University of Nottingham

UK | CHINA | MALAYSIA

The Development of an Integrated Participatory Framework for the Early Selection of Sustainability Indicators for Neighborhood Sustainability Assessment Tools: An African Perspective

Submitted August 2018, in partial fulfillment of the conditions for the degree of

Doctor of Philosophy

Ayotunde Oluwaseun Dawodu

6517877

Supervised by Dr Ali Cheshmehzangi and Dr Arthur Williams

Department of Architecture and Built Environment

University of Nottingham

University of Nottingham

Faculty of Science and Engineering

Department of Architecture and Built Environment

DECLARATION OF ORIGINALITY

Title of Thesis

.....

.....

.....

.....

This thesis has been written by me. Material from any outside source that I have used directly or indirectly is acknowledged accurately and I have made clear the extent to which it has been used.

Name .....

Degree .....

Signed .....

Dated .....

Abstract

Neighborhood sustainability assessment tools (NSATs) have been one of the most important tools for gauging and assessing sustainability practices on an urban scale. It is also the modern day tool used to mitigate undesirable changes due to urbanization while systematically and simultaneously improving communities or cities environmental, economic and social well-being. From the early 2000s till date, several tools have been developed in different regions of the world. The initial set of tools came from more industrialized parts of the words with tools such as BREEAM Communities - UK, LEED Neighborhood Development - US and CASBEE Urban Development - Japan. Slowly, less industrialized countries have followed suite, with tools such as Green Building Index- Malaysia, Green Township-India and BERDE Clustered Development - Philippines. Yet closer inspection showed that no such NSAT exists in the region of Africa. This observation was quite astounding based of the current situation in Africa, which include but not limited to rapid urbanization, severe impact of climate change such as droughts and floods, limited water access, lack of energy access, economic poverty, institutional failures in governance and planning, archaic or draconian technologies and infrastructure etc. These issues are heavily prevalent in African nations and yet it is baffling that no NSAT has been developed for countries within this region, especially since they stand the chance to gain immensely from the NSAT initiative, if applied properly. Further investigation also showed that these tools were not without their flaws and were not as effective as presumed to be. Some of these flaws include their overly environmental focus, the subjective nature of the point based system which NSATs have all come to adopt, their overly top-down method in indicator selection etc.

Considering the abovementioned motivations, this study aims to investigate the properties and characteristics of previously developed NSATs, in a bid to provide the means for African nations to develop their version of NSATs. The DNA of NSATs consist of three major phases (1) The selection of headline sustainability indicators (HSI) (selection of main

sustainability issues to be tackled) (2) the selection of sustainability indicators (otherwise called criterion in NSATs) that provide the metric to achieving the given HSI (3) the selection of the point based system to assign sustainability points. This research investigates the first stage, as this stage (early selection of HSI) provides the first point of action in the optimization process and research will subsequently show that some key flaws in NSAT development can also be addressed here. This study also utilizes the city predicted to becoming the most populous mega city in Africa by 2025, Lagos, Nigeria as a case study to illustrate the parameters to consider in not only the adoption of the tool to a different context but the optimization of the tool as a whole.

To achieve the above, a proposed indicator selection framework was developed to aid the early selection of HSI. Through a detailed analysis of selected NSATs, the concept of a sustainability pathway model (SPM), was developed, and based on the earlier conceptualizations of Valentin and Spangenberg (2000) was used to appraise and characterize the various Dimensions of sustainability (DoS) i.e. environmental, social, economic and institution; in order to coherently understand their relationships and applications in any given NSAT. The SPM approach was used to analyze 15 different NSATs. This was not only to bring out inherent traits of developed NSATs; it was used as a process to enhance the selection process of HSI. Subsequently, it was shown that the predominant focus of these NSATs was mainly environmental. It was also shown that the DoS under a given HSI need to be interrelated to enhance their ability to be more impactful in terms of sustainability operations in the implementation phase. In line with this, the study argued and demonstrates that the reason for the environmental aspect being the vantage point from which most NSATs are developed is due to the "top-down approach" and "local context" considered in the design of these NSATs. Accordingly, we posit that if such a "top-down approach" is adopted as the basis for the design of NSATs for African countries, there would be significant impediments particularly in the implementation phase.

Following our detailed critique and analysis, we then attempt to recreate a scenario, where elements of the NSATs concentrating on the themes of "Land use and Transportation" are designed using the results from questionnaires of 200 individuals residing in Lagos metropolis (the most densely populated region in West Africa). The methods used involved an extensive review of literature (variations of content analysis), survey based method (utilized the concept of critical case sampling) and analytical comparison of a range of NSATs. Our findings demonstrated that the "green agenda" which most NSATs usually pursue do not necessarily reflect the reality of the "populace" whom these NSATs are supposed to serve particularly from the standpoint of the prevailing developmental challenges in Lagos and African cities as a whole. Thusly, with the strong social and economic requirements displayed by the "populace" we were able to identify aspects in which a principally "expert-led" development of NSATs would falter for the specific case of Lagos as an example of an urbanizing sub-Saharan African metropolis. Based on the analysis of our results, we were able to identify congruence points between the "experts" and "populace" which then served as the basis for the design of an effective NSAT template for sub-Saharan African cities.

In line with our findings, we thus come to the conclusion that NSATs which would adequately serve Lagos, Nigeria's and indeed Africa's quest for sustainability must have the following characteristics:

(i) Indicators for NSATs should be developed or selected based on the interrelationship between the four dimensions of sustainability. An indicator that considers one dimensions is far less sustainable than that considers multiple dimensions.

(ii) Sustainability though important in the African context must not be "imposed", but rather be designed through detailed concentration on the social and economic aspects which are important to the "populace", and integrated with the environmental aspect which "experts" usually focus on, coupled with being able to adequately fit with institutional directives that are implementable and realistic

(iii) The early selection of HSI through an integrated of participatory process can be obtained through three steps:

a. Use of sustainable pathway model (understand previous NSATs and associated HSI).
b. Select HSI from preexisting NSATs developed by experts.
c. Validate the selected HSI and introduce new HSI if necessary through the community participation.

Acknowledgements

I would like to humbly and gratefully acknowledge practically, intellectually, emotionally and financially the support and help of all the professors, students, friends and family that took their time to ensure my well-being and support my journey towards achieving a doctorate degree.

First and foremost, I would like to thank God for keeping me and being faithful to me during the course of my study. Furthermore, I would like to give my deepest appreciation, gratitude and love to;

PhD Supervisors: I would like to thank my First supervisor, Dr Ali Cheshmehzangi, whose continuous support throughout the years was endless; by providing much needed advice and guidance in areas which I was unfamiliar with, and also providing feedback and generating different ideas at various stages of my research. I would also like to thank my second supervisor, Dr Arthur Williams for his support and feedback throughout the years.

Family Members: My Parents, Dr Jaiyeola Dawodu and Mrs Omowunmi Dawodu for their continuous prayers, emotional and financial support. I also owe thanks to my younger siblings, Seyi and Yemi Dawodu for their support and encouragement.

Colleagues and friends: I would also like to thank my friends who made this journey worthwhile through their support in various ways. I give special thanks Olutoye Remi-John, Olanubi Olawale, Babatunde Enilari, Chris Umebese, Ogbonna Nwodo, Olatoke Gbolahan Olaniyan Caxton-Martins, Felix Osebor, Collins Ezeh, Jumoke Oladejo, Nasiru Ibrahim, Abubakar Yusuf, Bamidele Akinwolemiwa, Azeezah Usman, Valerie Owamagbe, Chinazor Ukwuegbu and Megan Hau for the motivation, discussions, brainstorming, laughter and tears and above all being there for me. Finally, my colleagues in the IDIC PhD cohort year of 2014 for their friendship, advice and support.

