



PLEA 2017 EDINBURGH

Design to Thrive

[Re] Measuring [LEED] Sustainability: From a Global Rating System to Tropical Specificity

Eileen Díaz-Lamboy^{1&2}, Marisela Mendoza³ and Ana Souto³

¹ PhD Student, Architecture, Design and Built Environment, Nottingham Trent University, Nottingham, UK

² Interior Design Faculty, University of Puerto Rico- Carolina Campus, PR, eileen.diaz@upr.edu

³ PhD Supervisor, Architecture, Design and Built Environment, Nottingham Trent University, Nottingham, UK

Abstract: This paper explores the applicability of the LEED certification system through the case study of Puerto Rico (P.R.), a United States (U.S.) Commonwealth island in the Caribbean, where LEED has become widely recognized as a standard because of the geopolitical relationship with the mainland. Although LEED is used internationally, it was initially developed by the U.S. Green Building Council as a tool to measure building performance in a modern American urban environment with temperate climate, a steady economy and easy access to technology. Furthermore, regionalization strategies such as Regional Priority Credits (RPCs) and Alternate Compliance Paths (ACPs), do not address the sociocultural reality of many regions. Therefore, the focus of this research is to analyse what indicators should be added, modified or substituted to develop a revised LEED model for the specific sociocultural context of P.R.? A mixed methods research will be used to compare LEED criteria with Sustainable Assessment Systems (SAS) such as the Building Research Establishment Environmental Assessment Method, the Living Building Challenge and SB Tool. Also, SAS in tropical countries such as Singapore (BCA Green Mark), Costa Rica (RESET) and India (TERI-GRIHA) will be examined. Case studies will be analysed with a main focus in Schools.

Keywords: Sustainable building, School design, Socio-cultural indicators, Green building rating systems, LEED

Green Building, Certification Systems and Regional Adaptation

Introduction to green buildings and sustainability dimensions

Several definitions of sustainability and green building since the 1970s, emphasize on energy, water and materials efficiency; the reduction of environmental impact during the construction phase; as well as the health and wellbeing of building occupants (USGBC Media, 2016; Office of the Federal Environmental Executive, n.d.:8; EPA, 2016). However, “Our Common Future”, also known as the Brundtland Report (1987), stressed the need to target **social** and **economic** aspects in addition to the **environmental** considerations required to achieve sustainable development. While environmental sustainability is concerned with the protection of nature and its resources, its social counterpart deals with the protection of basic universal human rights, such as education; equity; health; safety and security, among others (Axelsson et al., 2013:218; Energy and Resources Institute et al., 2014:59; Walker, 2014:14).

Recent models, such as the “sustainability square”, include **culture** as the fourth pillar, alongside the social, economic and ecological dimensions (Ebert 2011:21, Mateus and

Bragança 2011:1962). While the term encompasses the characteristics of a society, its norms, values, skills, knowledge and beliefs, this new approach aspires to strengthen the cultural sector; and promote its integration in policies related to education, economy and communication, among others (Axelsson et al. 2013; United Cities and Local Governments, 2010:4). The socio-cultural dimensions of sustainability will be further explored throughout this investigation, to demonstrate its application to current certification systems.

Certification systems in Puerto Rico as case study

Worldwide, certification or ‘sustainable assessment’ systems (SAS) such as the Leadership in Energy and Environmental Design (LEED) and the Building Research Establishment Environmental Assessment Method (BREEAM), among others have provided a framework of reference by including criteria and objectives of what a sustainable building should be.

These systems have been used worldwide to rate buildings beyond their country of origin. This is also the case of Puerto Rico, an island located in the Caribbean, which holds the largest amount of certified projects in the region (USGBC, 2016). Being a United States Commonwealth, the LEED SAS has become the most widely recognized standard because of the geopolitical relationship with the mainland. While P.R. shares a common Hispanic background with nearby countries, green building is subject to U.S. laws, building codes and regulations even though its culture, climate, construction systems and native language are different.

