

# A Gap Analysis on Urban Sustainability Studies and Urban Sustainability Assessment Tools

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**Abstract** Urbanization rate has been accelerated especially due to industrialization. This acceleration has caused obstacles for healthy urbanization, (e.g. unplanned cities). Increase in the population and uncontrollable migration from rural areas to urban areas have contributed to this problem. New researches have been made and new terms have been created to solve this problem. Sustainability assessment became one of the popular terms in different research fields especially in the field of architecture and urban planning in recent years. This paper is based on an in-depth literature analysis and on the assessment tools analysis. 200 publications on urban sustainability published between 2000-2015 have been investigated with relevant key words. Besides this literature investigation, 6 world leading urban neighborhood sustainability assessment tools have been investigated. This study revealed two gaps in the literature and assessment tools with respect to the sustainable urban planning. These identified gaps are: the need for taking urban scale into account that has an important role for sustainability and the need for taking developing countries and their high population trends in the global sustainability assessment. This study is expected to contribute to the literature with respect to the lessons learned from the past and recent trends in the sustainable urban planning at the global scale.

**Keywords** Sustainable Urbanization, Gap Analysis, Literature Review, Assessment Tools, Urban Studies

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## 1. Introduction

Urbanization and its impact on environment have started to increase rapidly after the Industrial Revolution. Afterwards new terms took place in the literature which highlighted importance of the nature as a result of unplanned population migration from rural areas to cities. The term “ecology” was used for the first time in a letter of Henry Thoreau in 1858.

Industrial settlements have not only affected the brownfields where they were built on, but also all cities and the globe. Intensive migration caused by the industrialization affected urban habitats and floras adversely. Rural population is expected to reach its peak in 2020 as the global rural population is “now close to 3.4 billion and is expected to decline to 3.1 billion by 2050” (As of March 11, 2016, UN reported on its website) [1].

First COP (Conference of Parties) was held in Berlin in 1995 to take precautions against global climate change acts. The developed countries have started to gather annually

since then. After two years in 1997 Kyoto Protocol was signed by parties which guaranteed keeping global warming below 2 degrees Celsius and declining GHG emissions. Since then climate reports presented that this aim could not be achieved till 2015. COP21 Paris meeting in 2015 noted this and parties agreed to keep the global warming on 2 degrees Celsius level with taking precautions of GHG emissions and focusing on renewable energy usages (As of march 14, 2016, Conference of Parties reported on its website) [2].

Sustainable design on architectural scale was the beginning of the sustainable built environment topics. However, there is no at urban level urban sustainability assessment tool. Sustainable design at urban scale is an obvious and immediate need according to recent climatic output data. The recent city formations and reformations have unique situation with this problem. As Einstein contributed this topic with words of ‘The significant problems we face cannot be solved at the same level of thinking we used when we created them.’, we could not achieve our sustainable goals with our conventional understanding of planning. Innovations in planning and tracing trends of recent achievements should be adopted to these new planning approaches.

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Published online at <http://journal.sapub.org/arch>

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## 2. Methodology

This paper analyses recent years' sustainability researches in terms of urban design and neighborhood sustainability assessment tools. An in-depth literature review on the recent literature in the field has been carried out. An in-depth literature review can contribute to the solution of the problems and to obtain beneficial synthesis. Although literature review is usually an important part of the studies in most cases, it can also be a stand-alone work [3]. Systematic review is a specific and reproducible approach for identifying, selecting, and appraising all the literature at a certain agreed level of quality that are relevant to a research question (Booth *et al.*, 2012) [4].

**Table 1.** Systematic approach of the study (Left Side: Literature Research, Right Side: Assessment Tool Research)

1. Research	
Urban Sustainability Literature	World Wide Sustainability Assessment Tools
2. Selection	
Selection Based on Keywords	Common Sustainability Assessment Tools
Selection Based on Research Field	
3. Coding	
Year	Assessment Tools Urban Research Field
Title	
Keyword/s	
Aim	
Methodology	
Target/Result	
Focused Theme/s of the Year	
4. Data Analysis	
Year Profile of Publications	Grouping Assessment Sub Topics
Leading Topics of the Year	
Grouping Inferences of Studies	
5. Discussion	
Literature Gaps	Assessment Tools Gaps
6. Comparison	
Literature Out Puts	Assessment Tools Comparison Out Puts
7. Determination of Needed Gaps Between Literature and Assessment Tools	