Contents

Abstract 2
Acknowledgements 6
List of Tables 11
List of Figures 12
List of Abbreviations 13
Chapter 1 14
1.1 Sustainable Development: Neighborhood Sustainability Assessment Tools 15
1.2 Research aims and objectives 20
1.2.1 Aims and Objectives 20
1.2.2 Research questions 20
1.3 Research Approach 21
1.4 Motivations and Importance of Study 21
1.5 Thesis structure and synopsis 25
Research Questions 30
Aims 31
1.6 Innovation and Originality 33
References 35
Chapter 2 37
2.1 The quest for sustainable urban development 38
2.2 Aims and objectives 40
2.3 Literature review 40
2.3.1 Sustainability and the four dimensions 40
2.3.2 Neighbourhood sustainability assessment tools 43
2.2 Methodology and Overview 49
2.2.1 Conceptual motivation 49
2.2.2 Overview of theoretical model 50
2.2.3 Case study testing: overview of NSAT 50
2.3 Results 55
2.3.1 Introduction to sustainable pathway model (SPM) 55
2.3.2 Results from case study analysis 60
2.4 Discussion 63
2.4.1 SPM analysis of NSATs 63
2.4.2 SPM as a template in the development of NSATs 73
2.5 Conclusions 74

2.5.1 Aspects of sustainability visualization as a map for visualizing the sustainability pathway 74
References 77
Chapter 3 83
3.1 The institutional conundrum of NSATs 84
3.2 Literature review 90
3.2.1 Understanding the true nature of institution 90
3.2.2 Current situation in Africa and Nigeria 95
3.3 Methodology 100
3.3.1 Classification of institutions 101
3.3.2 Theme-based comparison 101
3.3.3 Dimensional analysis 101
3.3.4 Procedural, feature and performance categorization 103
3.4 Results 105
3.4.1 Classification of Institutional Dimension of Sustainability 105
3.4.2 General statistics on E-HSI 111
3.5 Discussion 117
3.5.1 Trend, characteristics and implications of Energy oriented sustainability indicators in currently existing NSATs 117
3.5.2 Impact, limitations and solutions to the adoption of existing HSI 122
3.6 Conclusions 134
References 137
Chapter 4 143
4.1 The pathway to the selection headline sustainability indicators 144
4.1.1 Significance of this study 147
4.2 Literature review: motivation and challenges of sustainability indicator development 148
4.2.1 The Importance of the four dimensions of sustainability in achieving sustainable development 148
4.2.2 Identification of the fundamental principles in sustainability indicator development 149
4.2.3 The Existence of global sustainability indicators 151
4.2.4 Systematic selection and clarity in sustainability indicator selection ... 152
4.3 Research methods 154
4.3.1 Qualitative and Quantitative Content Analysis 154

4.4 Results 167
4.4.1 Optimized selection of sustainability indicators 167
4.4.2 Selection of common set HSI and number optimization 168
4.4.3 Universal Sustainability Indicators 174
4.5 Discussion 176
4.5.1 Selection of ideology and conceptual frameworks 176
4.5.2 Selection of common set of HSI and number optimization 178
4.6 Conclusions 183
References 186
Chapter 5 195
5. 1 Introduction 196
5.1.1 The need for participatory approach for early selection of sustainable indicators 196
5.2 Literature Review 199
5.2.1 Integrated approaches to early selection of sustainable indicators 199
5.2.2 Best practices of the bottom-up participatory approach 202
5.2.3 Stakeholder analysis and methods 208
5.2.4 Selection of Case Study 211
5.3 Methodology 216
5.3.1 Phase 1: Literature review and Top-down selection 216
5.3.2 Phase 2: Bottom up approach via Questionnaire 220
5.4 Results 225
5.4.1 Bottom-up approach to sustainable site based HSI 225
5.4.2 Bottom-up approach to sustainable transport 231
5.4.3 Relevancy and constraints 236
5.5 Discussion 238
5.5.1 Expert initiated integrated participatory approach for early selection of indictors 238
5.5.2 Replacement of the point based system 255
5.6 Conclusions 256
References 258
Chapter 6 265
6.1 Debrief and Overall achievement of research aims and objectives 266
6.1.1 Perspectives on the development of practicable NSATs: road from template to actual tool 267

6.2 Limitation of the research 288
6.3 Implications of the findings 290
6.4 Implications for future research and application 291
References 293
Appendix 295
Appendix 1A: Questionnaire developed and participation Information sheet 296
Appendix 2A-1: Description of 15 Aspects of Sustainability 304
Appendix 2A-2: Dimension placement of NSATs 305
Appendix 2A-3: SPM percentage analysis of NSATs 309
Appendix 2A-4: SPM Aspect analysis of NSATs 310
Appendix 3B-1: Keys to the classification of energy based institutions 310
Appendix 3B-2: Energy based –headline sustainability indicator and frequency 312
Appendix 3B-3: Theme based comparison and Procedure, Feature and performance based placements 313
Appendix 3B-4: Number of E-HSI for each NSAT 317
Appendix 3B-5: Frequency of collated theme and SPM analysis of each E-HSI 318
Appendix 3B-6: Allocation of institutional dimensions according to region of the world 319
Appendix 4C-1: least used indicators (1, 2 occurrences) 321
Appendix 4C-3: theme placement of nine NSATs 323
Appendix 5D-1: Participants general information (SPSS) 335
Appendix 5D-2: Transport data and Land use data from (SPSS) 337
Appendix 6E-1: Breakdown of Verification process of Integrated Approach 366
Appendix 6E-2: Breakdown of Verification process of Integrated Approach 372

List of Tables

Table 1.1: World urban characteristics and predictions (Source: UN-habitat, 2013)……..16

Table 1.2: The overall structure of thesis……..25

Table 1.3: Innovation and originality……...33

Table 2.1: Variables to consider in a balanced sustainable assessment (Source: Komeily and Srinivasan, 2015) ……...47

Table 2.2: NSATs to of developed and developing nations……54

Table 2.3: Characterization of the different Aspects of sustainability metrics as viewed from the SPM……..60

Table 3.1: Status of building energy standards development and adoption in 60 developing countries (including emerging and newly industrialized countries) ……..97

Table 3.2: Recently selected policies in parts of sub-Saharan Africa……..98

Table 3.3: Neighborhood sustainability assessment tools and regions of development……100

Table 3.4: Classifications of institutions ……101

Table 3.5: Results of the classifications of institutionally oriented headline sustainability indicators……..107

Table 4.1: NSATs and basic properties ……155

Table 4.2: Dimensional analysis and number of occurrences of Disaster Resilience and Climate Adaptation……..164

Table 4.3: Table of number of HSI and frequency of occurrence of nine NSATs……171

Table 4.4: Table of common indicators and interrelationships of 3rd to 9th occurrence……172

Table 4.5: Point, linear and planar aspect of indicator occurrences……..174

Table 4.6: Statistics on most widely used SI (9, 8, 7 occurrences)……175

Table 4.7: Process flow of HSI selection and optimization of results……182

Table 5.1: Participation survey methods against a variety of evaluation criteria (Source: Gene and Lynn, 2000)…… 210