School Sustainable Assessment Systems (SAS)

Sustainable Assessment Systems such as LEED and BREEAM, among others, are mostly based on weighting building performance and environmental impact mitigation through resource consumption, mechanical systems efficiency and overall site planning. However, these criteria might overlook critical social components when assessing educational institutions. Schools, which influence the students’ views toward society and the environment and in addition to being the learning centre for more than 75% of the K-12¹ student population in Puerto Rico (Instituto de Estadísticas de P.R., 2014:13), makes the focus of this investigation to assess the applicability of LEED for Schools under the *Schools for the 21st Century* program. This federally funded² program included the “modernization, renovation, or repair of public school facilities”, which had to be certified, verified or consistent with LEED or other equivalent program (U.S. Department of Education, 2009; U.S. Senate, 2008:22099). This project was extended to all 78 municipalities and promoted Puerto Rico’s largest public school improvement program in decades (Fielding Nair, n.d.: 3)

The present study analyses and questions the validity of U.S. LEED as a reliable tool to evaluate buildings in the tropical Caribbean region with distinctly different environmental, economic, and socio-cultural conditions, to revise current and propose new sustainability indicators that could contextualize this system in P.R., for the particular case of Schools. Also, to assess USGBC’s regionalization strategies such as Regional Priority Credits (RPCs), used as part of the LEED for Schools certification process in P.R. to attempt to adapt the system to the local context. Other strategies for climatic adaptation, Alternate Compliance Paths (ACPs) and Innovation in Design credits, will be analysed to determine their applicability.

¹ Based on the U.S. and P.R. Educational system, which names school levels prior to college as kindergarten (K) through the 12th grade (12).

² The American Recovery and Reinvestment Act (ARRA) signed in 2009 by U.S. President Barack Obama, was developed to stimulate the economy of the U.S. and its Territories, including P.R. (“ARRA- Puerto Rico,” 2012).

This paper will discuss and demonstrate the gaps in current LEED indicators in regard to socio cultural factors as part of a larger body of work going on a PhD research project focused on the following objectives:

1. To inform how and determine if the U.S. LEED certification program addresses social and cultural elements as sustainability indicators.
2. To analyse why and propose how LEED indicators and regionalization initiatives by the USGBC could be modified to respond effectively to the tropical context of P.R.
3. To identify what aspects of sustainability³ in the tropical Caribbean P.R. region are excluded from LEED but could be incorporated as indicators.

Methodology and organization

To address the above-mentioned objectives, this research is divided into two main sections, the first includes an overview of the LEED system, as well as an in-depth analysis of its current regionalization strategies. Also, an implementation strategy for recommendations resulting from this investigation will be discussed.

This research will reference widely used **international** SAS such as **BREEAM**, **Sustainable Building (SB) Tool** and the **Living Building Challenge (LBC)**, its categories, indicators and weightings. A comparison between LEED and most recent versions of these SAS will inform what indicators may be added, modified or substituted to develop a revised LEED model for its specific socio-cultural context. Also, **localized** systems such as **Requirements for Sustainable Buildings in the Tropics (RESET)** in Costa Rica, **Green Mark** in Singapore and the **Green Rating for Integrated Habitat Assessment (GRIHA)** in India, that have emerged as a specific solution to the problems of a country or region within the tropics, will be discussed.

To analyse and compare the sustainability dimensions considered in the selected SAS, the second section includes a re-categorization of indicators that was developed as part of this investigation. Finally, contains a summary of social and cultural components deemed relevant for schools.

Leadership in Energy and Environmental Design (LEED)

LEED overview and its implementation in Puerto Rico

The US Green Building Council (USGBC) was established in 1993 by Rick Fedrizzi, David Gottfried and Mike Italiano (USGBC, 2016). LEED version 4 comprises a family of rating systems that address several building types in different stages of development (USGBC, 2016; Todd et al., 2013), that include Building Design and Construction, Operations and Maintenance, Interior Design and Construction, Neighbourhood Development and Homes.

Although LEED was designed in the United States and primarily reflects US market conditions, it has been used extensively around the world. As of July 2016, there are more than 161 countries and territories with LEED projects and over 33,500 certified commercial projects. Currently there are nearly 1,800 K-12 schools certified and over 2,000 registered (USGBC, 2016). Puerto Rico has the largest amount of LEED projects in the Caribbean region with a total of 47, out of which 9 are schools (19%). Additionally, 78 projects are labelled as “registered”, out of which 3 are schools (3.8%).

