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Social criteria of sustainable development in relation to green building assessment tools

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Abstract The social criteria of sustainable development, with a focus on green building assessment tool, have remained underexplored. Moreover, a large number of green building assessment tools and social sustainability documentations have been developed and have had a direct impact on social criteria issues, but there seems to be a substantial gap in the study of social criteria in green building assessment tools. The present study aimed at introducing the subject area supported by categories to monitor social criteria in building assessment tool. In light of this argument, this paper, through analysis of frequency data and results of studies, aims to identify some potential factors that will impact building practitioners toward making the right decision for selecting and implementing social criteria in green building assessment tools. In order to organize this paper, it adopts an analytic approach where social criteria would be interpreted in a new position. The aim is to identify social criteria of sustainable development to assist building practitioners in order to assess the building project and embed them toward building assessment tool to achieve sustainable development goal.

Keywords Social criteria · Building assessment tools · Sustainable development · Indicators · Social sustainability

1 Introduction

Green building assessment tools are no longer a new trend in achieving sustainable development in the built environment. However, this has stimulated a lot of debates and attracted research from various aspects. Two basic sets of tools have been derived: the criteria-based

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tools and the life cycle assessment tools. Moreover, enormous researches have been geared toward the criteria-based assessment tool where CASBEE, BREEAM, Green Star, LEED and many more others have been developed in order to curb the environmental degradation.

Scientific works have demonstrated that sustainable development involves three aspects the environmental criteria, economic criteria, and social criteria (Holmberg 1992; Reed 1997; Elkington 1997; OECD 2001; Commission of the European Communities 2001; Harris et al. 2001; Savitz and Weber 2006; Epstein 2008 and Harmon et al. 2009). Despite a plentitude of professional perspective and researchers, a stereotypical solution has been conceived. Sadly, the environmental criteria have become a flag bearer of most building assessment tool neglecting the social criteria.

Building assessment tools have been developed with a specific end goal to aid the application of sustainable development in the building and construction sector. However, the ideology behind the social criteria remains unclear (Empacher and Wehling 1999; Kopfmüller et al. 2001; Littig and Grießler 2004; Dempsey et al. 2011; Casula Vifell and Soneryd 2012). In other words, understanding the social criteria is not well elucidated. Thin et al. (2002), describes it as the most conceptual intangible criteria in sustainable development. This means building practitioners would have to take into considerations a wide range of probabilities to determine this aspect. Littig and Griessler (2005) were of opinion that the social criteria are more often placed in the aspect of power rather than policy lucidity. This is probably because it is still a new trend for expertise in the architecture, engineering, and construction (AEC) sector. Additionally, an absence of a convincing efficient structure for measuring human results and connecting them to the design elements make the social perspective complex (Lützkendorf and Lorenz 2005).

However, despite the global attention drawn to green building assessment tool as a phenomenon, it still lacks a tentative detailed analysis for the social aspect of sustainable development. Moreover, it is important to know the social dimension has not been well documented or emphasized due to the fact that there is no consensus on what social truly means (Lehtonen 2004). Cuthill (2009) and Vavik and Keitsch (2010) also contributed by stating that the social criteria have not received an equal fair of treatment as other two criteria of sustainable development. There are differences in the characterization of the core social indicators of sustainable development (Omann and Spangenberg 2002). As a result of this, Littig and Grießler (2004) analyzed selected international and national social sustainability concepts, and they came to a conclusion that their selected indicators were not based on theoretical reading other than practical indulgence of a logical and rational agenda politically. This interpretation relates the idea that a clear hypothetical notion for social sustainability is vividly void. Also, this can be due to the fact that people allocate diverse priorities to environmental and social aspects. These occurrences have initiated the urgent need for an effective approach/framework to develop a clearer understanding toward social criteria in building assessment tool.

Despite a plethora of assessment tool in operation, the seamless flow of knowledge and information regarding the social criteria in green building assessment tool is still impeded by a number of factors. Boulding (1985) claims that less accomplishment in the social and biological sciences has been witnessed. The inadequacy of thought toward institutional and financial parts of sustainability is to a great extent attributed to the building-driven approach of assessment tools. With tools like BREEAM, LEED, and CASBEE working on a method that totally cogitates the physical and material assets of built environment only (Komeily and Srinivasan 2015). An essential test for them is their powerlessness to broadly represent a nitty–gritty essential methodology for the distinctive social settings. Moreover, to attain certification from green building assessment tools such as LEED and many

other, they have become majorly customer needs oriented, where designers embark on pursuing credits (Komeily and Srinivasan 2015). Existing studies revealed that developers of projects developed by green building assessment tools indulgence criteria with the higher point weighting (Sharifi and Murayama 2013). Therefore, it is possible that these tools are utilized to guarantee the attractiveness of a group instead of its sustainability. A majority of the assessment tools are expert-driven and do not sufficiently involve a comprehensive assessment of stakeholders (Sharifi and Murayama 2013; Komeily and Srinivasan 2015).

While there is clearly an urgent need for a clear description of social criteria in green building assessment tool based on the statement slated above. Some of these tools have experienced success in many forms (LEED, BREEAM, CASBEE, etc.); however, not many of them support an effective outline of social criteria. However, there have been tremendous factors highlighted from the literature that influence the social criteria in green building assessment tool such as education, equity, participation, health, security, community cohesion. Therefore, this suggests a need to critically analyze existing green building assessment tools toward their true reaction to social criteria and social sustainability literature. Thusly, drawing from both existing data, the research aimed to identify a generic set of social categories/indicators in existing green building assessment tools and social sustainability literature, in order to highlight the need for implementing these categories/indicators into the core context of sustainable development with connection to its logical and provincial focuses to aid building professionals.

2 Green building assessment tools

Green building assessment tools evaluate, promote and improve sustainable construction in the building industry, and they provide a system that guides and gives a comprehensive understanding of sustainability through data investigation, evaluations, and differentiation (Nguyen and Altan 2011). The goal also is to compel a structure that assesses building environmental enactment and incorporating sustainable development into building and construction processes, and they are used as a configuration device by establishing viable design needs and objectives, creating proper design configuration procedures, and deciding measures of performances to control sustainable design and choice making process. Additionally, they give a quantitative performance pointer to design options and a rating for the entire building performance (Cole 2005).

Building environment seems to comprise two types of assessment tools: life cycle assessment tools and criteria-based tools. A major focus of this research would be on the criteria-based tool such as BREEAM, CASBEE, LEED, Green Star, GBTool, GSAS, and SBAT.

2.1 BREEAM

Building Research Establishment Environment Assessment Method (BREEAM), the first assessment tool, was developed in 1990, with the most recently updated version produced in 2016 (BREEAM 2016). Building specification assessment in the design, construction and use phases are the primary focus of BREEAM (BREEAM 2016).

BREEAM is comprised of four assessment tools, which are utilized in different phases of the building lifespan: Design and Procurement (D&P)—a design stage process used majorly on building renovation and project extension; Post-Construction Review (PCR)—a

verification process when construction is complete; Fit Out assessment—a process used in the renovation of existing building; and the Management and Operation (M&O)—evaluation process to assess the building performance during operation (Saunders 2008).

BREEAM has ten categories management, health and well-being, energy, transport, water, materials, waste, land use and ecology, pollution, and innovation. Points given are calculated, which helps define the environmental impact of the building (see Fig. 1). Each credit awarded in each category is multiplied by the environmental weight point allocated for that category, and then the categories score are summed up in an overall scale and are identified as, unclassified, pass, good, very good, excellent, and outstanding. Rating ranging from 1 to 5, star is provided: 1 star—pass: 30%; 2 stars:—good: 45%; 3 stars:—55%; 4 stars: excellent: 70%; 5 stars—outstanding: 85% (BREEAM 2016).

2.2 LEED

Leadership in Energy and Environmental Design (LEED), a building evaluation tool, was channeled by the US Green Building Council (USGBC) in 1998. Over more than 72,000 LEED-certified projects across the world have been accomplished, which makes it a standout among the most generally utilized assessment tools (LEED 2016). LEED version 4 (LEED 2013), the newest version, was officially launched in 2014, with systems like building design and construction, building operations and maintenance, interior design and construction, neighborhood development and homes introduced. This version of LEED evaluation system focuses on seven main aspects: the sustainable site, indoor environmental quality energy and atmosphere, water efficiency, materials and resources, innovation in design and regional priority (see Fig. 2). Building rankings are classified into four levels: certified (40–49), silver (50–59), gold (60–79), and platinum (80-above) (LEED 2013).

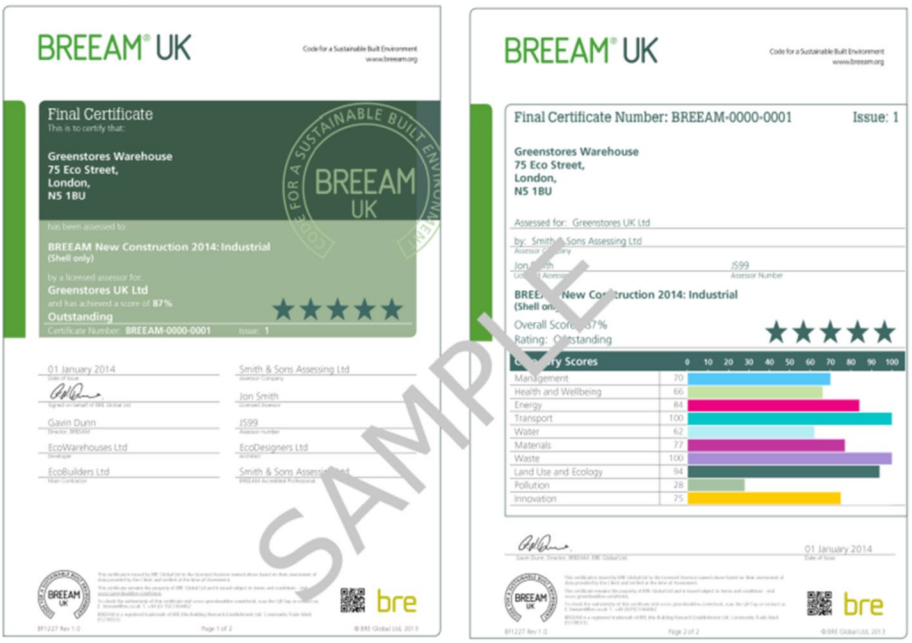


Fig. 1 Example of certificate at post-construction stage for BREEAM. *Source*: BREEAM (2014)