Table 5.2: Chosen HSI for investigation……210

Table 5.3: Breakdown of respondent's information……..222

Table 5.4: Key results on sustainable land use ……..225

Table 5.5: Key results on sustainable open spaces……229

Table 5.6: Key results on sustainable transport and connectivity……231

Table 5.7: Relevancy and constraints of HSI……236

Table 6.1: Gaps and limitations in Current Tools with respect to Africa……271

Table 6.2: Gaps and limitations in Current Tools with respect to Africa……..272

Table 6.3: Selected HSI from the list of low occurring HSIs……286

List of Figures

Fig. 1.1: Africa's 20 largest cities (Source: UN-habitat, 2015)....19

Fig. 1.2: Block overview of thesis....29

Fig. 2.1: Representation of the four dimensions of sustainability 49

Fig. 2.2: Illustration of the ideology of sustainability pathway model....58

Fig. 2.3: SP of NSATs of developed nations 61

Fig. 2.4: SP of NSATs of developing nations....62

Fig. 2.5: Percentage Aspect of SP....62

Fig. 3.1: Example of HSI for LEED-ND NSAT....103

Fig. 3.2: Sustainable pathway of all 15 NSATs (Energy)....110

Fig. 3.3: Business as usual indicators versus indicators that consider informal institution....111

Fig. 3.4: Energy based headline sustainability indicator and frequency from supply and demand side.112

Fig. 3.5: Percentage distribution of E-HSI from supply, demand side and hybrid side....113

Fig. 3.6: Procedure, feature and performance based indicators of all indicators in the fifteen NSATs and of only institutional based indicators (Energy)....114

Fig. 3.7: Number of E-HSI according assessment tool developers....115

Fig. 3.8: Comparison of number of E-HSI allocated to each NSAT....116

Fig. 4.1: Headline sustainability indicator extracted from GBI titled Regional Materials (Source: Green Building Index 2011)....161

Fig. 4.2: Headline sustainability indicator extracted from GSAS titled Regional Materials (Source: Abu Dhabi Urban Planning Council 2010)....161

Fig. 4.3: Headline sustainability indicator extracted from BREEAM communities titled Transport Assessment (Source: Bre global 2012)....162

Fig. 4.4: Concept of the sustainability pathway model 163

Fig. 4.5: Frequency use of total number of indicators....168

Fig. 5.1: Arnstein's participatory ladder obtained from (Source: from Arnstein, 1969)....203

Fig. 5.2: The Effective Decision Model of Public Involvement (Source: John Clayton, 1993)....204

Fig. 5.3: Simplified map of Lagos and Nigeria....212

Fig. 5.4: Methodological steps of testing relevancy of HSI via bottom-up approach....218

Fig. 5.5: Expert-initiated integrated participatory approach and guiding rules....239

Fig. 5.6: A questionnaire expert-initiated integrated participatory approach....248

Fig. 6.1: Multi-dimensional distribution of featured sustainability initiatives in eco-development....271

Fig. 6.2: Three stage pathway to the early selection of HSI through integrated participation....284

List of Abbreviations

Name	Abbreviations
BEAM Plus neighborhood (Hong Kong)	BEAM
BERDE Clustered Development (Philippines)	BERDE
Building Research Establishment Environmental Assessment Method for communities	BREEAM Communities
Comprehensive Assessment System for Built Environment Efficiency for Urban Development	CASBEE-UD
Dimensions of Sustainability	DoS
Gulf Cooperation Council	GCC
Greenhouse gas	GHG
Green Mark for Districts (Singapore)	GMD
Headline sustainability indicators	HSI
Indian Green building council - Township	IGBC
Leadership in Energy and Environment Design for Neighborhood Development	LEED-ND
Nigerian Building Code	NBC
Millennium development goals	MDG
Neighborhood Sustainable Assessment Tools	NSATs
Sustainable development goals	SDG
Sustaianble Pathway	SP
Sustaianble Pathway Model	SPM
Sustainability indicators	SI
Tractability, Relationality, Adaptability Contextuality	TRAC
United Nations	UN
United Nations Human Settlements Programme	UN-Habitat
United Nations Environment Programme	UNEP
United Nations Statistics Division	UNSD

Chapter 1

Introduction – Overview, Aims and Questions for Assessment Tools

"Let our advance worrying become advance thinking and planning."

~ Winston Churchill

1.1 Sustainable Development: Neighborhood Sustainability Assessment Tools

Buildings make the world go round, why? because it is no secret that buildings account for one quarter of world harvested wood, two fifths of all material and energy flow and about one sixth of the world's freshwater withdrawal (Emmanuel, 2004). This contextualizes the global environmental problems in the world, especially within the developing nation arena which is characterized with relatively high level of CO_2 emissions. To paint a clearer picture CO_2 emissions from the Gulf Cooperation Council (GCC) countries are three times higher than the average of 25- European Union countries (Alyami and Rezgui, 2012). According to Haapio and Viitaniemi (2008, 2012) and Reith and Orova (2015), this may be attributed to lack environmental assessment tools and planning tools which has the ability to diagnose and prescribe best practice sustainability procedures for the built environment. As such various schemes, planning procedures, frameworks and assessment tools have been established. These tools are currently seen as one of the best methods to achieve urban sustainability, noting that urban sustainability is a desired state in which the urban society strives to achieve a balance between environmental protection and integration, economic development and regeneration, and social equity and justice within cities as long–term goals through the strategic process of sustainable urban development as a desired trajectory. Thus, as a subset of urban sustainability, by achieving the aforementioned urban sustainability state in various neighborhoods, it becomes a viable method to reach city wide or country wide sustainability targets.

In most industrialized parts of the world, market driven industry frameworks has gradually become the order of the day. This generally commenced with the development in 1990 of sustainable environmental assessment and sustainable certification of buildings, which was then extended to Neighborhood and community based sustainable assessment tools (Haapio and Viitaniemi, 2008, Haapio, 2012). These initiatives were developed with the sole aim of evaluating and rating the performance of a community against pre-set criteria and themes thus determining a communities' success or failure towards the attainment of

sustainability (Haapio, 2012). The list of Neighborhood Sustainable Assessment Tools (NSATs) in the market include but is not limited to Leadership in Energy and Environment Design for Neighborhood Development (LEED-ND) - US, Building Research Establishment Environmental Assessment Method for communities (BREEAM Communities) – UK, Comprehensive Assessment System for Built Environment Efficiency for Urban Development (CASBEE-UD) – Japan, Green Star communities – Australia etc. However, the development of these tools has left Africa lagging behind once again with no be-spoke tool developed for its sustainable development of communities and cities. Yet, Africa is faced with compounding issues, with rapid urbanization set to reach 60% by 2050 of the 1960 Level (See Table 1.1). In addition to the fact that fossil fuel consumption is still a norm within these regions but replenish-able and renewable sources such as solar, wind and biomass energy are in abundance yet under-utilized (Wilkins, 2002). When the proposition that by 2020 between 75 to 250 million would be exposed to heightened water stress, soil degradation and reduction in agricultural productivity is considered, coupled with the pre-existing vulnerability to land, famine and lack of clean water; the issues facing sustainability in Africa becomes very dire and challenging.