This study adopts the systematic review as a methodological approach to review the existing sustainable urbanization literature to identify knowledge gaps for future research agenda. Table 1 shows the phases of this systematic review phases of this study. Listed seven steps have been followed in this study. The first four steps aim to collect enough data about sustainable urbanization in two columns (Literature and Assessment Tools). Although there are many

books written on sustainability, electronic databases (Science Direct Articles) have been examined in terms of recently published articles about urban sustainability. The research topics were then discussed from chronological and thematic perspectives. Research gaps in the literature and assessment tools were identified to guide future studies on sustainable urbanization.

Table 2 shows the first phase of this study. The objective of this review is not to give a comprehensive list of studies but to give an in-depth review of recent trends about sustainable urbanization. 400 articles related with the urban sustainability were examined. A preliminary review was conducted through reading abstracts and keywords of the 400 articles. Two (building scale, construction management studies were eliminated) filter criteria have been applied to select relevant publications for an in-depth review and analysis about urban sustainability. After application of the selection criteria, 200 relevant publications remained. In total 200 publications published between 2000-2015 have been analyzed. Publications have been scanned with 'Sustainable city', 'Smart City' and 'Sustainable Development' keywords. Results have been refined to the publications related with urban sustainability. Table 3 shows the number of articles in related urban study topics. Sustainable built environment studies are more than sustainable studies on energy, environment and ecological studies. The publications provided from Science Direct database at most. Electronic databases are reliable resources in scientific studies like other printed studies. Although there are so many written books, reference works and other works, even in these databases, this study focuses on articles.

**Table 2.** Chronology of first phase of study

Research phases	Studies
1. Literature Research	Electronic data bases and 35 journals are identified
2. Literature Selection	Year periods are determined, related keywords search is done for narrated results
3. Literature Coding	Publications coded in Year, Title, Keywords, Aim, Methodology, Target, Journal, Publisher
4. Data Analysis	Brief inferences of studies, related year popular topics, frequencies of same topic research, used Methods were found out
5. Discussion	Inferences of publications formed to be discussable

Table 3 shows the distribution of 200 publication from 35 journals under created relevant top topics. The journals in these categories are *Procedia Social and Behavioral Sciences* (had the largest number of relevant publications (68 publications)), followed by *Cities* (34 publication), then *Landscape and Urban Planning* (22 publication), then *Renewable and Sustainable Energy Reviews* (15 publication). The rest of the journals had the article count equal or less than 10 which indicates %5 percent and less.

**Table 3.** The number of related studies in the relevant top topics

Relevant top topics of articles	Number of articles	Percentage %
Sustainable Built Environment Studies	81	40,5
Social Science Sustainability Studies	69	34,5
Sustainable and Renewable Energy Studies	29	14,5
Environmental and Ecological Studies	19	9,5
Sustainable Economy Studies	2	1

The title, abstract and keywords of the publications were used for literature coding. When the required information could not be obtained from the title, abstract and keywords, the full publication was evaluated to facilitate coding. The following information was stored in the database during the coding process: publication year of each publication; publication title; publication keywords; research aim; research method; research target; leading themes of the year; journal title.

### 3. Results

#### 3.1. Publications Distributed by Topics

Urban studies have been evolved in the recent era due to

**Table 4.** Grouping inferences of studies by urban studies and related assessment topics

Row	Urban Study Topic	Assessment Topic Code	Assessment Topic
1	Accessibility	Acc1	Need for a sustainable transportation network and management
2	Locality	Loc1	Need for taking environmental and local properties and energy resources into account while building
3		Loc2	Need for taking different scales of public structure and culture into account in terms of sustainability
4		Loc3	Need for being sustainably cultural
5	Innovation	Inn1	Need of use of innovative ideas, inventions and information technologies
6		Inn2	Need for a more powerful and quantitative sustainability assessment
7	Governance	Gov1	Need of policy and management in sustainability
8		Gov2	Need of experience sharing, education and participation
9		Gov3	Need of taking urban scale into account that has an important role for sustainability
10	Ecology	Ecl1	Need for multi disciplinary, global, environmental approach and enterprise
11		Ecl2	Need for sustainable construction, responsive for natural environment
12		Ecl3	Need for taking macro and micro economies into account while assessing sustainability
13	Economy	Ecn1	Need for following recent trends, guessing future trends and guessing problems
14		Ecn2	Need for evaluating economic state
15		Ecn3	Need for taking developing countries and their high population trends and its importance into account about global sustainability assessments