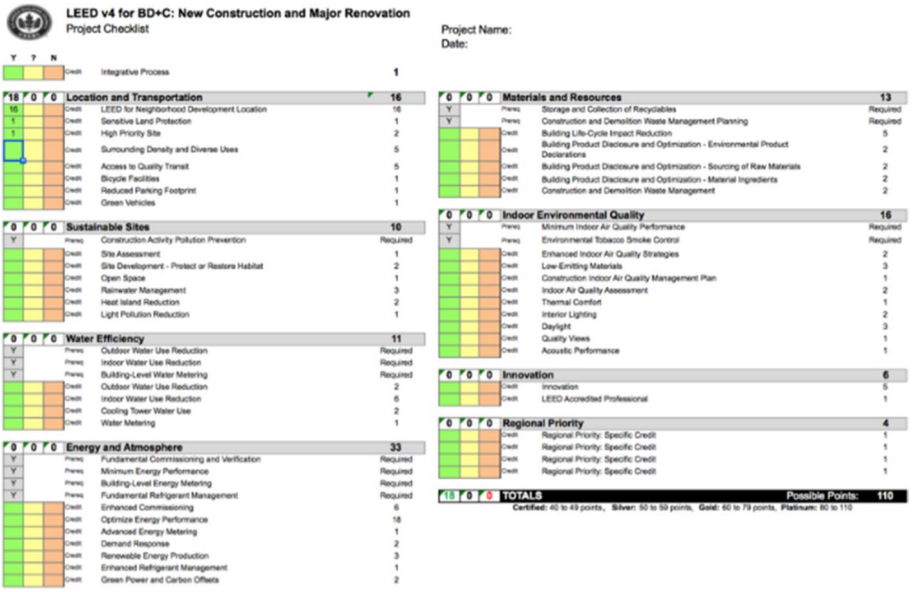


Fig. 2 Sample reporting and certification for LEED. *Source*: LEED (2013)

Without a hesitation, the best concern in regard to the LEED demonstrate is the evident overemphasis on environmental advantage without an equivalent worry for the resilience of the products utilized to accomplish this ecological advantage.

2.3 CASBEE

Comprehensive Assessment System for Building Environment Efficiency (CASBEE) was launched by the Japan Sustainable Building Consortium in 2001. The tool majorly focused on green building certification in Japan and Asia (CASBEE 2016). BEE (Building Environmental Efficiency) is used to calculate the scores. CASBEE consist of four basic assessment tools:

- "CASBEE for Pre-Design (CASBEE-PD), for projects at a very early stage to help with planning and site selection.
- CASBEE for New Construction (CASBEE-NC), to assess buildings during design and construction stages.
- CASBEE for Existing Buildings (CASBEE-EB), for buildings that have been occupied for at least 1 year.
- CASBEE for Renovation (CASBEE-RN) to help generate proposals for building upgrades and to assess improvements" (Endo et al. 2007; CASBEE 2016).

CASBEE utilizes weightings to adjust the esteem tending issues with the quantity measures accessible. Notwithstanding, the weight is connected to every category (quality of service, outdoor environment onsite, indoor environment, resources and material, off-site environment, and energy) (see Fig. 3). Each category is streamlined under headings such as serviceability, building thermal load, lightning, and illumination. It also contains

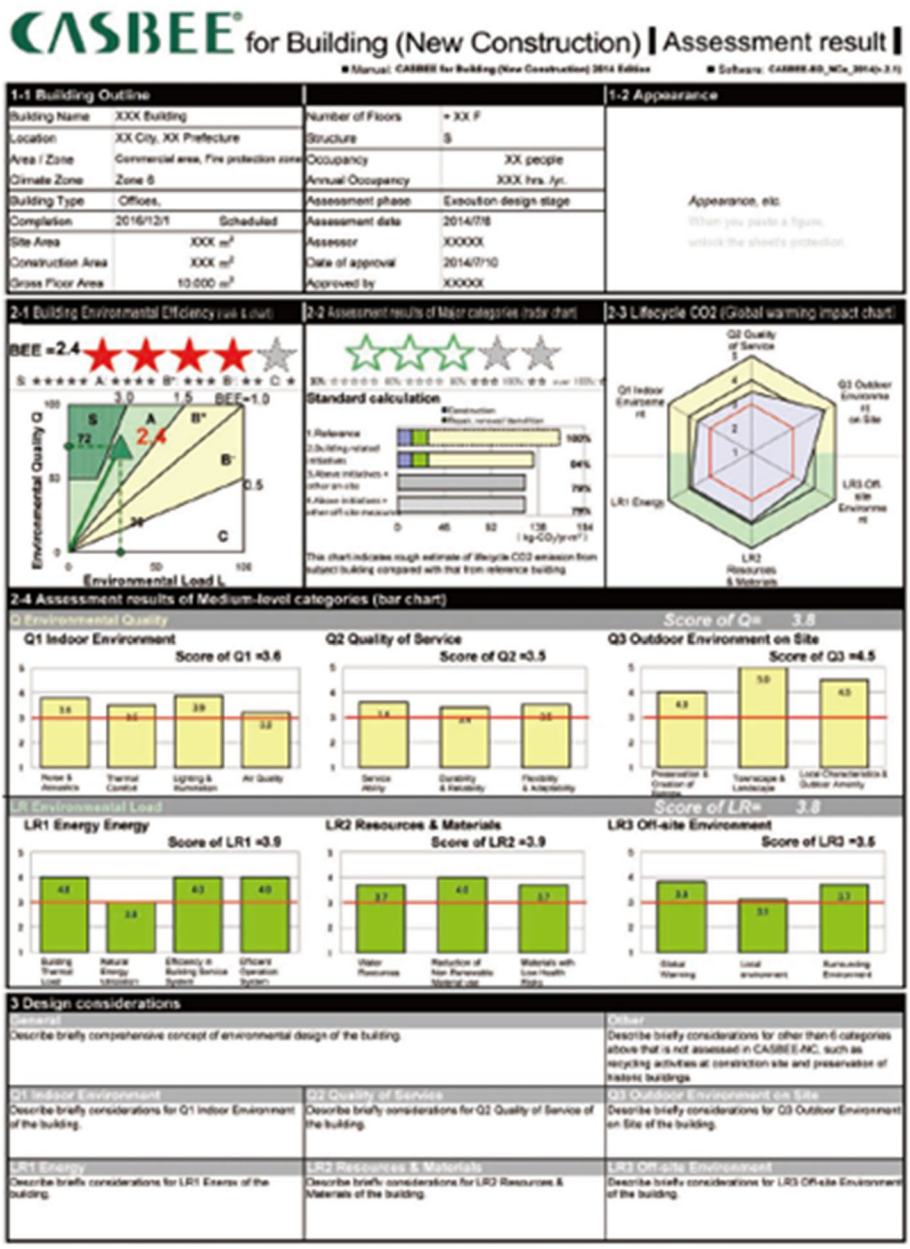


Fig. 3 Sample assessment result of CASBEE for Building (new construction). *Source*: CASBEE (2016)

sub-issues which are ventilation rate, CO^2 monitoring, adaptability of floor plate, etc (Endo et al. 2007; Saunders 2008).

According to CASBEE (2016), results are designed on charts, with the environmental load on and quality. Each category is scored from level 1 to level 5, with level 1 being the lowest point and level 5 being the highest point of accomplishment. The score and rating are

displayed in different ways, which make them more flexible on how the information can be used, and also this might lead to a greater potential confusion or clarity of assessment.

2.4 Green Star

Green Building Council of Australia (GBCA) launched Green Star in 2002 to assess the environmental issues relating to design and construction of buildings in Australia. The objective of creating Green Star was to encourage sustainable building development while promoting green building technologies, practice, and operations (GBCA 2009a; NZGBC 2009).

Green Star is a standout among the most took after willful building evaluation device created to oblige the requirement for building in hot atmospheres where cooling frameworks and solar shading are of significance (Cole 1999). Green Start consists of four rating tools which are space use, spatial differentiation, conditional requirements and timing of certification. The building accreditation is communicated as various stars: 1–3 Stars (10–44 points; not qualified); 4 Star (45–59, best practice); 5 Star (60–74, Australian excellence); 6 Star (75–100, world leadership) (GBCA 2009b).

2.5 SB tool

International Green Building Challenge initiative, later named the Sustainable Building Challenge in 1996, set up an energy and environmental tool for both universal and national settings. Initiating from the SBMethod, Green Building Tool (GBTool) was later renamed to Sustainable Building Tool (SBTool) (Bernardi et al. 2017). It was important to recognize evaluation tool that, through various methodological bases, would have the capacity to dispassionately survey the necessities of the environmental, economic, and social effects of a building during its life cycle. SBTool is based on area and site particular setting factors, and these are used to decline certain weights, and giving establishment information to all environment. The SBTool is a fundamental structure for rating the environmental execution of a building by distributing points for different aspects (iiSBE 2017).

The SBTool process is managed by IISBE (International Initiative for a Sustainable Built Environment). The evaluation is basically through the aggregate examination counts. The plan is partitioned into two areas: Module A and Module B. They, however, handle new and renovation projects or a mix, up to five occupancy types in a single project, buildings up to 100 floors in height, and offer relative and complete outputs. They are also applicable to various processes through the development phases from the pre-design phases, the design phase, the construction phases, and to the operation phases as demonstrated by different results starting from various data inputs. It focuses on seven categories: site selection, project planning and development; environmental loadings; energy and resource consumption; indoor environmental quality; functionality and controllability of building system; long-term performance; and social and economic aspects (see Fig. 4). The categories are scored from −1(below typical practice) or from +1 to +5 (good to very high performance). Weighting at some point can be modified partly by an authorized third party (iiSBE 2017).