Table 1.1: World urban characteristics and predictions (UN-habitat, 2013)

Region	Urban Population (Millions)					Percentage Urban (%)				
	1950	1975	2000	2011	2050	1950	1975	2000	2011	2050
More developed Region	442	718	881	964	1127	54.5	68.7	74.1	77.7	85.9
Less Developed Region	303	819	1977	2688	5124	17.6	27	40.1	46.5	64.1
Africa	33	108	288	413	1264	14.4	25.6	35.6	39.6	57.7

Furthermore, these NSATs utilize sustainability indicators (SI) and headline sustainability indicators (HSI). In this regard, NSATs are key tools that are driven by the impact and value of the SI. Notably, for NSATs, an SI is essentially the assessment criterion, while a series of related SI can be placed together under a given HSI (Cappuyns, 2016). Broadly speaking, if the HSI is considered to be a finite set then the SI are elements of this set. Each HSI is given a specific point or weight, the weight signifies the importance of the specific issue to the locale. Each HSI then has several SI termed as criterion that must be achieved in order for the points to be given. After points are accumulated together, rankings, such as platinum, gold, silver etc. are used to represent or indicate the sustainability performance quantitatively, therefore allowing sustainability comparison with other developments and buildings (Komeily and Srinivasan, 2015, Reith and Orova, 2015). However, several issues plague indicator development of assessment tools. These includes the subjective HSI selection system, which is top-down oriented and the fact that selection of these HSI is generally shrouded in secrecy. In fact, the methodology to develop such NSATs and associated SI have been reported to have no public participation (Ameen et al., 2015, Berardi, 2015, Charoenkit and Kumar, 2014, Komeily and Srinivasan, 2015). This has led to several authors recommending more integrated approach, particularly in the area of SI selection (Gan et al., 2017, Sharifi and Murayama, 2013). What is also common amongst most developed tools is that the majority of them are focused on the environmental dimension of sustainability, such as CASBEE and LEED, limiting their focus on the other dimensions of sustainability (DoS) (such as social and economic dimensions). This has made these tools somewhat incomplete as it is essential aspect of urban sustainability to consider the three DoS simultaneously in any urban development project or indicator system. Nevertheless, a couple does focus on other DoS such as the UK-based tool (BREEAM-communities). Consequently, the BREEAM-communities tool has high element of the social dimension linked with the environmental dimension of sustainability

Based on current investigation, there is no research that has developed a strategy for an integrated selection of sustainability indicators for NSATs. Furthermore there is none that has done so with the African continent in mind. To this end, this research takes transparent and systematic steps in optimizing the development of NSATs from an indicator selection perspective. It also looks into additional challenges and gaps that would hinder the implementation of NSATs within the African region. This would aid developers in the optimization of their processes to achieve sustainable urban development, while also considering the context of where the development lies e.g. Africa. This will be pursued via critical analysis of theory and a case study approach (a survey via questionnaires). The case study representation will be Lagos city in Nigeria, the 2nd most populous city in Africa and the city predicted to become the most populous by 2025, with 90% of its GDP reliant on fossil fuel (oil and gas) (see Fig. 1.1).

These urban challenges and recent push for sustainability presents the perfect time for assessment tools to come into play. As they can provide a structured strategy to develop the urban form and infrastructure of Lagos, Nigeria. The use of NSATs have been created, tried and tested in Asia, America and Europe, yet, understanding that 'context' of any location would mean that best practices of developed nations cannot simply be 'copy and pasted'. It is also important for African regions to begin the process of being self-sufficient as opposed to relying on international aid for its sustainable urban development, thus providing the impetus for this study. Accordingly, this research aims to develop a procedural approach to optimizing the development of NSATs, but doing so with a focus on Lagos, Nigeria. As mentioned above, due to the characteristics of Lagos it serves as a good template for African cities to learn from. The critical focus is to show how Lagos can function as a sustainable city in the face of an acute lack of basic amenities and public infrastructure

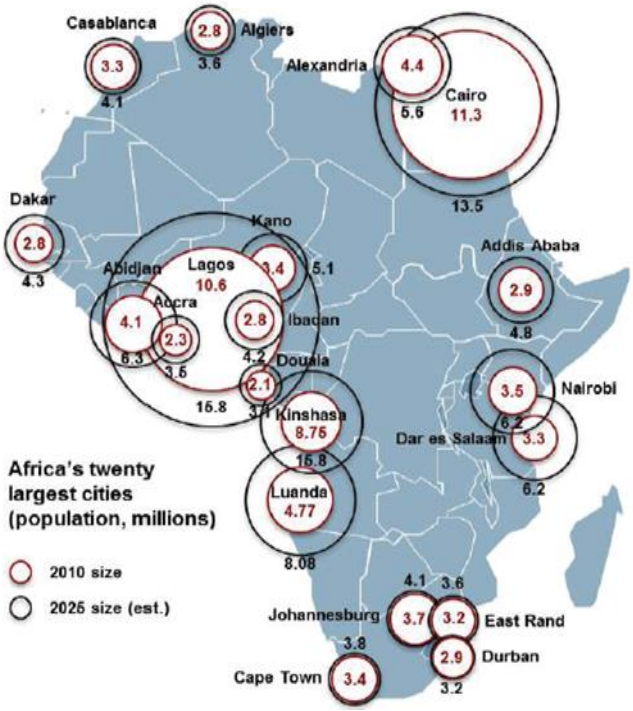


Fig 1.1: Africa's 20 largest cities (UN-habitat, 2015)

1.2 Research aims and objectives

1.2.1 Aims and Objectives

The main aim of this study is to:

- Develop an integrated framework for the early selection of indicators for NSATs.

The main objectives of this study are to:

- Develop a framework for evaluating the effectiveness of NSATs.
- Elucidate the successes and shortcoming in current tools and how this would affect tools created in Africa as well as other world regions.
- Elucidate the importance of top-down and bottom-up approach to early indicator selection.

In order to achieve these aims certain research questions need to be asked and answered.

1.2.2 Research questions

- Why can't the existing NSATs be utilized directly in African nations such as Nigeria?
- Why are current tools Top-down focused?
- Why current NSATs are environmentally focused and what significance does that bear to Africa?
- What is the significance of the bottom-up approach in early indicator selection?
- How can indicators be selected from pre-existing tools to aid the development of future tools?
- How can indicators be selected to integrate the needs of both the experts and the local community?
- Can indicators be global i.e. relevant in all regions of the world?

1.3 Research Approach

The research aims and questions will be achieved through a combination of both qualitative and quantitative research methods. In the study the research method varies according to the specific objective and type of data available at the given time of the specific analysis. The first section provides the motivation and issues that Africa (in particular Lagos, Nigeria) currently face and why assessment tools are needed. This was done through the study of existing literature, which served as the main data source. Thereafter, an in-depth content analysis and analytical comparisons of selected NSATs is executed for the all subsequent chapters after chapter 1 but excluding chapter 6 (conclusion chapter). However, the main analysis in chapter 5 utilizes content analysis, analytical comparisons and case study analysis, with the case study being informed through a questionnaire survey approach (see Appendix 1A and 5D-1). These methods were used to bring out the characteristics of the NSATs in order to develop an optimized indicator selection process for NSATs.

Elements of each methodology are presented in more detail in the respective chapters of this thesis. Also overall data used for the content analysis and data obtained from the questionnaire can be seen in the Appendix section. Furthermore, it is important to note that neighborhood sizes which the NSAT tools can be applied to varies across all NSATs (from 0ha – 400ha). However, for indicator development the size of the neighborhood is only important when seeking out opinions of the public on indicator selection (explained further in chapter 4 – methodology).

1.4 Motivations and Importance of Study

In recent decades, urbanizations and its associated traits has been experienced in different developing countries of the world, thus producing different urban forms and social consequences. Unlike Western civilization (Western Europe and North America) that links urbanization strongly with high economic development, rapid urbanization in developing

countries is occurring in countries with the lowest levels of economic development. Simply put, in developing nations industrialization lags behind rate of urbanization (Ilesanmi, 2010).