the environmental changes. While accessibility, governance, ecology and economical perspectives of urban planning are being researched since the very beginning, some new perspectives (e.g. innovation, being local added to sustainable urban planning topics) have been added due to globalization.

Table 4 provides a list of assessment topics obtained from 200 publications. This analysis revealed the needs for more sustainable urban planning.

Assessment topic reference frequencies have been shown in the Figure 1 to emphasize the dominant sustainable topics.

At local level local resource usage and being environmental are among the emphasized topics. At the innovation level it is repeated also so many times in publications that ideas are very important for new inventions. Besides macro and micro ecologies, multidisciplinary work has a significant importance about protecting our environment. At the economic level, it is advocated that foreseeing what the people will consume in the near future and making economical policies based on their attitudes are the basis of the economics' understanding.

#### 3.2. Publications Annual Distribution

Publications have been analyzed to determine topics about sustainable urbanization in each year. Figure 2 shows the number of publications per year. Frequencies of the relevant publications have increased in the recent 3 years.

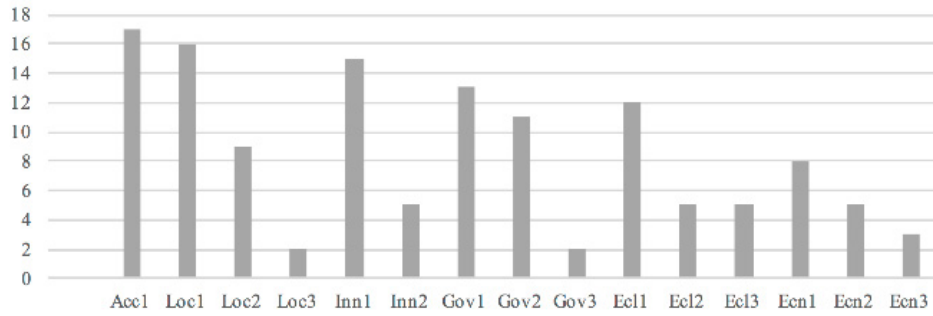


Figure 1. Related reference frequencies

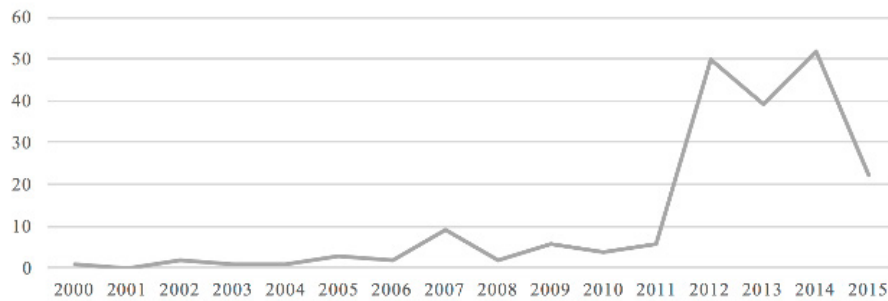


Figure 2. Number of publications per year (till August 2015)

From 2000 to 2015 mostly investigated urban study topics have been analyzed in this phase of the study to understand urban trends and study topics of the recent years.

As seen from the Table 5, sustainable urbanization researches have started to work on energy topic and on building scale from the beginning of 2000. Each year new research topics have been added to research in the field of the sustainable built environment. According to annual topic trends, it is understood that urban policies have changed their scale from macro to micro.