2.6 GSAS

Gulf Organization of research and Development (GORD) in 2009 established Global Sustainability Assessment System (GSAS), as an incorporated and performance-based assessment tool. It was modeled on the best practice from the region drawing from global rating

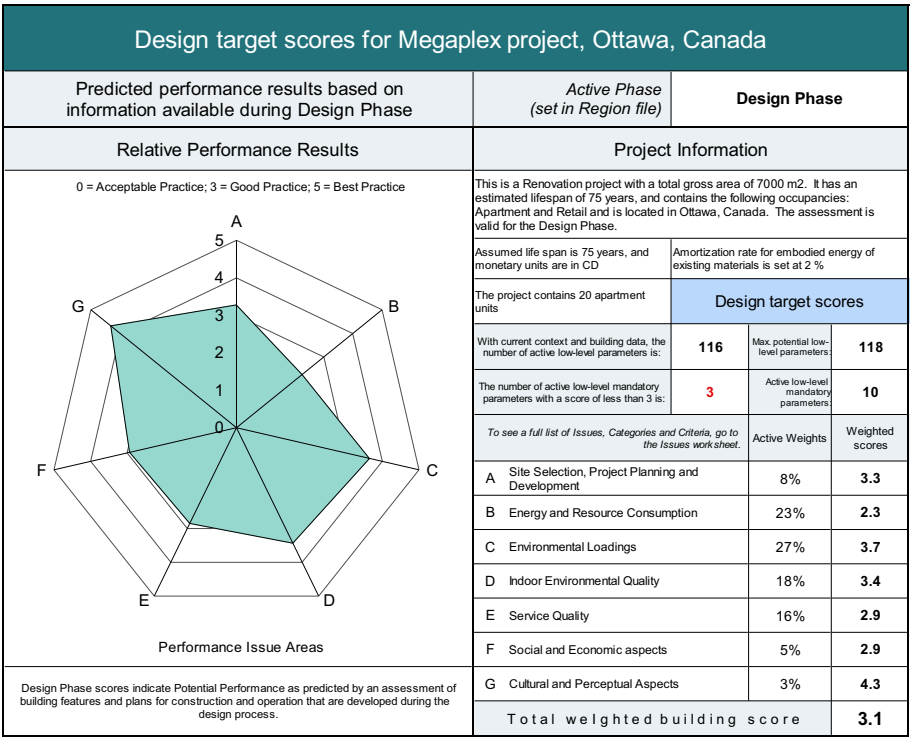


Fig. 4 Sample assessment result of SBTool. *Source*: Larsson (2007)

systems such as BREEAM, LEED, CEPAS, CASBEE, GREEN GLOBES and International SBTool. GSAS consists of eight main categories: energy; water; indoor environment; cultural and economic; site; urban connectivity; materials; management; and operations (see Fig. 5). GSAS scoring is measurable on the scale of −1 to 3 (−1, 0, 1, 2, 3), which signifies a fundamental uniform ordinal scale from negative level (−1) to optimal level (3), and has 1–6 Stars certification that can be achieved (GSAS 2017).

2.7 SBAT

South African Council for Scientific and Industrial Research (CSIR) developed SBAT. On July 2000, in the issue of engineering news report, it stated that "the programme has also seen the development of an assessment tool known as the building environmental assessment rating system, which measures the effect of the building have the environment, as well as the various indoor components of the building." The tool derived was known as BEARS (Building Environmental Assessment rating System) which was developed into a current prototype Sustainable Building Assessment Tool (SBAT). SBAT was developed to help set out parameters which adhere to achieve a more sustainable building (Gibberd 2002).

Sustainable Building Assessment Tool (SBAT) was developed to measure sustainability performances in a building environment. It contain 15 aspects which are arranged around the environmental, social and economic criteria, namely: Education;

GLOBAL SUSTAINABILITY ASSESSMENT SYSTEM (GSAS)

DESIGN STAGE

Project Information	
Project ID:	
Project Name:	
Project Location:	
Gross Area (m²):	
Typology	COMMERCIAL

No	Category	Point 0.964
UC	Urban Connectivity	0.055
S	Site	0.148
E	Energy	0.000
W	Water	0.320
M	Materials	0.031
IE	Indoor Environment	0.101
CE	Cultural & Economic Value	0.210
MO	Management & Operations	0.099
	Level Achieved	2 Stars

Fig. 5 Sample assessment result of GSAS tool kit. *Source*: GSAS (2017)

Material and components; Local Economy; Efficiency; Ongoing Costs; Adaptability; Capital Costs; Water; Access to facilities; Waste; Site; Occupants Comfort; Energy; Inclusive Environments; participation and control; Health and Safety (Gibberd 2002).

The performance of each category is measured out of 5 and presented in radar diagram as seen in (Fig. 6). A concluding assessment is based on 75 indicators which include 15 areas with 5 criteria in each of them (Gibberd 2002). The 5 criteria are formed by three steps (a) Setting the Project Up, (b) Entering Measurements, and (c) Reading the Report.

A nine-stage building lifecycle process was also considered for this tool, which includes: briefing, site analysis, target setting, design, design development, construction, handover, operation and reuse/refurbishes/recycle.

It is not the aim of this research to draw a parallel among the assessment tool but to learn from the discourse and to develop a relationship string between the assessment tool while identifying their limits and merits. This creates a new means of perceiving sustainable development and a need for laying out a social criterion sustainable objective based on the projects culture and social demand.

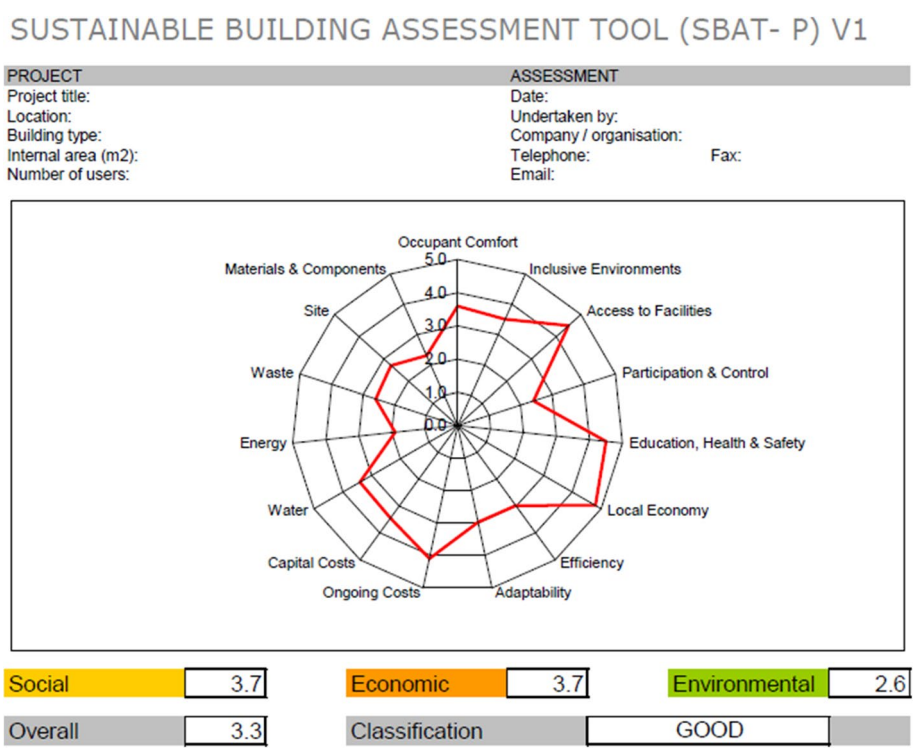


Fig. 6 Sample assessment result SBAT reporting documentation. *Source*: Gibberd (2002)

3 Methodology

Seven green building assessment tools were selected, on how best they fit the objective of the study. Green building assessment tools were studied while addressing it through the social criteria of sustainable development. Literature documentation was used as a feature of discussion to support the study of the research objective, taking into consideration the criteria of sustainable development (environmental, social and economic) and social categories from experts. Qualitative analysis was piloted as a strategy for sorting each system credits under sustainable criteria. The sustainable criteria here refer to the three principle aspects of sustainable development.

The category selection of social criteria in sustainable development was based on interpretation of research documents from authors using a bottom-down approach, where each indicator identified had features contributions from experts relating to the subject. To identify the categories in the green building assessment tool using the triple bottom line framework, a statistical documented analysis was adopted using a bottom-down approach to conduct an overview of green building assessment tool from 5 geographical regions (Europe, America, Asia, Gulf Region, Africa) based on their popularity and influences. In order to examine how green building assessment tool addresses sustainable development, the triple bottom framework was used, based on the credit points assigned to the assessment tools, regardless of the category it belongs to.

Then, based on literature presented in GBAT and social criteria a comparative study was conducted to limit the research focus to social criteria, in order to help define the preselected sets of categories that would be generated. Therefore, in this study, the social criteria categories were adopted. Table 1 shows the road map for this research.

4 Findings and analysis

4.1 Social criteria in sustainable development

Social criteria of sustainable development are defined as improving and maintaining the well-being of individual of present and future generations (Chiu 2003). The term well-being is broad; however, in this research, it is defined as providing a high quality of life—social satisfaction, rather than the psychological meaning—mentally. Social criteria of sustainable development can also be referred to as social sustainability. Social sustainability is set to be achieved when an environment is created to work harmoniously, while reducing the social inequalities and difference, thereby promoting and improving the quality of life (Enyedi 2002). Generally, social sustainability is viewed as a basic quality or objectives of social orders for development in foreseeable future. The basic quality or objectives consist of a different categories and factors: equity, participation, satisfaction, basic needs, social cohesion, income, well-being, social justice, employment, safety, and education. However, because of the absence of a coordinated applied system and a far-reaching meaning of the idea of social sustainability the thought stays ambiguous to some degree (Littig and Griessler 2005; Colantonio 2009; Colantonio and Dixon 2011, Jaeger et al. 2011; Ahman 2013; Weingaertner and Moberg 2014). With this instance, green building assessment tool has been duly been affected with a single faced assessment tool developed aimed at attaining sustainable development in the building environment.