While most Green Building Councils in Latin America and Caribbean countries promote LEED as their main SAS, countries including Brazil (Selo Azul de Caixa), Mexico (PCES), Costa Rica (RESET) and US Virgin Islands (Green Building Certification) have developed their own SAS that incorporate socio cultural indicators in an attempt to address

³ Sustainability includes environmental, economic, social and cultural dimensions.

local needs.

LEED section weightings, categories and credits

LEED contains prerequisites and credits in nine (9) categories: Integrative Process, Location and Transportation, Sustainable Sites, Water Efficiency, Energy and Atmosphere, Materials and Resources, Indoor Environmental Quality, Innovation and Regional Priority (USGBC, 2016). To determine the LEED score, the total obtained in each criterion is added up, the maximum being 110 points. The number of credits achieved determines the project certification level as Certified, Silver, Gold or Platinum (the highest ranking) (USGBC, 2016).

The process to determine LEED v4 priorities and credit weightings, in order to target “**social, environmental and economic goals**”, was dedicated to answering this question: “**What should a LEED project accomplish?**” (Owens et.al., 2013:2,6). Hence, the LEED Steering Committee developed seven (7) weighted goals, namely: Climate change (35%), Health and well-being (20%), Water resources (15%), Material resources (10%), and Biodiversity (10%), while Economy (5%) and Social equity, environmental justice, and community quality of life (5%) were given the least percentage.

LEED’s Regionalization Strategies

In order to improve global reach, several **regionalization strategies** such as Regional Priority Credits (RPCs), Alternate Compliance Paths (ACPs) and Pilot Credits, have been implemented.

Regional Priority Credits (RPCs)

The **Regional Priority Credit** category, introduced in LEED 2009 allows project teams to earn bonus points by demonstrating compliance with the priority credits identified for a specific location. These credits, selected by the LEED International Roundtable and volunteers from green building chapters around the world, target environmental issues that affect their particular region or country (USGBC, 2016). Social, cultural and economic dimensions could not be considered because RPCs only recognize compliance of existing credits, and these are currently not included in LEED.

Alternative Compliance Paths

In addition to RPC’s **Alternative Compliance Paths (ACPs)**, attempt to adapt LEED to the local context and recognize differences in climatic conditions, codes, standards and laws applicable to projects outside the US (Horst, 2014). Even though projects in Puerto Rico can use some of these Global-ACP’s (USGBC-FAQ), these would not be an effective strategy to locally adapt LEED considering that P.R. references U.S. standards and building codes. While overall consistency would be achieved, the recognition of local social, cultural and economic conditions in LEED indicators would need to be strengthened.

Pilot Credits and Innovation in Design Category

Projects may pursue **Pilot Credits (PC)** within the **Innovation in Design Category**. This strategy allows teams to test criteria in the PC Library developed by others or submit new credits (USGBC, 2016). All proposals are then evaluated by the Pilot Credit Committee (PCC) and approved by the LEED Steering Committee (USGBC 2016).

An analysis of existing PC can give valuable insight about trends and new criteria proposed by project teams. For instance, most of the PC for LEED BD+C are related to the Materials and Resources category (33%), however a smaller percentage of credits (15%) belong to the Innovation category. It is relevant to acknowledge that within this category,

project teams proposed criteria that target social issues such as: (a) Social equity within the community and the project team, (b) Green training for contractors, trades and workers, (c) Integrative Process for Health Promotion, and (d) Prevention through Design.

The above-mentioned PC suggest an interest and need for LEED to target social aspects, however, there is no mention of any cultural aspects. As result, the USGBC's LEED Steering Committee created a Social Equity Working Group to improve the practical implementation of the above-mentioned Social Equity PC (USGBC 2016). Considering that the social and cultural sustainability dimension should be strengthened, the PC Library may be a valuable tool to propose new LEED criteria and test its effectiveness.

