	0.43
	Restoration of habitat or wetlands and water bodies	1	0.00%	0.00	0.00
Neighborhood pattern and design	Walkable streets	12	100.00%	6.00	3.05
	Compact development	6	100.00%	4.61	1.69
	Access to civic and public spaces	1	94.44%	0.94	0.24
	Access to recreation facilities	1	83.33%	0.83	0.38
	Mixed-use neighborhood centers	4	83.33%	2.33	1.53
	Tree-lined and shaded streets	2	77.78%	1.56	0.86
	Mixed-income diverse communities	7	72.22%	4.22	3.04
	Neighborhood schools	1	66.67%	0.67	0.49
	Transit facilities	1	55.56%	0.56	0.51
	Visibility and universal design	1	50.00%	0.50	0.51
	Community outreach and involvement	2	50.00%	1.00	1.03
	Local food production	1	50.00%	0.50	0.51
	Reduced parking footprint	1	27.78%	0.28	0.46
	Street network	2	27.78%	0.44	0.78
	Transportation demand management	2	22.22%	0.22	0.43
Green infrastructure and building	Infrastructure energy efficiency	1	83.33%	0.83	0.38
	Solid waste management infrastructure	1	77.78%	0.78	0.43
	Certified green buildings	5	72.22%	3.11	2.25
	Water efficient landscaping	1	72.22%	0.72	0.46
	Heat island	1	66.67%	0.67	0.49
	Building water efficiency	1	55.56%	0.56	0.51
	Building energy efficiency	2	50.00%	0.78	0.88
	Recycled content in infrastructures	1	38.89%	0.39	0.50
	Stormwater management	4	38.89%	1.56	2.01
	Historic resource preservation and adaptive use	1	27.78%	0.28	0.46
	Minimized site disturbance in design and construction	1	27.78%	0.28	0.46
	Solar orientation	1	16.67%	0.17	0.38
	Existing building reuse	1	16.67%	0.17	0.38
	On-site renewable energy sources	3	11.11%	0.28	0.83
	Wastewater management	2	11.11%	0.11	0.32
	Light pollution reduction	1	11.11%	0.11	0.32
	District heating and cooling	2	5.56%	0.11	0.47
Regional priority credits	All	4	72.22%	2.00	1.61

to put more emphasis on context of the project through creating a more regionally flexible assessment program.

3.3. Focus on cross-scale relationships

NSA tools, rarely consider the sustainability of building in relation to the complex social and ecological functioning of the built environment. Although they focus on the environmental impacts produced by buildings, as well as on infrastructures and people behaviors, they do not consider key relationships, which actually reciprocally connect the building to the complex functioning of the built environment. The assessment can be improved by understanding the connections between sustainability in building level, neighborhood level, and city and regional level.

3.4. Focus on intergenerational aspect of sustainability

One of the important factors in sustainability is that it cannot be limited to a certain time dimension. By definition, sustainability is about the present and future generations. Consequently, it is important for a successful assessment to adopt an intergenerational approach. Changes in demographics, climate, resources, and economy are part of every community's life and any assessment tool must be able to consider these changes. Hence it is necessary for the NSA tools to have a lifetime approach toward projects. Current NSA tools have not paid enough attention to the dimension of time in their assessment. Some tools have broken down their certification process in separate stages from design to development and completion stage, but their assessment abruptly ends as the project becomes operational. However, this might change soon as some tools already stated to take operational phase of project into consideration. For example Pearl Community grants the last stage of its certification after a minimum of two years after construction completion and when the buildings have reached a minimum of 80% occupancy. Although in this case, it seems this operation is limited to building performance, it is still a positive development in consideration of operational life of project. A main reason for this can be attributed to prominent role of project developer in using NSA and its voluntary nature. This issue strongly challenges NSA tools on how successful they are in achieving intergenerational equity, and their ability to adapt to changes and evolutions in neighborhood over time. It is necessary for NSA tools to introduce mechanisms to have a continuous assessment over the life of project.

4. Conclusion

This paper investigated the NSA tools' characteristic toward a balanced approach. This was done using a two-phase analysis procedure. In the first phase, the development of the NSA tools was studied in detail; five well-known NSA tools from different regions in the world were selected for detailed study on how they measure the sustainability of projects. Despite pursuing the same goal, they have different methods of assessment, which can be attributed to region, and parties involved in the development of the tool. Despite improvements in some tools compared to their predecessors, the analysis shows lack of balance in considering all pillars of sustainability in a meaningful way. In the second phase, the implementation phase, this paper used actual results from 115 projects, which received at least LEED certified recognition. The results show shortcomings in achieving a balanced approach during project implementation, which is caused by the static nature of these NSA tools. The variation in contextual factors in each project necessitates departing from static assessment and moving toward dynamic assessment. In conclusion, we provided several focus points for improvement of these tools to be considered in the future revisions of the NSA tools.

Appendix A. NSA tools used worldwide.