Several of literature sources have endeavored to address the conceptualization of social sustainability in sustainable development from different disciplines such as sociological perspective, planning perspective, and political perspective. However, despite the difference, some of the factors overlap each other to give a certain character to the definition of social sustainability (Liu et al. 2017).

Table 2 shows a list of authors and organizations with literature that reveals various understanding and provides a basis for what social factors/theme/categories of sustainable developments are represented. This development would aid to give an in-depth understanding from the expert viewpoint in order to identify the basis of the social character defined in sustainable development. The table identifies social classification and theme in social indicator sets as the UN Commission for Sustainable development, EU Sustainable Development, and OECD Social indicators evaluate (UNCSD 1996; UNDESA 2001; UNBESDA 2007; Eurostat 2007; OECD 2016). These indicators of sustainable development defined in accordance with the vision, policy, and goal of sustainable development.

Becker and Jahn (1999) express social sustainability as long-term relationships among nature and society which lead to the feasibility of society. Sachs (1999) was of opinion that social sustainability lays on the fundamental estimations of equity and democracy. Meanwhile, social sustainability as a development occurs by balancing the evolution of a civil society, where the development should result in a rich environment (Polèse and Stren 2000). Biart (2002) was of opinion that social sustainability embraces

Table 1 Road map for the research

Aim	To explore and evaluate social criteria of sustainable development and green building assessment tools system that is able to assist building practitioners to attain a sustainable development		
Stages	Objectives	Undertaking	Method
1. Review	1) Current views and background information about the research relating to green building assessment tool	Step 1: examining relevant literature through analysis of recently published data (books, journals, articles etc.)	DA
	2) Examination of current terminologies used in building assessment tool and social sustainability in reference to social criteria, to highlight their strength and weakness	Step 2: reviewing relevant literature and classifying the categories identified	DA
2. Unification	3) To identify the vital influential categories that affect the social criteria selections	Step 3: conducting a study using a bottom-down approach on issues relating to social factors of sustainable development	DA, OBS, BD
		Step 4: carrying out an inspection on the building assessment tool identified in the literature and observational study on how they function in operation, while cataloguing them into different criteria	
3. Analysis	4) To establish and specify the categories identified	Step 5: analyzing data gathered from the surveyed exercise, while using comparative analytical principle	DA, C
4. Application	5) To develop a pre-selected set of categories for social criteria	Step 6: assembling of key components and data generated from analysis using a top-down approach.	DA, TD
		Step 7: development of a conceptual framework of the proposed system into a refined model	
	6) Conclusion	Step 8: describing result using relevant data to give a feedback on the necessary adjustment needed in social criteria	

DA documented analysis, *OBS* observation, *C* comparative, *TD* top-down, *BD* bottom-down

Table 2 Authors and organization definition of social factors in sustainable development

Concept of social factors as described by authors and organizations	
Authors/organizations	Social factors/classifications/themes. Categories
UN commission for sustainable development (UNCSD 1996)	Combating poverty
	Sustainable demographic dynamic
	Protecting human health
	Promoting human settlement
	Promoting education, public awareness and training
Sachs (1999)	Equitable income
	Social homogeneity
	Access to goods
	Service and employment
Polèse and Stren (2000)	Social integration
	Cultural diversity
	Equity
UN commission of sustainable development (UNDESA 2001)	Equity
	Health
	Education
	Housing
	Security (combating crime)
McKenzie (2004)	Equity
	Diversity
	Quality of life
	Interconnectedness democracy government
Littig and Griessler (2005)	Basic need and quality of life
	Social justice
	Social coherence
UN commission for sustainable development (UNDESA 2007)	Poverty
	Governance
	Health
	Education
	Demography
EU sustainable development indicators (Eurostat 2007)	Public health
	Social inclusion
	Demographic changes
	Good governance
Chan and Lee (2008)	Social infrastructure
	Availability of job opportunities accessibility
	Townscape design
	Preservation of local characteristics
	Ability to fulfill psychological needs
Cuthill (2009)	Social capital
	Social infrastructure
	Social justice + equity
	Engaged governance

Table 2 (continued)

Concept of social factors as described by authors and organizations	
Authors/organizations	Social factors/classifications/themes. Categories
Colantonio (2008)	Basic need
	Equity
Vavik and Keitsch (2010)	Poverty
	Illiteracy
	Access
Dempsey et al. (2011)	Social equity
	Sustainability of community
Vallance et al. (2011)	Equity
Woodcraft et al. (2011)	Social and cultural life
	Social amenities
	System for citizen engagement
	Space for people and place to evolve
Murphy (2012)	Equity
	Awareness of sustainability
	Participation
	Social cohesion
Ahman 2013	Equity
Davoodi et al. (2014)	Social interaction in place
	Architectural identity
	Social security
	Hierarchy
	Participatory design
	Flexibility
OECD social indicators (OECD 2016)	Self-sufficiency
	Equity
	Health status
	Social cohesion
Eizenberg and Jabareen (2017)	Equity
	Safety
	Urban form
	Eco-prosumption

the nominal and acute social requirements for the long-term sustainability of societies. Therefore, to achieve social sustainability the long-term survival of society should be clearly recognized.

Social sustainability was also defined "as a positive condition within communities and a process within counties that can achieve that condition" (McKenzie 2004), thereby describing social sustainability as a progression rather than a goal that is to be achieved in the future. They indicated five principal themes: equity, diversity, quality of life, interconnectedness and eventually democracy and government. Littig and Griessler (2005) investigated the lack of sociological theory in the concept of social sustainability, where it was highlighted that social indicators and policy objectives in the discourse

of social criteria. They suggested that social sustainability indicators are to be derived from sociological theories for better understanding. They classify the set of indicators into three aspects namely: (1) Need and quality of life—an aspect that relates to basic material needs and fulfillment such as individual income, poverty, unemployment, education, income distribution, housing condition, security, health, housing satisfaction and the environment. They advised that these features are to be met to provide basic need and quality of life to individuals or communities. (2) Social Justice—this set of indicator describes the equality of opportunities, where justice regarding the distribution of income and equal opportunities are offered toward the quality of life, education, gender, and participation in the society. (3) Social Coherence—this set of indicator describes there unity among different social groups, where there is an integration of a social network, activity involvement, solidarity and tolerant attitude. Colantonio (2008) advocated two basic concepts: the basic need—focuses on the physical aspect of life and society (health, housing, and food); equity—focuses on the social difference and other concepts such as (equal access to services and education).

More factors that affect social sustainability urban development projects were highlighted: (1) Provision of social infrastructure—this aspect describes the provision of physical infrastructure such as public facilities which delivers services that are locally based and creates an avenue for social interaction. (2) Availability of job opportunities—this aspect describes the provision of employment, where employment provides the general income of an individual and the working area that provides a room for social connexion and interaction. Thereby improving the social well-being of the citizens. (3) Accessibility—it defines the provision of convenient and proper access in crucial live, work and leisure activities that do not involve traveling a lot. (4) Townscape design—this aspect entails the provision of townscape designs that are visually attractive, functional and able to promote social interaction within the community. (5) Preservation of local characteristics—it entails the ability to preserve/conserve properly the physical and social/local characteristic for the future generation. (6) Ability to fulfill psychological needs—this aspect entails providing a safe and secure environment for the community to participate and meet their needs and desires (Chan and Lee 2008).

Cuthill (2009) employs four vital factors of classifying social sustainability namely: Social capital—this describes the advancement of social linkages and a logic of social responsibility. Social infrastructure—this entails offering facilities that discuss the limit with regard to support to the general public. Social justice and equity—giving of even-handed access to fundamental well-being services and employment, particularly for defenseless people. Engaged governance—this entails the promotion of bottom-up (individual elements to a whole) and participatory democracy within the society. Dempsey et al. (2009) identify the concept of social sustainability into two core notions social equity (equal use to service, facilities, and opportunities) and sustainability of community (social interaction/social network, social participation, stability, sense of pride in local place, security, and safety). Vavik and Keitsch (2010) identify three goals of social criteria of sustainable development: poverty (encouraging incorporation by giving essential needs); illiteracy (encouraging easy access to education); access (encouraging access to partake in decision making). Meanwhile, Woodcraft et al. (2011) define social sustainability as a process where a rich society is created by an exhaustive indulgent of people's wants and needs. This includes the process of creating a sustainable society that promotes social and cultural life, social amenities, a system for residents to participate, places and space for people to develop.

Vallance et al. (2011) suggested a social conceptualization based on three aspects: Development—addresses the basic needs, education, equity and access to influential decision makers. Maintenance—addresses the up keeping of social-cultural features that affect changes and how people react to changes. Bridge—underlines the behavioral change keeping in mind the end goal to accomplish bio-physical environmental objectives. Murphy (2012) employs four conceptual classifications of social criteria of sustainable development namely: equity, participation, awareness for sustainability and social cohesion that links social and environmental policy objectives. Ahman 2013, sees equity as the main concept of social sustainability; however, they categorized equity into several aspects (social cohesion, education, social capital, diversity, sense of place, quality of life and integration.

From the architectural design perspective, Davoodi et al. (2014) observed six principles of social sustainability and its indicators namely: Social interaction in place—design of a place which increases social interaction within the building. Architectural identity—building design rooting from the culture and history of the society. Social security—increasing the sense of security within the building, Hierarchy—using different hierarchy system to increase the sense of order within the society. Participatory design—engaging in participatory design programs as a social process of design which helps play a key role in the society. Flexibility—flexibility in architectural design forms to conform to the rate of economic and social changes and technological advancement. Eizenberg and Jabareen (2017) suggested an inclusive social conceptual framework of social sustainability, which comprises equity, urban form, safety, and eco-presumption.