Proposed Implementation of Research Findings

LEED regionalization strategies were analysed to determine the best approach to adapt the system for countries in tropical regions. In P.R., the USGBC local chapter, determined RPCs based solely on climatic and environmental conditions in the Island. Since Regional Priority credits were selected from existing indicators, no social or cultural factors were considered.

Out of the LEED Regionalization strategies, the innovation category could be a starting point to test the proposed indicators product from this research. Once approved by the USGBC and tested as PC, a Socio-cultural Working Group, under the LEED Steering Committee, could be developed by the USGBC to further develop these indicators, as it happened with Social Equity credits. Proposed PC could be used by other project teams within the Innovation in Design Category or could be incorporated into LEED as part of a new Socio-cultural Category. Green Building Chapters could then recognize social and cultural credits as critical and select them as Regional Priorities (see Figure 2).

International Comparison of School Sustainable Assessment Systems (SAS)

This section will examine criteria in international and tropical SAS worldwide (BREEAM, Green Mark, GRIHA Prakriti, TERI GRIHA, LEED, LBC, RESET, SB Tool), to determine possible aspects missing in LEED and indicators that could be added into the system. The sustainability square, which includes the environmental, economic, social and cultural dimensions, was used as an initial reference for this analysis. A total of 8 certification systems and 779 indicators were added to a matrix, labelled according to the main issues identified; and regrouped into the following categories and subcategories, as shown in Figure 3 (Ebert 2011:21, Mateus and Bragança 2011:1962).

- **Building Technology and Environmental Impact:** Includes building and site considerations such as Infrastructure; Quality; Management; Efficiency; Material and Resource Availability (Sources); Consumption and Economic issues.
- **Design Criteria:** Includes indicators related to planning and spatial quality in buildings.
- **Social Needs and Integration:** Includes user related social and cultural aspects.

To further determine relevant sustainability cultural and social aspects that should be included in school SAS, a qualitative literature review analysis was developed. The study references work by several authors such as Walker (2014) and Axelsson, et al. (2013), that have developed cultural and social sustainability indicators and metrics to support design strategies and planning. Selected SAS manuals; documentation from the United Nations Education, Scientific and Cultural Organization's (UNESCO) proposal for Culture as the 4th Pillar of Sustainable Development in the Process of the Rio+20 Summit (Culture 21, 2011) and Culture for Development Indicators (United Nations, 2014) were also used as reference.