Africa is urbanizing faster than any other continent according to (Siemens AG, 2011) (SAG). The transition from rural to urban dwelling has doubled in the past 20 years, with about 40%. I.e. 412 million people account for this urban population shift. Adding to this population conundrum, the United Nations (UN) population's division estimates double the current number of urban dwellers dominating Africa by 2035, which amounts to about 870 million. This will place Africa in the population forefront second only to Asia, thereby raising the urban population percentage to 50% (SAG, 2011). SAG (2011) further estimate that growth will be predominantly be from south of the Sahara identifying Lagos and Kinshasa as the heavy weights of population increase and Lagos is predicted to easily surpass the current African leaders in city population, Cairo. Mid-sized cities such as Darasalem and Nairobi are estimated to also grow at a rapid rate and double in population size. Generally, UN-habitat (2009) state claim that cities with population above a million in sub-Saharan Africa have an estimated growth of 32% in the next decade with exception given to South African cities and Congo Brazzaville.

With this in mind, it well known that African cities suffer from unplanned sprawl, where unplanned settlements are rampant and perhaps constitutes the highest level of city dwellers in the world. Infrastructure is stretched to its absolute limit and there is strong desire and utmost need for what the western world would term as basic amenities i.e. water and electricity, and services such as waste management and sanitation (UN-habitat, 2009). Legitimizing this argument the UN-habitat (2009) report on the state of African cities states, contending that the rapid urbanization can no longer be ignored by any single African government and as such urban planning for communities and cities must be a matter of

priority for public policies. The chairman of the Steering Committee of UN Habitat's World Urban Campaign (Nicholas You), in an interview on African development says that:

"Sustainable development policies at the city level in Africa are far from being a 'nice-to-have option. These policies will ultimately determine Africa's capacity to ensure sustainable development for society as a whole. (SAG, 2011, p.6)."

This sets the stage for the coastal mega city of Lagos, the fifth largest city in the world. There has been increased interest in Lagos' as the city comes under 'intense critical scrutiny', particularly from architectural and cultural theory and critical urban studies. The mega-city is one of the most rapidly urbanizing areas in the world, and Nigeria's most populous city. Its growth has been phenomenal, both demographically and spatially. From a population of about 25,000 in 1866, Lagos reached 665,000 by 1963, covering 69.9 (km^2). The population of Lagos attained mega city status in 1995 by reaching population over 10 million, thereby fulfilling requirements by the UN needed to be labelled a mega city. The current population is estimated at over 16 million. Although the mega-city occupies only 37 percent of the land area of Lagos State, it accommodates nearly 90 percent of the population, thus making it a severely dense mega city (Elias and Omojola, 2015, Ilesanmi, 2010).

By studying Lagos, it may be possible to explain and expound on the workings of an African city; Lagos exemplifies many of the cities of the global South, which face an escalating crisis in terms of the provision of basic services such as water, housing and mass transit systems. Lagos is considered paradoxical in urban development because the demographic expansion over the past two decades has occurred under extensive economic decline. Lagos portrays 'the paradoxical characteristics of the contemporary African city as a dysfunctional yet dynamic urban form' (Gandy, 2006). This has led to certain transformational traits, and is best recognized by the deterioration in the state of the city since the post-independence in

the early 1960s. This went on till the 1990s as Lagos was labeled as one of the dirtiest cities in the world, up to its present transitional state. Essentially, Lagos in the past two decades has been marked by severe deterioration in quality of life: high level of poverty; proliferation of slums; environmental degradation; dilapidated and congested road system; massive flooding; disrupted sewerage network; and increasing crime rates (Ajibade and McBean, 2014, Ilesanmi, 2010). In terms of spatial expansion, from its original lagoon setting, Lagos has become a sprawling city and engulfed a vast expanse of surrounding areas including over 100 different slums. This further exacerbated by the lack of policies and regulation to help optimize the Lagos urban Arena. Regulations and policies that do exist are outdated and not applicable in current times, where principles of sustainability has become the focal point of the global agenda in the age of climate change (Cheshmehzangi and Dawodu 2018).

However, in recent times, Nigeria as a whole is making strides to address the issues of climate change and urbanization, and have previously enrolled in the millennium development goals (MDGs) agenda. Though partially successful, they took the lessons learned from implementing MDGs and have subscribed to the sustainable development goals (SDGs) and made commitments to attain relevant goals needed to improve their society, such as clean water and sanitation, affordable energy, strong institution, partnerships and sustainable cities and societies (Cheshmehzangi and Dawodu 2018).

These urban challenges and recent push for sustainability presents the perfect time for assessment tools to come into play. As they can provide a structured strategy to develop the urban form and infrastructure of Lagos, Nigeria. The use of NSATs have been created, tried and tested in Asia, America and Europe, yet, understanding that 'context' of any location would mean that best practices of developed nations cannot simply be 'copy and pasted'. It is also important for African regions to begin the process of being self-sufficient as opposed to relying on international aid for its sustainable urban development, thus providing the

impetus for this study. Accordingly, this research aims to develop a procedural approach to optimizing the development of NSATs, but doing so with a focus on Lagos, Nigeria. As mentioned above, due to the characteristics of Lagos it serves as a good template for African cities to learn from. The critical focus is to show how Lagos can function as a sustainable city in the face of an acute lack of basic amenities and public infrastructure.

All aspects of the operations of NSATs are not considered in this research due to the large scale process but rather the most important aspect (initial selection of HSI) is used to illustrate the advantages that NSATs hold if such tools can be specifically developed for Lagos and therein any other African country.

1.5 Thesis structure and synopsis

This section provides a synopsis of the flow of thesis, in terms of the results achieved, the links between each chapter and how the research questions are answered. This monograph is divided into six chapters. The overall structure of the thesis in terms of thesis plan and timeline for execution is displayed Fig 1.2 (overview) and Table 1.2 (detailed execution). The chapters have been designed in such a way that they are all paper based and each paper links seamlessly with the next. The first chapter has set the context for later chapters by describing the background of the research, explaining the approach taken, elucidating the motivation of study and outlining the major aims and objectives pursued in this study, subsequently;

In chapter 2, an analysis of NSATs, their gaps and implication for Africa particularly Nigeria is discussed. This is done through the development of a relational model called the sustainability pathway method (SPM) and content analysis which categories and investigates the successes and shortcomings of already developed NSATs such as CASBEE-UD, BREEAM Communities, Indian Green building council - Township (IGBC) and Green Building Index

(GBI), in order to develop and implement an enhanced NSAT that exploits the successes of these tools, whilst avoiding their pitfalls. The three main gaps observed were the top-down heavy approach to development, the high level of environmental focus, the lack of institutional dimension of sustainability and text specific nature of the tools. This was demonstrated by the SPM model, which gave detailed illustrations of how the dimensions of sustainability (DoS) are reflected in various HSI adopted by different NSATs. The use of the SPM is the starting point in the early selection of HSI and invariably the development NSATs for Lagos, Nigeria.