Conclusively social criteria of sustainable development theme/categories appear to be a very diverse topic. According to Dempsey et al. (2009), Bostrom (2012), Eizenberg and Jabareen (2017) and Liu et al. (2017), they described social criteria of sustainable development as they vary from abstract (social justice) to concrete (equity), from subjective (satisfaction and well-being) to objective (health and income), from non-physical (quality of life and safety) to physical (housing, urban custom and environmental value), from individuals (activities) to social relations (social capital and cohesion), and from substantive (need) to procedural (participation and empowerment) some of which are observed in Table 2.

However, this research tends to study social criteria in relation to the building environment; therefore, information derived from the social sustainability literature was streamlined to issues that affect the building environment, in terms of achieving sustainable development in the construction industry.

The complexity of social criteria in sustainable development involves the building and the community simultaneously. The community is involved in the active planning of the project and also contributing to the design, development, and management of physical spaces.

4.2 Green building assessment tools and social criteria

With the advent of sustainable development, numerous green building assessment tools have been coordinated to aid the environmental criteria with a few considering the social criteria in decision making and design practice. This section explores the information building practitioners require to attain a socially sustainable stage using green building assessment tool while formulating the decision regarding sustainable development.

In this section, seven assessment tools in developed and developing countries were identified and examined in details. Developed nations, possess of most basic human needs and most likely to be surpassed in many cases (Loh 2000). Therefore, in these developed

countries they only try to maintain an assured standard of living while decreasing the resources diminution and environmental alterations (DETR 2000), and assessment tool such as BREEAM, LEED was established to curb this aspect. Meanwhile, in under-developed nations, with an average standard of living way lower compared to developed nations, the basic human need has not been attained in many cases. This, therefore, stipulates a need for a development that aims, at addressing the basic need while avoiding the undesirable impact of the environmental factors.

Sustainable development is attributed to three basic criteria, with the social criteria been as important as environmental and economic criteria in decision making. Regarding numerous studies surrounding green building assessment tool and its environmental and social impacts, it has witnessed a clear neglect of social criteria of sustainability where the environmental attributes such as energy, material selection, water efficiency largely emphasize the impact of these factors on the building. Therefore, it can be said that social sustainability aspect and its indicators neglected were individual understanding and perception within the building remains void or negligible.

In order to examine how green building assessment tool addresses the social criteria of sustainable development, Figs. 7, 8, 9, 10, 11, 12 and 13 illustrate the weighting system given to the three criteria of sustainable development with an emphasis on the social criteria. With some credit points allocated to procedural aspect, which was highlighted in each assessment tools. The Procedural aspect are related to authorizing, responsible construction, and integrative process credits. They generally have an indirect influence on one or more of the sustainable development criteria.

The social criteria in the illustration were sorted based on each assessment tool categorization. Social criteria were defined as an aspect that affects the final users within the living space of the building (indoors and outdoors) such as its health, safety, visuals, accessibility, cultural values, and participation in attaining sustainability. Also sorting out the environmental, social and economic criteria in the assessment tool was based on bottom-down approach, to solidify the selection of the categories.

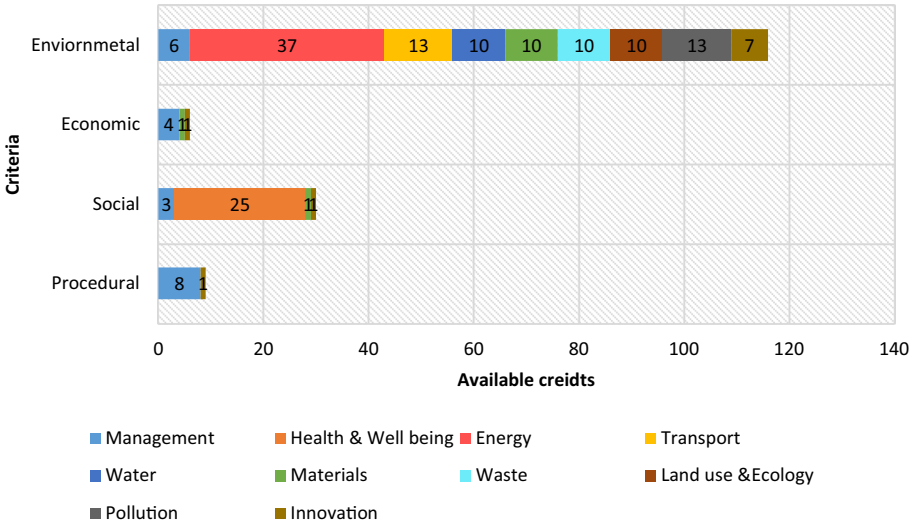


Fig. 7 BREEAM credit weight for environmental, social and economic criteria

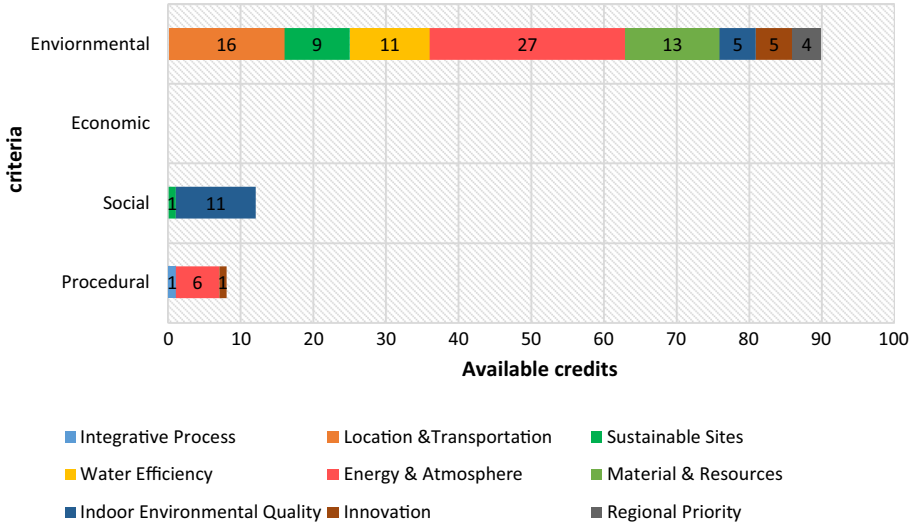


Fig. 8 LEED credit weight for environmental, social and economic criteria

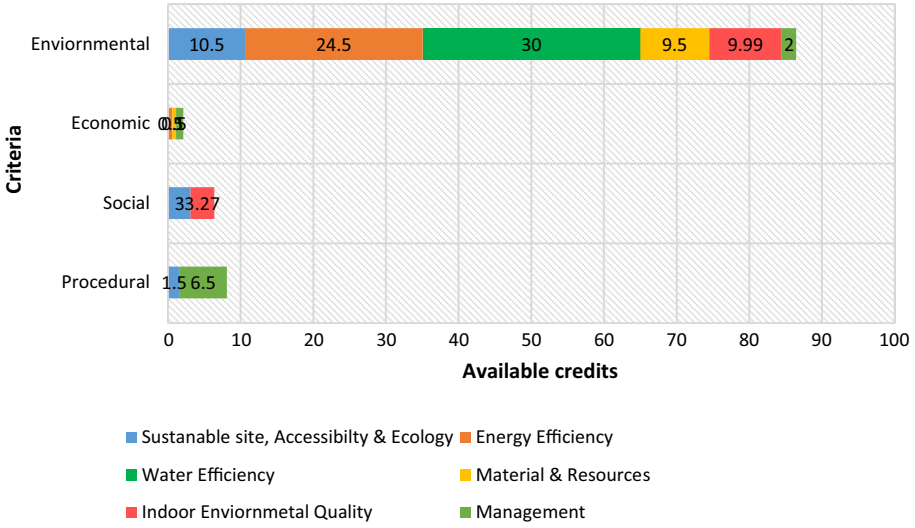


Fig. 9 CASBEE credit weight for environmental, social and economic criteria

The BREEAM International 2016 New Construction assessment tool addresses three criteria (environmental, social and economic) with an uneven weight point. It can be observed that six of the assessment tools give more importance on the environmental criteria, while only SBAT has the social criteria as its highest weight of point. This, therefore, describes that the majority of the assessment tools are environmentally driven rather than sustainably oriented, as argued by (Cole 2005; Berardi 2013; Ameen et al. 2015; Sharifi and Murayama 2013; Komeily and Srinivasan 2015) where environmental aspects are