Rating system	Country/Region	Developer
LEED-ND	US	USGBC, CNU (Congress for the new urbanism), NRDC
Enterprise Green Community	US	Enterprise Partners
Green Land Development	US	Home innovation research labs
BREEAM Communities	UK	Building Research Establishment
One Planet Communities	UK	BioRegional
CASBEE-UD	Japan	Japan Sustainable Building Consortium (JSBC), and Japan Green Building Council (JaGBC)
EarthCraft Communities (ECC)	US – Greater Atlanta	Greater Atlanta Home Builders Association, Atlanta Regional Commission, Urban Land Institute, Atlanta District Council and Southface
DGNB for Urban Development	Germany	German Sustainable Building Council
Green Star Communities	Australia	Green Building Council of Australia
GSAS for Districts	Qatar	Gulf Organization for Research and Development
Green Mark for Districts	Singapore	Building and Construction Authority (BCA)
GBI Township	Malaysia	Malaysian Institute of Architects (PAM) and the Association of Consulting Engineers Malaysia (ACEM)
Neighborhood Sustainability Framework	New Zealand	Beacon Pathway
HQE2R	CSTB	France
ECOCITY	EU	EU Research Project
Green Townships	India	Indian Green Building Council
Aqua for Neighborhood	Brazil	Vanzolini Foundation, (with Certivea/France – HQE)
Pearl Community for Estidama	UAE	Abu Dhabi Urban Planning Council, United Arab Emirates
BEAM Plus Neighborhood	China (HK)	Hong Kong Green Building Council (China)
EnviroDevelopment	Australia	Urban Development Institute of Australia
BERDE for Clustered Development	Philippines	Philippine Green Buildings Council

Appendix B. Characteristics of selected NSA tools.

Rating system	LEED-ND	BREEAM Communities	DGNB-NSQ	CASBEE-UD	Pearl Community for Estidama
Title	Leadership in Energy and Environmental design-Neighbrhood Development	Building Research Establishment Environmental Assessment Methodology (for) Communities	German Sustainable Building Council – New City Districts (Deutsche Gesellschaft für Nachhaltiges Bauen – Neubau Stadtquatiere)	Comprehensive Assessment System for Built Environment Efficiency – Urban Development	The Pearl Rating System for Estidama – Community Rating System
Country	US	UK	Germany	Japan	UAE
Developer	USGBC, CNU (Congress for the new urbanism), NRDC	Building Research Establishment	German Sustainable Building Council	Japan Sustainable Building Consortium (JSBC), and Japan Green Building Council (JaGBC)	Abu Dhabi Urban Planning Council
Initial Year	2007	2008	2009	2004	2010
Latest Year	2009	2012	2013	2007	2010
Categories	1) Smart Location and Linkages, 2) Neighborhood Pattern and Design, 3) Green Infrastructure and Building, 4) Innovation and Design Process, 5) Regional Priority	1) Governance 2) Social and economic wellbeing 3) Resources and energy 4) Land use and ecology 5) Transport and movement 6) Innovation	1) Environmental Quality 2) Economic Quality 3) Sociocultural and functional Quality 4) Technical Quality 5) Process Quality 6) Site Quality (Integrated as a Criterion for Assessment)	1) Natural environmental quality (microclimates and ecosystems), 2) Service function for the designated area, 3) Contribution to the local community (history, culture, scenery, and revitalization), 4) Environmental impact on microclimates, façade, and landscape, 5) Social infrastructure, 6) Management of the local environment	1) Integrated Development Process, 2) Natural Systems, 3) Livable Communities, 4) Precious Water, 5) Resourceful Energy, 6) Stewarding Material, 7) Innovation Practice
Rating Method	(40–49) Certified, (50–59) Silver, (60–79) Gold, (80+) Platinum	Score %: (<30) Unclassified (30–45): Pass (45–55): Good (55–70): Very Good (70–85): Excellent (85<): Outstanding	Certified: total performance index >35% Bronze: total >50% & minimum 35% Silver: total >65 & minimum >50% Gold: total >80% & minimum >65%	S: Excellent BEE = >3.0, A: Very Good BEE 1.5–3.0, B+:Good BEE 1.0–1.5, B– Fairly Poor BEE 0.5–1.0, C Poor BEE <0.5	1 Pearl: all mandatory credits, 2 Pearl: 55+ credit points, 3 Pearl: 75+ credit points, 4 Pearl: 100+ credit points, 5 Pearl: 125+ credit points
Certification Process	Stage 1: conditionally approved plan Stage 2: pre-certified plan Stage 3: certified neighborhood development LEEDV4: Stage 1: neighborhood development plan Stage 2: built project	Step 1: establishing the principles of development Step 2: determining the layout of the development Step 3: designing the details	Pre certification: phase I validity 3 years Certificate Infrastructure: phase II: 5 years Urban District: phase III validity unlimited	–	Stage 1: design Stage 2: construction Stage 3: operation
Website	www.usgbc.org	www.bream.org	www.dgnb.de	www.ibec.or.jp	www.upc.gov.ae

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