This led to further focus on the limitations in chapter 3, particularly the environmental and institutional limitations and their direct implication on Lagos, Nigeria. The argument of chapter 3 is that the popularity and replication of these tools has led to the replication of its limitations. The most notable limitation and motivation for this study is the inadequate recognition of the complexities of institutional dimensions (i.e. policies, laws and regulation) within a neighborhood development. Studies that have investigated NSATs generally argue lack of coverage of the institutional dimension. However, there has been little consistent and explicit mention of the precise indicators and criterion sought out to make this claim. This chapter, via the lens of energy based indicators, expands on the role of the institutional dimension by utilizing three institutional classifications, which are organizations, regimes and informal rules. This study also utilizes the SPM method developed in chapter 1 for indicator analysis and draws out current trend or characteristics of institutional indicators in the 15 NSATs. The results showed a limited view on the classification of institutional dimension. This chapter also demonstrated that there are more institutionally-based indicators than previously reported in prior studies. Additionally, this study confirms that the institutional dimension cannot be a single entity or identity that operates under the linkage of the other dimensions (environment, social and economic). The study reaffirms the heavily environmental focus of the tool. Finally, the result addresses why from an institutional perspective, NSATs would currently find it difficult to work in Lagos, Nigeria, unless certain measures are taken

(developing competent urban policies and regulations, developing energy codes and building standard). In conclusion, future development of NSATs was recommended to look into the explicit applications of the institutional dimension in indicators, as this could optimize the overall process of NSAT development, particularly for the regions of Africa that are interested in developing their own assessment tools.

With the limitations fully understood in terms of DoS, the process is then used to select indicators in chapter 4. The selection of HSI was noted to be top-down, as investigation showed that the tools were created from an expert-led viewpoints, with no input from the communities in which the tools would be used for. In terms of the selection process, chapter 4 investigated how this can be optimized by first illustrating that the development of this tool in several countries have been plagued with pitfalls, such as: a lack of transparency in the development process and selection of HSI, debatable adoption of sustainability pathways, and difficulties in determining a common set and standard number of urban HSI for assessment tools. Thus, in chapter 4, a coherent and transparent methodology was developed, which can be used in selecting a common set of HSI for NSATs. The motivation for this approach which involved selecting NSATs from pre-existing tools was that developing new sets of HSI in the African context would be both expensive and time consuming. Thus, by investigating the properties of already developed tools, the effectiveness of the HSI selection process for African cities can be optimized. The result, which is the methodological process, emphasized four steps in the selection of HSI: (1) consider as many NSATs as possible. (2) Identify the motivation for the study and select a sustainability outlook. In the method developed herein four DoS was chosen and this included the institutional dimension which served as a means of addressing the short comings of the institutional setup in Africa. (3) Allocate sustainability dimensions to all HSI and subsequently merge similar HSI. (4) Use the interrelationships between the dimensions of HSI to select a common set of HSI.

This observations and strategies in chapter 4 was further investigated in chapter 5, and this chapter illustrated how the top-down approach used in chapter 4 could be integrated with a bottom-up approach via questionnaire survey. Hence, a methodology was developed to infuse the bottom-up (community-led) approach to the top-down selected HSI from previously developed assessment tools. The main aim was to create an integrated method for the early selection of HSI to optimise the use of NSATs in Lagos, Nigeria and other African regions. Aside Lagos state, this study focused on the theme of transportation and land utilization, which are key SDG 11 targets. Theoretical inspiration is obtained from Arnstein (1969) Ladder of participations approach; John Clayton (1993) effective decision model for public involvement; Reed (2009) Stakeholder analysis and identification methods; Beierle (2002) five questions to ascertain quality of stakeholder decisions and Gene and Lynn (2000) Ten requirements for effective public participation methods. The method was developed via the aforementioned ideologies and tested via questionnaire application involving the citizens of Lagos. The method was also based on an expert-initiated approach. This is essentially a participatory technique where pre-existing framework or sets of indicators developed by non-local experts are used as a starting point, followed by a participatory assessment. The study identified four categories of relevance; which are: 'improbable'; 'relevant'; 'debatable'; and 'mandatory' HSI. Key strengths and conclusions from adopting the bottom-up process in testing the relevancy of HSI include: (1) it identifies constraints and motivators that make HSI more usable; (2) it allows for the reduction of redundant and otherwise useless HSI that would not thrive if implemented in Lagos; (3) it allows for the potential elimination of the point based system that current NSATs use; (4) to a certain degree, it certifies the relevance of HSI that are deemed as popular or common, when developed via the top-down approach; (5) it illustrates that adopting this approach brings about a local perspective on sustainability which enhances the conventional environmentally focused tools by considering the social, economic and institutional drivers. The aforementioned discoveries were used to then develop eight rules for integrated participation to select and create indicators for NSATs. The eight

rules are as follows: (1) Rule of Power/Influence (2) Rule of boundaries (3) Rule of Stake (4) Rule of goals (5) Rule of theory (6) Rule of execution (7) Rule of resources (8) Rule of verification and feedback.

The five chapters are rounded up in chapter six by bringing all the results together and showing how they answered the research questions and thereafter, the limitations to study and recommendations for future studies.