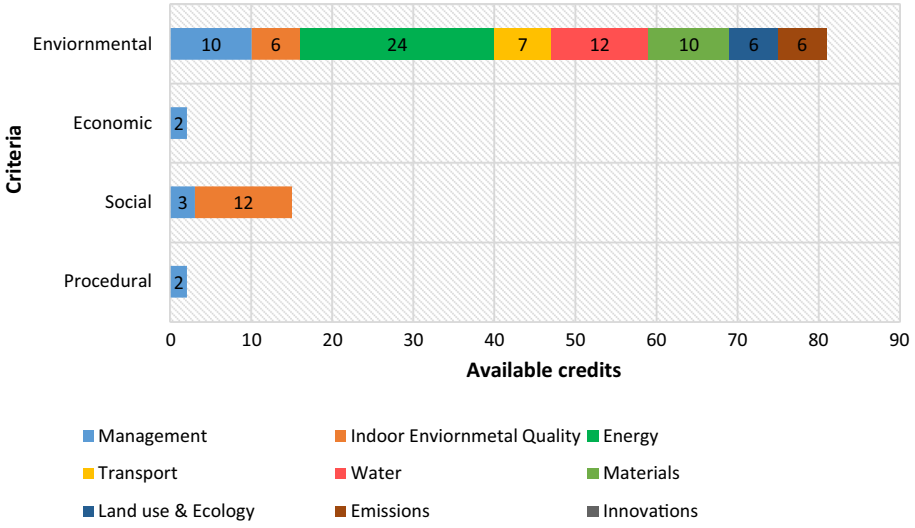


Fig. 10 Green Star credit weight for environmental, social and economic criteria

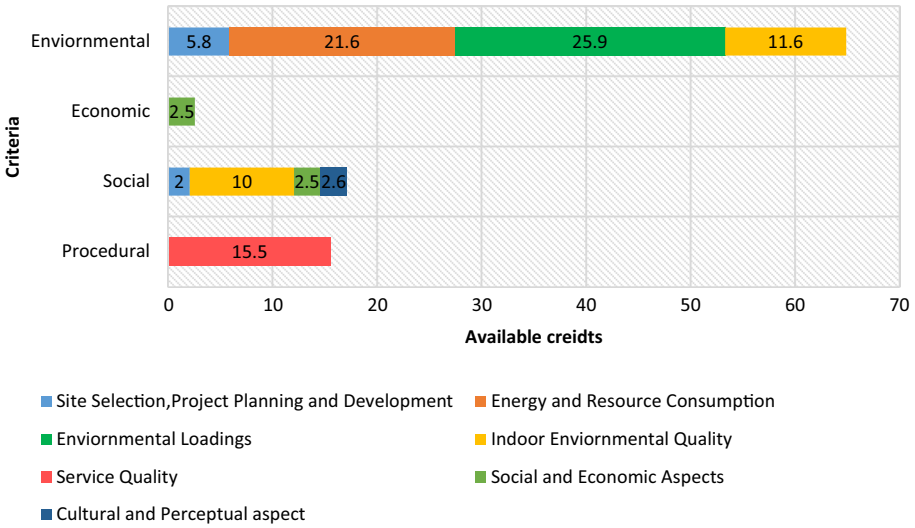


Fig. 11 SBTool credit weight for environmental, social and economic criteria

dominant. This implies that sustainability as a general concept which involves the environmental, social and economic aspects of life, and assessment tools are designed with the aim of easing the conversant decision making for sustainable development. However, assessment tools only address the environmental aspect, while all other dimensions are to be addressed simultaneously, in order to encompass the full scope of sustainable development in the built environment.

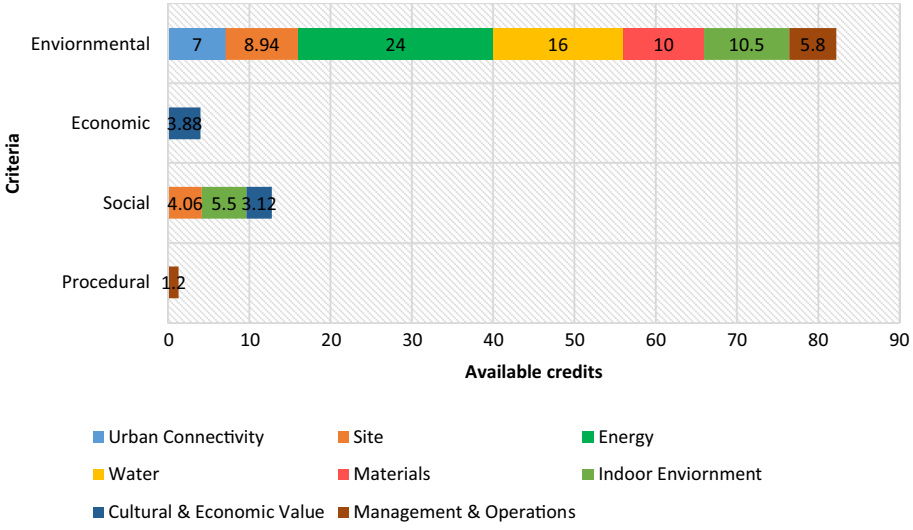


Fig. 12 GSAS credit weight for environmental, social and economic criteria

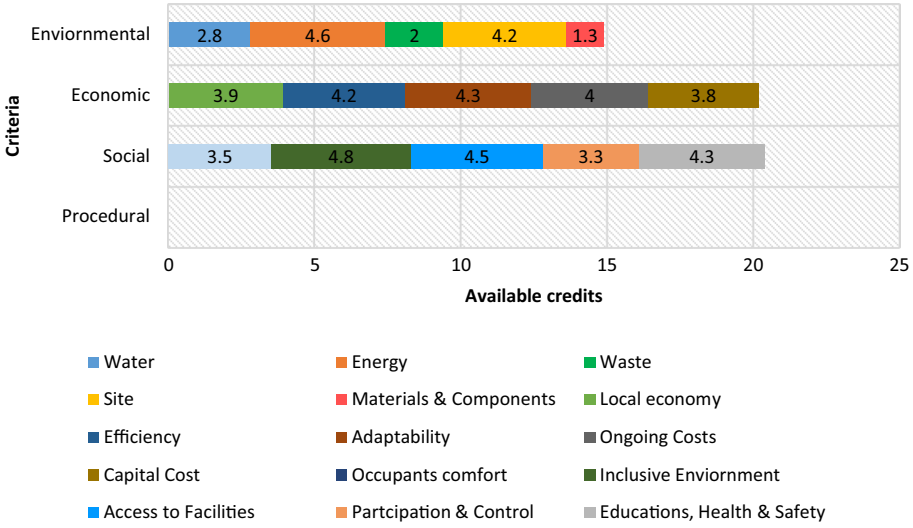


Fig. 13 SBAT credit weight for environmental, social and economic criteria

With respect to the social criteria, this aspect has been given less consideration in green building assessment tool decision-making process and weight allocation. To calculate the percentage of each assessment tool criteria, the highest point allocated for each category was recorded and summed up, then the total for each category was added up to form a sum total, and this was put into a percentage calculator, as illustrated below.

$$\frac{\text{Sum total of(each criteria)}}{\text{Sum total}} \times 100$$

SBAT has the highest point allocation to social criteria given it a total of 36.7%, BREEAM allocates 19%, GB Tool allocates 15%, LEED assigns 11% and the rest which were below 10% weighting point: Green Star assigning 9.8%, and CASBEE allocating 6%. This shows a pattern where a neglect of the social aspect of sustainable developed has been neglected majorly in developed countries. It was noted that in developed countries a pattern of the design approach is driven by the project decision where the environmental aspects are considered and brought up before the social aspects. Also, LEED, BREEAM, CASBEE, GBTool and Green Star address the social aspect through neighborhood rating system rather than building system (Awadh 2017). However, the design for a socially oriented building is not always in question, due to the fact that the sustainable practices are compelled by the certification rather than looking at the operational phases with the social aspect inclusive. It must be noted that in the Middle East with GSAS, cultural and economic values are identified as indicators. This shows a trend where the social aspect is being considered due to the cultural difference within the region.

According to Komeily and Srinivasan (2015), the majority of the tools are marketing-driven oriented and developers embark on pursuing points. Existing studies revealed that developers of LEED project indulgence criteria with the higher point weighting (Sharifi and Murayama 2013). In this way, it is conceivable that those tool mentioned above are used to guarantee the selling rate of a community as opposed to its sustainability. The majority of the assessment tools are expert-driven and do not sufficiently involve a comprehensive assessment of stakeholders (Sharifi and Murayama 2013; Komeily and Srinivasan 2015). Berardi (2011) stated that to address the social criteria in sustainable development it involves an appropriate design which relates the building to its neighborhood.

A clear-cut comparative analysis between assessment tools in connection to sustainable aspects has been piloted to additionally introduce the varieties between the green building assessment tools, with the assessment tools generally sharing almost same credit sets, and the comparison would be parallel presented.

5 Result of analysis

5.1 Social criteria comparison between GBATs

In the comparison result amongst the green building assessment tools, SBAT possesses the highest weight point for this criterion in its assessment tool 36.7%, and it highlights water, inclusive environment, access to facilities, health and safety participation and control and education, as key indicators. Indoor Environmental Quality is highly encouraged in all the assessment tools looking through the comfort, health and safety aspect of the occupants within the building. Table 3 shows the social categories considered in the GBAT analyzed.

Due to the fact that developed nations possess most of the basic human needs, and social criteria of sustainably developed in these nations have not been extensively analyzed, with LEED and CASBEE most specifically having the least allocated percentage with 11 and 6%, respectively. However, for developing nations where the human need and standard of living are below average, SBAT encourages social criteria with a higher percentage (36.7%) to aid sustainable development within the region. Moreover, this does not imply that developed nations are exempted from social needs, and the analysis addresses the lack of social character in the developing nations, and in urgency in creating a socially sustainable environment through its assessment tool as developed in SBAT tool.

Table 3 Social criteria credits for GBAT

Categories	BREEAM	LEED	CASBEE	GB tool	Green Star	GSAS	SBAT
Sustainable site and accessibility		✓	✓	✓		✓	✓
Indoor environmental quality	✓	✓	✓	✓	✓	✓	✓
Water							✓
Education, health and safety	✓						✓
Participation and control							✓
Management	✓				✓		
Innovations	✓						
Cultural and economic value						✓	

When it comes to the social aspect of sustainable development, indoor environmental quality is first to be accounted for in most green building assessment tools (see Table 3), where indoor environmental quality entails the comfort, air quality, view and lighting within the building. Sustainable site and accessibility are highly encouraged in LEED—10%, CASBEE—15%, SBTool—7.8%, GSAS—13% and SBAT—8.7%, where this aspect tends to help encourage interaction with the environment, passive recreation, physical activities and social interaction. Also, this aspect helps improve and educate the tenants about the implementation of sustainable design features to their buildings. SBAT seems to be more demanding when it comes to education, comfort, and participation with a total sum of 11.1%, due to the lack of social credibility within the region. Therefore, the tool encourages a higher weight pointer for this aspect.

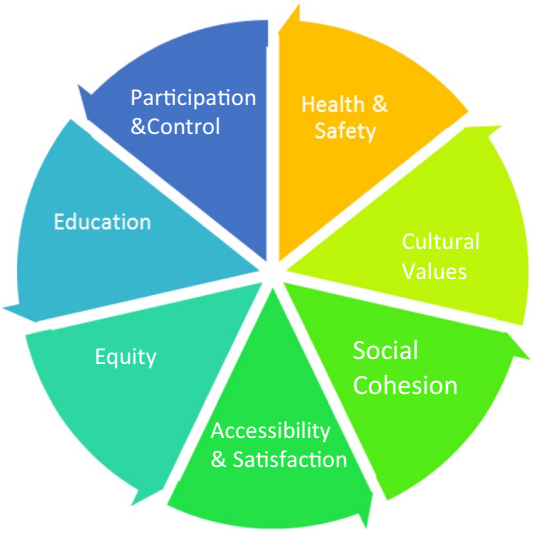
The difference between the assessment tools are related but not limited to prioritizing aspect that affects their region; emphasizes on weight pointers that affect their region; considers various credits that are interrelated. From literature observed, there are enormous social criteria categories (see Tables 2 and 3). The process started with the collection of the most appropriate international literature on social sustainability and social aspects of green building assessment tool. Using a top-down methodological approach, a pre-selected list of social criteria categories were derived (see Fig. 14).