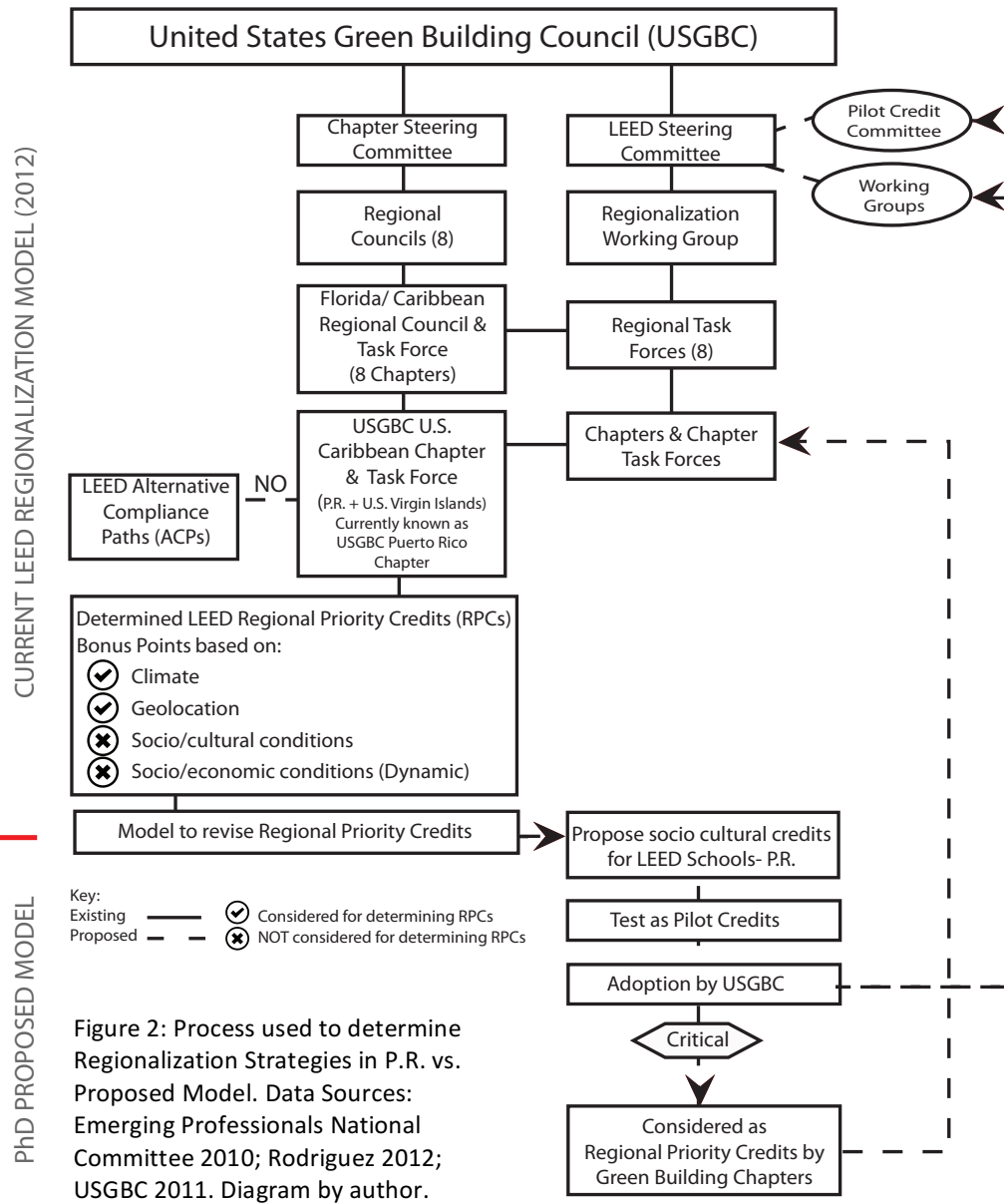


Figure 2: Process used to determine Regionalization Strategies in P.R. vs. Proposed Model. Data Sources: Emerging Professionals National Committee 2010; Rodriguez 2012; USGBC 2011. Diagram by author.

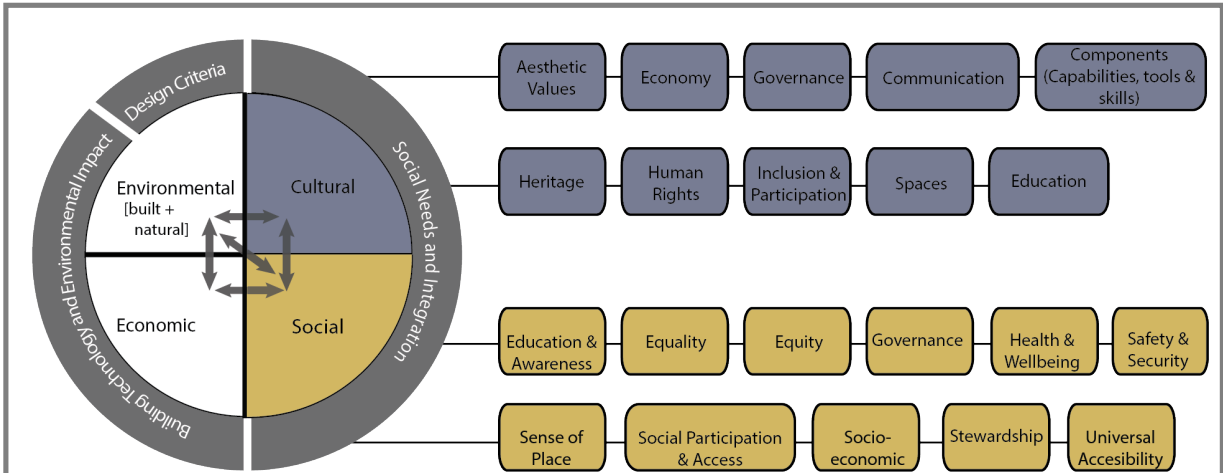


Figure 3: Sustainability Dimensions + Categorization of Indicators in Green Building Certification Systems. Diagram by author.