Table 5 shows that from 2000 to 2011 researches<sup>1</sup> have focused mainly on the energy consumption in the built environment. Although energy is keeping its importance in the environmental sustainability, sustainability topic has been started to be studied focusing on the livability from perspective of quality of citizens' life after 2012<sup>2</sup> intensively. In 2013<sup>3</sup> it is shown that as one of the result of urban sprawl and highly urbanization, peripheral of cities have been effected by the harmed ecologies. Quality of life has been effected adversely due to poor air quality (e.g. in China). After 2014<sup>4</sup>, researchers have focused more on policies' and decision making organizations' affects on sustainable built and unbuilt environment. Studies on transportation, logistics and innovations have been intensified after 2014. Educating developing countries besides developed countries became an emphasized topic in the studies in recent years. Furthermore, participation identity became noteworthy subject in 2015.<sup>5</sup>

Table 5. Frequently investigated research topics since 2000 in the field of sustainable urbanization

Years	Leading topics
2000-2005	Energy consume models
2006	Sustainable designs

2007	Energy based sustainability
2008	Sustainability assessments
2009	Debate on sustainability critics
2010	Energy based green construction
2011	Energy efficient buildings
2012	Energy assessment of built environment
	Sustainable urbanization
	Public realms
	Macro economies
	Quality of urban realms
	Urban sprawl
2013	Urban ecosystem
	Urban renewable energies
	Sustainable development
	Urban resilience
	Zero carbon
	Quality of life
2014	Energy consume
	Sustainable energy policies
	Regional sustainability and social adaptation
	Urban logistics
	Sustainability education
	Future sustainable city models
	Innovation and information techniques
2015	Assessment of renewable energy resources
	Intelligent Transportation
	Green infrastructure and nature relation
	Comfort and quality of life
	Participation and identity

### 3.3. Urban Neighbourhood Sustainability Assessment Tool Selection

Urban sustainability is not a new discussion topic. After the smart city term was unveiled in the urban planning and construction in 1950s, in 1960s the Eco-City term became a popular topic as a result of ecologically destroyed lands in the post industrial revolution period. Afterwards ecological planning came on to table in the following decade. Many precautions had been taken to protect our environment. There were, however, some problems. In 1986 the “Green Washing” (by Jay Westewelt) term took place in the publications. This indicates that there were still problems in achieving a real sustainable environment. One of the mile stones about the sustainability achievement is the Brutland Report “Our Common Future” in 1987. This report announced that sustainability is a common problem which can be solved by global common policies.

After the United States Green Building Council (USGBC) and United Nations Commission of Sustainable Development (UNCSD) were founded in 1993 first neighborhood scale sustainability assessment tool, CASBEE UD (Japan) was launched in 2006. Subsequently LEED ND (USA) in 2009, The Pearl Rating System (Abu Dabi, UAE) in 2010, DGNB NUD (Germany) 2011, Breeam Communities (UK) in 2011 and many other neighborhood sustainability assessment tools were released. In this study world recent top 6 sustainability rating system at urban neighborhood level have been analyzed. The investigated topics in these assessment tools have been analyzed and cross matched between literature review to find gaps that can enlighten and contribute to urban sustainability researches.

### 3.4. Sustainability Assessment Tools Criteria Analysis

Sustainability assessment tools calculate sustainability of architectural and urban planning projects. The six leading sustainability tools and certification systems analyzed in this paper are: LEED ND (USA) [5], Breeam Communities (UK) [6], DGNB NUD (Germany) [7], CASBEE for UD (Japan)

[8], Greenstar Communities (Australia) [9] and Green Mark for Districts (Singapore) [10]. It was paid attention to analyze most recent versions of these tools.

It is noticed that leading assessment tools are released from developed countries. These tools are applicable worldwide. As it is seen in Figure 3 selected tools have different origins.

## 4. Discussion

From the beginning of the second millennium until the end of the first decade, sustainability topic has been mainly focused on the energy topic. Energy efficient building movement spread rapidly throughout the world. While sustainability was a popular topic in the beginning of 2000s, quality of life and participation in cities became more important research topics mainly after 2012. Studies, after 2012, show that education plays a critical role in the public’s adaptation of the sustainable approaches and in the success of the policies.

A cross evaluation and check has been performed between literature and assessment tools analysis in this part of this paper. Urban study topics have been listed in the Table 6, and assessment topics cross checks with the assessment tools have been provided in the Table 7.