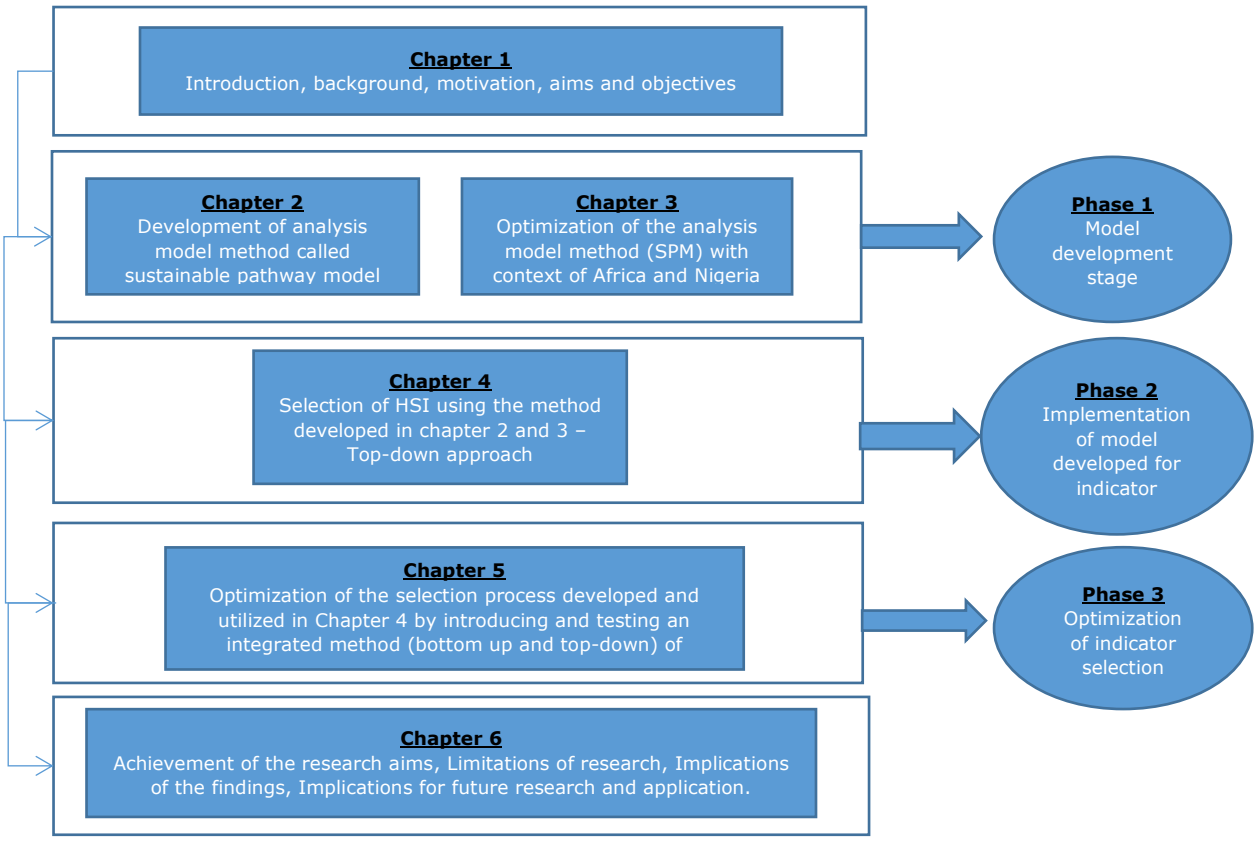


Fig 1.2: Block overview of thesis

Table 1.2: The overall structure of thesis

Chapters	Title of chapter and publications	Research question answered
Chapter 1 (Introductory Chapter) Overview, Aims and Questions for Assessment Tools	**1.** Background **2.** Research aims and objectives **3.** Research approach **4.** Motivations and Importance of Study **5.** Thesis structure and synopsis **6.** Innovation and originality behind study	
Chapter 2 A conceptual re-visualization of the adoption and utilization of the Pillars of Sustainability in the development of NSATs	**1.** Current gaps in Neighborhood Sustainability Assessment Tools **2.** Development of multi-dimensional approach (sustainable pathway model) to analyse NSATs **3.** Critically reviewing four NSATs (form both developed and developing nations) to validate the developed model **4.** SPM as a Template for assessing the efficacy of indicators, that are to be used in the development of NSATs.	**Aims** **1.** Develop a framework for evaluating the effectiveness of NSATs **2.** Elucidate the successes and shortcoming in current tools and how this would affect tools created in Africa as well as other world regions ***Research Questions*** **1.** Why can't the existing NSAT's be utilized directly in African nations such as Nigeria **2.** Why are current tools environmentally focused and what significance does that bear to Africa **Published under Sustainable Society (Elsevier)**

		https://doi.org/10.1016/j.scs.2016.11.001
Chapter 3 **Is Africa ready for NSATs: The Institutional Conundrum**	**1.** Use of SPM on 15 NSATs to understand the institutional limitations to indicator selections. (only energy indicators used for analysis) **2.** Institutional limitations and its effects on Africa	***Aims*** Elucidate the successes and shortcoming in current tools and how this would *affect tools created in Africa as well as other world regions* ***Research Questions*** Why are current tools environmentally focused and what significance does that bear to Africa **Under review from Cities and Energy policy (Elsevier)**
Chapter 4 **The Systematic Selection of Headline Sustainable Indicators for the development of Future Neighborhood Sustainability Assessment Tools for Africa**	**1.** A top-down method to determine an optimum number and common set of HSI a newly developed NSAT should possess, as a prerequisite for its development in African countries (used SPM on nine NSATs). **2.** To investigate if obtaining universal HSI is realistic and to identify context specific HSI and discuss its significance in an African context	**Aims** **1.** Elucidate the importance of top-down and bottom-up approach to early indicator selection. **Research Questions** **1.** How can indicators be selected from pre-existing tools to aid the development future tools. **2.** Can indicators be global i.e. relevant in all regions of the world. **Published under Sustainable Society (Elsevier)** **https://doi.org/10.1016/j.scs.2018.05.033**
Chapter 5 **Expert-initiated integrated approach to development of**	**1.** Integrate the bottom-up approach into already top-down developed NSATs, to optimize future selection of NSAT for Lagos, Nigeria.	**Aim** **1.** Develop an integrated framework for the early selection of indicators for NSATs.

Sustainability Indicators for Neighborhood Sustainability Assessment Tools: An African perspective	**2.** Identify key motivations and constraints that could inhibit the successful implementation and transfer of already developed HSI in an African society.	**2.** Elucidate the successes and shortcoming in current tools and how this would affect tools created in Africa as well as other world regions. **3.** Elucidate the importance of top-down and bottom-up approach to early indicator selection. **Research Questions** 1. What is the significance of the bottom-up approach in early indicator selection? 2. How can indicators be selected to integrate the needs of both the experts and the local community? **Under review by Journal of Cleaner air production (Elsevier)**
Chapter 6 (concluding Chapter) Perspectives on the Development of Practicable NSATs	**1.** Achievement of the research aims. **2.** Limitations of research. **3.** Implications of the findings. **4.** Implications for future research and application.	

1.6 Innovation and Originality

Table 1.3 addresses how this study is innovative and provides a high level of originality, the concept was modified from (Brandon and Lombardi, 2005).

Table 1.3: Innovation and originality

Definitions of Originality	Addressing definitions
Saying what has not been said before	- Investigating how NSATs can be developed for African cities, starting with an integrated participatory process for early selection of HSI. - There are interrelationships between dimensions of sustainability.
Identify and making new interpretation of another authorities work	- This research builds on studies of Sharifi Murayama, Ali Komeily and Valentin Spangenberg by using a dimensional approach to assess HSI of NSATs. - This research builds on previous understanding of the institutional dimensions. - This research shows how integrated participatory processes can be implemented for indictor selection
Being cross disciplinary and using different methods for analysis and providing synergy in subjects area which have not been combined for study	- A combination of a qualitative review via content analysis, survey techniques via questionnaire and statistical analysis is used in this research
Looking at aspects of my research which has been neglected or barely looked at by people in my field and providing innovative insight to another person's idea	- Focusing research on African cities. - Introducing institutional dimension of sustainability. - Focusing research on the interrelationship of the four dimensions of sustainability. - Investigating the impact of institutional dimensions of sustainability in African cities.

	- Focusing research on HSI and early selection. - Executing an integrated participatory approach to HSI selection.
Adding Knowledge in ways that has not been done before	- Utilizing dimensional approach for HSI analysis and selection. - Utilizing questionnaire as part of an integrated process for selecting HSI.
Providing a single original technique, observation or result in an otherwise unoriginal but competent piece of research	- This is represented in the structure and result of this thesis and synthesized in the concluding chapter.

References

AJIBADE, I. and MCBEAN, G. 2014. Climate extremes and housing rights: A political ecology of impacts, early warning and adaptation constraints in Lagos slum communities. *Geoforum,* 55**,** 76-86.

ALYAMI, S. H. and REZGUI, Y. 2012. Sustainable building assessment tool development approach. *Sustainable Cities and Society,* 5**,** 52-62.

AMEEN, R. F. M., MOURSHED, M. and LI, H. 2015. A critical review of environmental assessment tools for sustainable urban design. *Environmental Impact Assessment Review,* 55**,** 110-125.

BERARDI, U. 2015. Chapter 15 - Sustainability assessments of buildings, communities, and cities A2 - Klemeš, Jiří Jaromír. *Assessing and Measuring Environmental Impact and Sustainability.* Oxford: Butterworth-Heinemann.

BRANDON, P. S. and LOMBARDI, P. 2005. Evaluating Sustainable Development in the Built Environment. Blackwell Science.

CAPPUYNS, V. 2016. Inclusion of social indicators in decision support tools for the selection of sustainable site remediation options. *Journal of Environmental Management,* 184, Part 1**,** 45-56.

CHAROENKIT, S. and KUMAR, S. 2014. Environmental sustainability assessment tools for low carbon and climate resilient low income housing settlements. *Renewable and Sustainable Energy Reviews,* 38**,** 509-525.

CHESHMEHZANGI , A. and DAWODU , A. 2018. *Sustainable Urban Development in the Age of Climate Change: People, the Cure or Curse*, Palgrave Macmillan.

ELIAS, P. and OMOJOLA, A. 2015. Case study: The challenges of climate change for Lagos, Nigeria. *Current Opinion in Environmental Sustainability,* 13**,** 74-78.

EMMANUEL, R. 2004. Estimating the environmental suitability of wall materials: preliminary results from Sri Lanka. *Building and Environment,* 39**,** 1253-1261.