An analysis of previous studies suggest that cultural sustainability can be defined by the following components: Aesthetic values; Economy, Governance, Communication; Capabilities, tools and skills; Heritage; Human rights, Inclusion and participation; Cultural spaces; as well as Education, as shown in Figure 3 (Axelsson, R. et.al., 2013: 217; Culture 21 2011:1; Intl. Living Future Institute 2014: 59–60; UNESCO, 2014, 1989, 1972; UN, 2014:12; Walker, 2014:12).

While the term **culture** relates to the characteristics of a society or group of people, **social** relates to the “individual, family, or individuals in a society” and their interaction (Axelsson et al., 2013:215; Merriam-Webster, n.d.). Based on the literature review, **social sustainability** can be defined as a combination of the following components: Education and awareness; Equality; Equity; Governance; Health and well-being; Safety and security; Sense of place; Social participation and access; Socioeconomic; Stewardship, as well as Universal accessibility, as shown in Figure 3 (Aguilera et.al., 2006; Axelsson, R., et.al., 2013: 217-218; Diaz-Chavez, 2014:5, Gibberd, n.d.; GBC South Africa, 2014; “Sustainable socioeconomic development,” 2015; Government of Canada, 2010; Intl. Living Future Institute, 2014; Owens 2013:16; Energy and Resources Institute et al., 2014: 57-60; United Nations, 2014; Walker 2014:14; Wynhoven, n.d.).

Even though social and cultural indicators are included in the selected SAS (schools and others), not all components identified on the literature review and outlined on Figure 3 are considered by the certification systems analysed. Table 1 shows the components that are contemplated, the majority being socially related.

LEED’s indicators, classified under the Social Needs & Integration category, for the purpose of this research, are mainly focused on Governance, Social participation and access, as well as the provision of Cultural Spaces. Other relevant indicators can be found under the PC library, as previously discussed, and are focused on Social equity, Education and awareness, Health, as well as Safety and security.

Table 1: Cultural and social components and indicators included in the selected SAS- Schools

Social and Cultural Sustainability Components in SAS					
Cultural Sustainability Components	Other systems	LEED Schools	Social Sustainability Components	Other systems	LEED Schools
Aesthetic values			Education and awareness		*
Cultural economy			Equality		
Cultural governance			Equity		*
Cultural communication			Governance		
Cultural components			Health & well-being		*
Cultural heritage			Safety & security		*
Culture and human rights			Sense of place		
Cultural inclusion & participation			Social participation & access		
Cultural spaces			Socioeconomic		
Cultural education			Stewardship		
			Universal accessibility		
Key	The SAS includes all indicators identified in the literature review; * Indicator included in LEED PC				
	Other Systems (Schools): BREEAM International In Use & NC 2016; Green Mark Existing Schools & New non-residential buildings 2015; GRIHA Prakriti Existing Schools; TERI GRIHA; LBC V3.0; RESET; SBTool 2015-16.				
	LEED for Schools: LEED V4 BD+C & O+M Schools				

Conclusions and future research

The discussion and findings of this paper will inform the overall objectives of the PhD. The sociocultural components identified will be further researched by developing a questionnaire to be administered to green design professionals and school directors. Results from this investigation could benefit LEED and SAS worldwide.