The central aim of the proposed category and indicator set is to provide a Delphi panel of experts with an infrastructural category and indicator as a startup point from which they would be able to filter and deliberate on, in order to create a list of applicable category and indicator sets for social criteria in green building assessment tools. The proposed categories are illustrated in Fig. 15, and they are outcomes of the comparative study which covers well-known green building assessment tool and social sustainability theories in sustainable development.

6 Conclusion

In this paper, a synopsis of the green building assessment tool in assessing the social aspect of the building was presented. Green building assessment tool demonstrates the need for adopting an assessment tool to compare and contrast the level sustainable development in buildings, where social criteria merit a particular attention. However, over the last few years, the assessment tools have failed to underline the social criteria, with specific categories and indicators to meet. This research, therefore, gives

Fig. 14 Social criteria categories



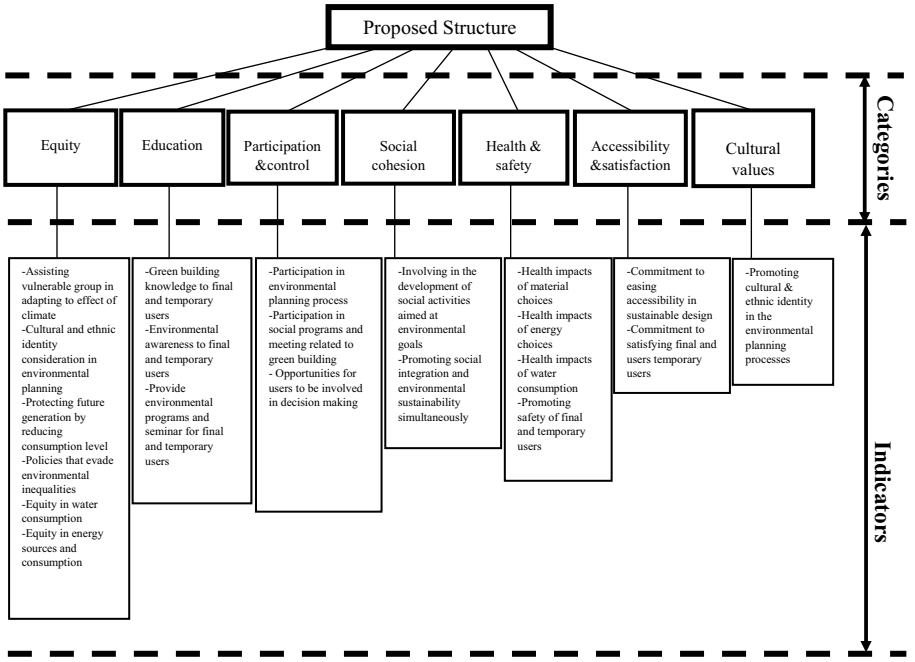


Fig. 15 Proposed structure of social criteria for assessing green building assessment tools

a summary of the relationship between green building assessment tool and the social criteria of sustainable development. The aim of this paper based on the proposed set of categories was to explore different kinds of social sustainability data which would be adopted for the assessment of social criteria operations in green building assessment

tools. The categories were adopted from well-known social sustainable reports and green building assessment tools.

The study shows that SBAT system gives the highest weighting point of the social aspect, while LEED, BREEAM and other prioritize the environmental aspect. Achieving social criteria under LEED and CASBEE system is the most lenient. BREEAM, GSAS, Green Star and SBTool system are not quite rigorous, while SBAT is most rigorous. This productive comparison demonstrates the need to concentrate on the growth toward attaining sustainable development and not aiming certification within a different region. It also depicts a difference in social character between regions, with developing and undeveloped nations focusing majorly on the social criteria as a direct impact factor to aid sustainability, and the developed nation being careless of the social criteria.

From research, gathered social criteria of sustainable development are still rather underexposed and under-theorized in the green building assessment tool. With a diverse perception of social sustainability, 73 social categories were assembled. This makes it difficult to acquire a vibrant definition or comprehension of the social criteria. Likewise, an absence of contextualization confines the grasp and elucidation of social criteria into green building assessment tool. However, from research information gathered this gave a more basic understanding of what social criteria entail and its usefulness in assessment tool. Therefore, social criteria in the built environment can be regarded as an aspect which considers user's needs, quality of life, fairness, satisfaction, and involvement in the built environment according to various contextual factors. This paper aimed to construct a holistic understanding into social sustainability and green building assessment tool. The comparative analysis also indicates that the social criteria of sustainable development can be evaluated by sustainability assessment tools. However, as previously stated, the sustainability assessment depends on a few key categories and indicators. Thus, the available data from green building assessment tool have conditioned the evaluation of only 8 social criteria categories (see Table 3). Thereby, the paper proposed seven sets of social criteria categories (health and safety; participation and control; education; equity, accessibility and satisfaction; social cohesion; and cultural values). However, future efforts should concentrate on improving the categories and further develop them into a framework to aid in identifying the indicator sets. This will serve to assist the development of more sustainable environment and help the regeneration of cities, serving as support to building practitioners, green building assessment tool and government entities to achieve sustainability in the built environment.

The presented analysis demonstrates the importance of the social criteria in design project regardless of its region. Green building assessment tool was developed to help obtain sustainable developed and is not limited to the environmental criteria alone. It should include an overall criteria base system which would aid decision making, consistency toward setting out a sustainable design focused team. The results gathered from the analysis will help define the benchmarks of best practice, which will be useful in preparing the social criteria assessment tool guide.

However, future efforts should concentrate on improving the categories and further develop them into a framework for assessing social criteria in buildings. This will serve to assist the development of more sustainable environment and help the regeneration of cities, serving as support to building practitioners, green building assessment tool and government entities to achieve sustainability in the built environment. This study is a first step toward the development of social criteria in green building assessment tool. The next step will be to conduct a study based on the category and indicator set derived using Delphi technique and AHP in a 3-round process with experts (academy, industry) ranging from

30 to 50, which would aid in the development of category and indicators set by assigning weight point and sorting them in order, so they can reflect the social characteristics of a building.

References

Ahman, H. (2013). Social sustainability- society at the intersection of development and maintenance. *Local Environment, 18*(10), 1153–1166.

Ameen, R. M., Mourshed, M., & Li, H. (2015). A critical review of environmental assessment tools for sustainable urban design. *Environmental Impact Assessment Review, 55,* 110–125.

Awadh, O. (2017). Sustainability and green building rating systems: LEED, BREEAM, GSAS and Estidama critical analysis. *Journal of Building Engineering, 11,* 25–29.

Becker, E., & Jahn, T. (1999). *Sustainability and the social sciences*. New York: Zed Books.

Berardi, U. (2011). Beyond sustainability assessment systems: Upgrading topics by enlarging the scale of assessment. *SUSB, 2*(4), 276–282.

Berardi, U. (2013). Sustainability assessment of urban communities through rating systems. *Environmental Development Sustainability, 15,* 1573–1591.

Bernardi, E., Carlucci, S., Cornaro, C., & Bohne, R. (2017). An analysis of the most adopted rating systems for assessing the environmental impact of buildings. *Sustainability, 9*(7), 1226.

Biart, M. (2002). Social sustainability as part of the social agenda of the European community. In T. Ritt (Ed.), *Soziale Nachhaltigkeit: Von der Umweltpolitik zur Nachhaltigkeit?* (pp. 5–10). Arbeiterkammer Wien, Informationen zur Umweltpolitik 149, Wien. Available at http://wien.arbeiterkammer.at/pictures/importiert/Tagungsband_149.pdf.

Bostrom, M. A. (2012). missing pillar? Challenges in theorizing and practicing social sustainability: Introductory article in the special issue. *Sustainability, 8,* 3–14.

Boulding, K. E. (1985). *The world as a total system*. Beverly Hills, California, USA: Sage.

BREEAM. (2014). *BREEAM UK new construction non-domestic buildings technical manual 2014. SD5076 – Issue: 5.0*. Accessed 6 October 2017.

BREEAM. (2016). *BREEAM international new construction 2016, technical manual SD233—Issue: 1.0*. Dublin: BRE Global Ltd.

CASBEE. (2016). *CASBEE brochure. Institute of Building Environment and Energy Conservation (IBEC)*. Retrieved July, 2017, from www.ibec.or.jp/CASBEE/english/document/CASBEE_brochure_2016.pdf. Retrieved 10 July 2017.

Casula Vifell, A., & Soneryd, L. (2012). Organizing matters: How "the social dimension" gets lost in sustainability projects. *Sustainable Development, 20*(1), 18–27.

Chan, E., & Lee, K. (2008). Critical factors for improving social sustainability of urban renewal projects. *Social Indicators Research, 85*(2), 243–256.

Chiu, R. L. H. (2003). Social sustainability, sustainable development and housing development: The experience of Hong Kong. In R. Forrest & J. Lee (Eds.), *Housing and social change: East-west perspectives* (pp. 221–239). Florence, USA: Routledge.

Colantonio, A. (2008). *Social sustainability: A review and critique of traditional versus emerging theme and assessment method*. Oxford, UK: Oxford Brookes University.

Colantonio, A. (2009). Social sustainability: A review and critique of traditional versus emerging themes and assessment methods. In: M. Horner et al. (Ed.), *SUE-Mot conference 2009: Second international conference on whole life urban sustainability and its assessment: Conference proceedings* (p. 865). Loughborough: Loughborough University.