Table 6 indicates that the Breeam Communities involves all investigated topics. Locality and ecology topics are concerned by all tools. Accessibility topic takes place among the assessment criteria in all tools except in the Greenstar Communities. DGNB NUD and CASBEE for UD have no innovation criterion.

According to the Table 7, all assessment tools investigated cover intensively the 3 assessment criteria (1,2,12) in Table 4. The two gaps identified are: the need for taking urban scale into account that has an important role for sustainability and the need for taking developing countries and their high population trends in the global sustainability assessment’.



Figure 3. Selected world six leading neighbourhood sustainability assessment tools’ geographical locations

**Table 6.** Urban study topic comparison between literature review outputs and the urban planning sustainability assessment tools investigated (1: included, 0: excluded)

	USA	UK	Germany	Japan	Australia	Singapore
	LEED v4 ND	Breeam Communities 2012	DGNB NUD v.2012	CASBEE for UD v.1.0	Greenstar Communities v.1.0	Green Mark for Districts v.2.0
Accessibility	1	1	1	1	0	1
Locality	1	1	1	1	1	1
Innovation	1	1	0	0	1	1
Governance	0	1	1	1	1	0
Ecology	1	1	1	1	1	1
Economy	0	1	1	0	1	0

**Table 7.** Assessment criteria comparison between literature review outputs and the urban planning sustainability assessment tools investigated (#: related sub topic numbers of assessment tools, 0: excluded)

	USA	UK	Germany	Japan	Australia	Singapore
Related row number in Table 5	LEED v4 ND	Breeam Communities 2012	DGNB NUD v.2012	CASBEE for UD v.1.0	Greenstar Communities v.1.0	Green Mark for Districts v.2.0
1	12	9	7	23	3	3
2	11	13	19	21	3	14
3	0	1	2	1	3	0
4	1	0	1	0	0	0
5	7	1	0	8	3	9
6	0	0	0	0	0	1
7	0	5	7	9	2	1
8	3	0	2	3	7	2
9	0	0	0	0	0	0
10	1	0	0	0	0	0
11	9	1	0	9	0	2
12	6	8	5	12	6	5
13	0	1	2	0	4	1
14	1	2	0	0	1	0
15	0	0	0	0	0	0

## 5. Conclusions

Cities are living complex entities built up by human beings. As Herbert Girardet says in his work on *Cities and Sustainability* ‘currently cities are not centres of *civilisation* but *mobilisation* of people and goods’ [11]. Nevertheless, more researches should be concentrated on this complexity to find solutions about how to live more sustainable in cities.

This paper provided trends in the recent years’ sustainability researches in terms of urban design. According to investigated studies more participated and multi disciplinary understanding urban design and planning with support of innovations are advised.

This paper also provided analysis about the neighbourhood sustainability assessment tools. Assessment tools’ scale and scope need to cover urban scale sustainability. Neighbourhood scale studies are not common as the studies at the building scales. The main reason might

be the complexities of the cities. Creating a comprehensive and ultimate city scale sustainability tool is not an easy task to achieve. As studies mention local properties, citizens’ attitudes and their life habits affect their sustainability performance. Instead of trying to explore or invent one acceptable approach for a sustainable development, local sustainable tools at urban levels should be studied. This study has identified two gaps, namely: the need for taking urban scale into account that has an important role for sustainability and the need for taking developing countries and their high population trends in the global sustainability assessment’. These two point should be taken into account by first key actors, governments. As also Jorgen Sanders emphasizes on governing ‘Most of the solutions to today’s global problems exist, and the only reason they’re not implemented is that we don’t have strong government’ [12].

It is suggested that the findings of this study can contribute to planners and policy makers in creating more sustainable

cities. Further studies are recommended to be carried out on sustainability education and on encouraging citizens to live and behave sustainably

## ACKNOWLEDGEMENTS

This study is a part of continuing Ph.D. study in the Urban and Regional Planning Program at Istanbul Technical University.

## Notes

1. Studies published in 2000-2011 and listed in the bibliography part of this study
2. Studies published in 2012 and listed in the bibliography part of this study
3. Studies published in 2013 and listed in the bibliography part of this study
4. Studies published in 2014 and listed in the bibliography part of this study
5. Studies published in 2015 and listed in the bibliography part of this study

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