References

- Anon., 2012. *ARRA- P.R.* [online]. Available at: <https://www2.pr.gov/> [Accessed 5.1.17].
- Axelsson, R., et al., 2013. Social and cultural sustainability. *AMBIO*, 42, 215–228.
- Brundtland, G.H., 1987. *Our common future: report for the WCED, United Nations.*
- Culture 21, 2011. *Lobbying for culture as the 4th pillar of sustainable development in the process of the Rio+20 Summit.* United Cities and Local Governments.
- Diaz-Chavez, R., 2014. Indicators for Socio-Economic Sustainability Assessment. In: Rutz, D. and Janssen, R. (Eds.), *Socio-Economic Impacts of Bioenergy Production.* Springer Intl. Publishing, Cham, 17–37.
- EPA, 2016. *Green Building |US EPA* [online]. Available at: <https://archive.epa.gov/> [Accessed 30.12.16].
- Fielding Nair Intl., n.d. *Schools for the 21st century: Setting a new global standard for excellence.* P.R.: AFI.
- Gibberd, J., n.d. *Sustainable building assessment tool residential design (SBAT) 1.04.* Gauge.
- GBC South Africa, 2014. *Technical manual Green Star SA: Socio economic category pilot.* GBC South Africa.
- Horst, S., 2014. *ACPs continue to localize LEED* [online]. Available at: <http://www.usgbc.org/> [Accessed 17.2.16].
- Instituto de Estadísticas de P.R., 2014. *Anuario Estadístico del Sistema Educativo 2011-12.* P.R.: IEPR.
- Intl. Living Future Institute, 2014. *Living Building Challenge* [online]. Available at: <https://living-future.org/lbc/>
- Mateus, R. and Bragança, L., 2011. Sustainability assessment and rating of buildings: Developing the methodology. *Building and Environment*, 46, 1962–1971.
- Merriam-Webster, n.d. *Definition of Social* [online]. Available at: <https://www.merriam-webster.com/dictionary/social> [Accessed 27.3.17].
- Office of the Federal Environmental Executive, n.d. *The federal commitment to green building: Experiences and expectations.* [online]. Available at: <https://obamawhitehouse.archives.gov>
- Owens, B., et al. 2013. *LEED v4 Impact Category and Point Allocation Process Overview.* USGBC.
- Rodriguez, C., 2012. *Regionalization 2012.* San Juan: U.S. Caribbean Chapter.
- Eurostat, 2015. *Sustainable Socioeconomic development* [online]. Available at: <http://ec.europa.eu/eurostat/statistics-explained/index.php> [Accessed 3.2.17].
- The Energy and Resources Institute, Association for Development and Research of Sustainable Habitats, 2014. *GRIHA Prakriti rating for existing day schools manual (Pilot V. 1.0).* India: GRIHA Council.
- Todd, J., Pyke, C. and Tufts, R., 2013. Implications of trends in LEED usage. *BRI*, 41, 384–400.
- UIA, 2012. *RESET: Requirements for sustainable building in the tropics.* Costa Rica.
- UNESCO, 2014. *Basic texts of the 2003 Convention for the Safeguarding of the Intangible Cultural Heritage.* France: UNESCO.
- UNESCO, 1989. Draft Medium-term plan, 1990-1995. In: *General Conference, 25th Session, Paris, France, 17 October - 16 November 1989.* Paris: UNESCO.
- UNESCO, 1972. Convention concerning the protection of the world cultural and natural heritage. In: *General Conference, 17th Session, Paris, France, 17 October - 21 November 1972.* Paris: UNESCO.
- United Cities and Local Gov., 2010. *Culture: Fourth pillar of sustainable development.* Barcelona: UCLG.
- United Cities and Local Gov., 2008. *Agenda 21 for culture.* Barcelona: UCLG.
- United Nations, 2014. *UNESCO Culture for development indicators: Methodology manual.* Paris: UNESCO.
- U.S. Department of Education, 2009. *School Modernization* [online]. Available at: <http://www2.ed.gov/policy/gen/leg/recovery/modernization/index.html> [Accessed 28.12.16].
- U.S. Senate, 2008. Congressional Record. In: *110th Congress Second Session.* Washington D.C., 22098–22099.
- USGBC, 2016. *U.S. Green Building Council* [online]. Available at: <http://www.usgbc.org/> [Accessed 5.1.17].
- USGBC, 2011. *Introduction to LEED Regionalization* [online]. Available at: <http://www.usgbc-illinois.org/> [Accessed 30.4.2016].
- USGBC, 2010. *Emerging Professionals local leaders toolkit* [online]. Available at: <http://www.usgbc.org>
- Walker, E., 2014. *Exploring socio-cultural dimensions of sustainability.* MLA thesis, University of Maryland.
- Wynhoven, U., n.d. *Social sustainability* [online]. U. N. Glob. Compact. Available at: <https://www.unglobalcompact.org/what-is-gc/our-work/social> [Accessed 3.1.17].