Colantonio, A., & Dixon, T. (2011). Urban regeneration: Delivering social sustainability. *Urban Regeneration & Social Sustainability: Best Practice from European Cities*, 54–79.

Cole, R. J. (1999). Building environmental assessment methods: Clarifying intentions. *Building Research and Information, 27*(4/5), 230–246.

Cole, R. J. (2005). Building environmental assessment methods: Redefining intentions, In *Proceedings of the 2005 world sustainable building conference, Tokyo* (pp. 1934–1939).

Commission of the European Communities. (2001). *A sustainable Europe for a better world: A European union strategy for sustainable development. Communication from the Commission (Commission's proposal to the Gothenburg European Council). COM (2001) 264 final*. http://europa.eu.int/eur-lex/en/com/cnc/2001/com2001_0264en01.pdf.

Cuthill, M. (2009). Strengthening the social in sustainable development: Developing a conceptual framework for social sustain-ability in a rapid urban growth region in Australia. *Sustainable Development, 18*(6), 362–373.
Davoodi, S., Fallah, H., & Aliabadi, M. (2014). Determination of affective critrions on social sustainability in architectural design. In *Current trends in technology and science. 8th SAS Tech 2014 symposium on advances in science & technology-commission-IV*. Iran.
Dempsey, N., Bramley, G., Power, S., & Brown, C. (2009). The social dimension of sustainable development: Defining urban social sustainability. *Sustainable Development, 19,* 289–300.
Dempsey, N., Bramley, G., Powers, S., & Brown, C. (2011). The social dimension of sustainable development: Defining urban social sustainability. *Sustainable Development, 19*(5), 289–300.
DETR. (2000). *By design: Urban design in the planning system: Towards better practice*. London: Thomas Telford.
Eizenberg, E., & Jabareen, Y. (2017). Social sustainability: A new conceptual framework. *Sustainability, 9*(1), 68.
Elkington, J. (1997). *Cannibals with forks—Triple bottom line of 21st century business*. Stoney Creek, CT: New Society Publishers.
Empacher, C., & Wehling, P. (1999). Indikatoren Sozialer Nachhaltigkeit. Grundlagen und Konkretisierungen. In Institut fUr sozial-okologische Forschung (ISOE) (Ed.), *ISOE Discussion Papers 13, Frankfurt am Main*.
Endo, J., Murakami, S., & Ikaga, T. (2007). Application of a building environmental assessment, CASBEE, and its influence on the building market. Retreived from http://www.irbnet.de/daten/iconda/CIB8054.pdf on 5th of June 2017.
Enyedi, G. (2002). Social sustainability of large cities. *Ekistics, 69*(412–414), 142–144.
Epstein, M. (2008). *Making sustainability work: Best practices in managing and measuring corporate social, environmental, and economic impacts*. San Francisco: Greenleaf.
Eurostat. (2007). *Measuring progress towards a more sustainable Europe: 2007 monitoring report of the eu sustainable development strategy*. Luxembourg: Office for Official Publications of the European Communities.
Gibberd, J. (2002). *The sustainable building assessment tool, the built environment professionals conference*, 1–3 May. Johannesburg.
Green Building Council of Australia (GBCA). (2009a). *Green star overview, certification*. [Online] Available: http://www.gbca.org.au. Green Building Council of Australia. Sydney, Australia. 2009. Accessed 6 October 2017.
Green Building Council of Australia (GBCA). (2009b). *Green star rating tools. Web page on the GBCA Website*. Updated June 16, 2009. Green Building Council of Australia. Sydney, Australia. 2009. [Online] Available: http://www.gbca.org.au/green-star/rating-tools/ August 6, 2012.
GSAS. (2017). *Gulf organization for research and development, GSAS technical guide 2017*, Issue 2, 2017. Reteievd July, 2017, www.gord.qa/admin/Content/Link2322017121232.pdf.
Harmon, J., Bucy, F., Nickbarg, S., Rao, G., & Wirtenber, J. (2009). In J. Wirtenberg, W. Russell, & D. Lipsky (Eds.), *The sustainable enterprise field book, (89–115)*. New York: Greenleaf Publishing.
Harris, J. M., Timothy, A. W., Kevin, P. G., & Neva, R. G. (Eds.). (2001). *A survey of sustainable development: Social and economic dimensions* (Vol. 6). Washington, DC: Island Press.
Holmberg, J. (1992). *Making development sustainable: Redefining institutions policy and economics*. Washington, DC: Island Press.
Jaeger, C., Tàbara, J. D., & Jaeger, J. (2011). *European research on sustainable development: Volume 1: Transformative science approaches for sustainability* (Vol. 1). Berlin: Springer.
Komeily, A., & Srinivasan, R. S. (2015). A need for balanced approach to neighborhood sustainability assessments: A critical review and analysis. *Sustainable Cities and Society, 18,* 32–43.
Kopfmüller, L. et al. (2001). Nachhaltige Entwicklung Integrativ Betrachtet. Konstitutive Elemente, Regeln, Indikatoren, Edition Sigma, Berlin.
Larsson, N. (2007). *Rating systems and SBTool—The international initiative for a sustainable built environment*. Retrieved from http://www.otago.ac.nz/law/conferences/otago036362.ppt. Accessed October 6, 2017.
LEED. (2013). *LEED reference guide for building design and construction 2013 edition, leadership in energy and environmental design program*. Washington, USA: US Green Building Council.
LEED. (2016). *LEED v4 for building design and construction* (pp. 1–144). Washington, USA: United State Green Building Council.
Lehtonen, M. (2004). The environmental-social interface of sustainable development: Capabilities, social capital, institutions. *Ecological Economics, 49,* 199–214.

Littig, B., & Grießler, E. (2004). *Soziale Nachhaltigkeit. Informationen zur Umweltpolitik Nr. 160*. Wien: Bundesarbeiterkammer Google Scholar.
Littig, B., & Griessler, E. (2005). Social sustainability: A catchword between political pragmatism and social theory. *International Journal of Sustainable Development, 8*(1–2), 65–79.
Liu, Y., Dijst, M., Geertman, S., & Cui, C. (2017). Social sustainability in an ageing Chinese society: Towards an integrative conceptual framework. *Sustainability, 9*(4), 658.
Loh, J. (Ed.). (2000). *The living planet report* (p. 1). Gland, Switzerland: WWF.
Lützkendorf, T., & Lorenz, D. (2005). Sustainable building investment: Valuing sustainable buildings through performance assessment. *Building Research and Information, 33*(3), 212–234.
Mckenzie, S. (2004). *Social sustainability: Towards some definitions*. Magil: Hawke Research Institute, University of South Australia.
Murphy, K. (2012). The social pillar of sustainable development: A literature review and framework for policy analysis. *Sustainability: Science, Practice & Policy, 8*(1), 15–29.
New Zealand Green Building Council (NZGBC). (2009). *Green star New Zealand web site*. New Zealand Green Building Council, 2009. Auckland, New Zealand. [Online] Available: http://www.nzgbc.org.nz/main/greenstar. August 6, 2012.
Nguyen, B. K., & Altan, H. (2011). Comparative review of five sustainable rating systems. In 2011 *international conference on green buildings and sustainable cities, Procedia Engineering* (Vol. 21, pp. 376–386).
OECD. (2001). *Sustainable development: Critical issues*. Paris: OECD.
Omann, I. & Spangenberg, J. (2002). Assessing social sustain-ability: The social dimension of sustainability in a socio-economic scenario. In *Seventh biennial conference of the international society for ecological economics.* March 6–9, Sousse, Tunisia.
Organization for Economic Cooperation and Development (OECD). (2016). *Society at a Glance 2016—OECD social indicators*. http://www.oecd.org/social/society-at-a-glance-19991290.htm. October, 10 2017.
Polèse, M., & Stren, R. E. (2000). *The social sustainability of cities: Diversity and the management of change*. Toronto: University of Toronto Press.
Reed, D. (1997). Review brief-structural adjustment, the environment, and sustainable development. *Long Range Planning, 30*(1), 143–144.
Sachs, I. (1999). *Social sustainability and whole and whole development: Exploring the dimensions of sustainable development*. London: Zed Book.
Saunders, T. (2008). *A discussion document comparing international environmental assessment methods for buildings*. Watford, United Kingdom: BRE Global.
Savitz, A., & Weber, K. (2006). *The triple bottom line: How today's best-run organizations are achieving economic, social and environmental success—And how you can too*. San Francisco: Jossey Bass.
SBTool | International Initiative for a Sustainable Built Environment. (2017). Retrieved from http://www.iisbe.org/sbmethod. Accessed October 6 2017.
Sharifi, A., & Murayama, A. (2013). A critical review of seven selected neighborhood sustainability assessment tools. *Environmental Impact Assessment Review, 38,* 73–87.
Thin, N., Lockhart, C., & Yaron, G. (2002). *Conceptualizing socially sustainable development*. London: Department for International Development and World Bank.
United Nations Commission for Sustainable Development (UNCSD). (1996). *Indicators for sustainable development, framework and methodology*. http://www.un.org/esa/sustdev/natlinfo/indicators/indisd/english/english.htm. October, 10 2017.
United Nations Department of Social and Economic Affairs (UNDESA). (2001). *Indicators of sustainable development: Framework and methodologies*. New York: United Nations.
United Nations Department of Social and Economic Affairs (UNDESA). (2007). *Indicators of sustainable development: Guidelines and methodologies*. New York: United Nations.
Vallance, S., Perkin, H., & Dixon, J. (2011). What is a social sustainability? *A clarification of concepts Geoforume, 42*(3), 342–348.
Vavik, T., & Keitsch, M. (2010). Exploring relationships between universal design and social sustainable development: Some methodological aspects to the debate on the sciences of sustainability. *Sustainable Development, 18*(5), 295–305.
Weingaertner, C., & Moberg, Å. (2014). Exploring social sustainability: Learning from perspectives on urban development and companies and products. *Sustainable Development, 22*(2), 122–133.
Woodcraft, S., Hackett, T., & Caistor-Arendar, L. (2011). *Design for social sustainability: A framework for creating thriving new communities*. Young Foundation.