GAN, X., FERNANDEZ, I. C., GUO, J., WILSON, M., ZHAO, Y., ZHOU, B. and WU, J. 2017. When to use what: Methods for weighting and aggregating sustainability indicators. *Ecological Indicators,* 81**,** 491-502.

Gandy M (2006). Planning, anti-planning and the Infrastructure crisis facing Metropolitan Lagos, Urban Stud., 43(2): 371-396.

HAAPIO, A. 2012. Towards sustainable urban communities. *Environmental Impact Assessment Review,* 32**,** 165-169.

HAAPIO, A. and VIITANIEMI, P. 2008. A critical review of building environmental assessment tools. *Environmental Impact Assessment Review,* 28**,** 469-482.

ILESANMI, A. 2010. *Urban sustainability in the context of Lagos mega-city*.

KOMEILY, A. and 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.

REITH, A. and OROVA, M. 2015. Do green neighbourhood ratings cover sustainability? *Ecological Indicators,* 48**,** 660-672.

SHARIFI, A. and MURAYAMA, A. 2013. A critical review of seven selected neighborhood sustainability assessment tools. *Environmental Impact Assessment Review,* 38**,** 73-87.

SIEMENS AG 2011. African Green City Index. London: Siemens AG.

UN-HABITAT 2009. Planning Sustainable Cities: Policy Direction - Global Report on Human Settlement. UK and USA: Earthscan.

UN-HABITAT 2013. Global Activities Report: Our Presence and Partnership.

UN-HABITAT 2015. Sustainable Urban Development in Africa.

WILKINS, G. 2002. *Technology transfer for renewable energy : overcoming barriers in developing countries,* London, Earthscan.

Chapter 2

A conceptual re-visualization of the adoption and utilization of the Pillars of Sustainability in the development of Neighborhood Sustainability Assessment Tools

"*In the Eastern conception, good imitation is an art, and it would be silly to reinvent the wheel with much effort and painful trial and error if borrowing state of the art is both cheaper and more solid*."

~ de Jong

Published under Sustainable Cities and Society (Elsevier)
https://doi.org/10.1016/j.scs.2016.11.001

2.1 The quest for sustainable urban development

In most industrialized parts of the world, market-driven industry frameworks has gradually become the order of the day (Haapio, 2012). However, in the context of Africa, such tools and assessment systems are not yet developed, hence, there is essentially no robust framework on which to anchor the sustain-able development of communities and cities. Yet, Africa is faced with compounding issues, with rapid urbanization set to reach 60%by 2050 of the 1960 level. In addition to the fact that fossil fuel consumption is still a norm within these regions, replenish-able and renewable sources such as solar, wind and biomass energy are in abundance yet under-utilized (Wilkins, 2002). When the proposition that by 2020 between 75 and 250 million would be exposed to heightened water stress, soil degradation and reduction in agricultural productivity is assessed in conjunction with the pre-existing vulnerability to land encroachment, famine and lack of clean water; the issues facing sustainability in Africa becomes one of immense challenge (UNEP, 2012). Aside from environmental issues, factors such as social segregation and prevalence of slum facilities constitutes some serious challenges from a social viewpoint. From an economic standpoint, urbanization and lack of planning has left many without jobs, affordable housing and basic infrastructural amenities such as constant power for day to day living and efficient function of business. Furthermore, with respect to the institutional standpoint, (categorized as governance in some literature), African countries displays a lack of adequate policy implementation, and a lack of requisite structures that enforce effective participation in city development and access to knowledge, information and education (UN-habitat, 2015; UN,2014).The issues mentioned above led to the development of the Brundtland report, which established that Sustainable Development is about securing and meeting the basic needs and wants of everybody from both rich or poor countries now and in the future (World Commission on Environment and Development, 1987). The aforementioned definition by the Brundtland report is what governs and guides the global pursuit for urban sustainability. This has led to the formation of the three pillars/dimensions of sustainability (DoS) or the triple bottom-down approach (environmental, social and

economic dimensions) (de Jong, Joss, Schraven, Zhan, and Weijnen, 2015). This has further guided the tools which are currently adopted to achieve sustainability targets such as Neighborhood Sustainability Assessment Tools (NSATs). However, such tools have been developed largely neglecting the institution aspect, which is also considered the fourth dimension (Komeily and Srinivasan, 2015). Most authors, when developing urban strategies; choose to neglect this dimension for reasons which include ease of analysis and skepticism about its importance (Valentin and Spangenberg, 2000).This work for the first time introduces a new method for visualizing the interrelationships between the DoS, and also gives a coherent qualitative means of understanding how indicators can be explained from the standpoint of the adoption of the DoS. The model developed in this work i.e. the Sustainability Pathway Model (SPM) is a novel tool that can easily be used to identify the presence of these DoS in indicators of NSATs, and as such can be used to rigorously assess the properties and features of various NSATs. Briefly, the SPM can thus be used to qualitatively and semi-quantitatively assess the contextual nature inherent in the use of various HSI by mapping out the trajectory of the DoS as utilized in a given NSAT. As such, the SPM can be used to understand the contextual nature of existing NSATs, or could be used as a tool in developing HSI for new NSATs. In essence, we have developed a systematic model that considers all four DoS and investigates the patterns of previously developed NSATs, in order to provide recommendations for the development of bespoke NSATs. In other words, we re-appraised and extended the features inherent in the model developed by Valentin and Spangenberg (2000), and developed a tool which can serve as a means of qualitatively and quantitatively appraising various NSATs and other indicator-based tools used for assessing sustainability in different contexts. It would also be briefly shown in this work that new NSATs which can be developed by the use of this model could find applications in an African context.

2.2 Aims and objectives

The preceding overview brings us to the focus of this thesis, which aims to develop a conceptual model for the sole purpose of investigating developed NSATs, identifying the sustainability pathway (SP) which these NSATs have taken i.e. what ingredients within the pillars of sustainability is prevalent or non-existent in these tools and then how can this model then inform the development of NSATs for contextually different locations such as countries within Africa, which operate on different social, economic, environmental and institutional dynamics. Furthermore, this work also compared and critically reviewed four NSATs in order to validate the model developed. Of the four NSATs reviewed, two are taken from developed nations and two from developing nations. Also, an attempt is made to assess the SP of these already developed NSATs. The aim of assessing the SP of developed NSATs is to clearly understand the disparities and similarities in these models. The information gained could then be used to inform the development of an African oriented SP and eventually NSAT. To achieve the above, reviews of the basic structure that constitute NSATs will be analyzed, in order to provide justification and evidence for the development of the SPM.

2.3 Literature review

2.3.1 Sustainability and the four dimensions

The Brundtland report was majorly focused on reconciling two primary issues, these are environmental consideration and development. Development in this context included economic and social dimensions of human development. As such, the famous definition and quote used severally in various literatures emerged which was "development that meets the needs of the present with-out compromising the ability of future generations to meet their own needs" (WCED 1987). The ultimate gain was the ability for the report and governing principles to be placed on the political platform of decision makers where the social, environmental and economic dimensions were debated. However, it was unable to address the driving forces behind the environmental and development problems (Spangenberg, Pfahl,

and Deller, 2002). This was addressed a decade later in Johannesburg at the World Summit for Sustainable Development, where the focus was the review of the implementation of Agenda 21. From this summit, the fourth dimension emerged, which was a result of attempts made to operationalize the indicators present in Agenda 21 (Spangenberg et al.,2002). Although, the newly reviewed Agenda 21 had validated the idea of institution as the fourth DoS, it was not explicitly mentioned as a separate dimension. The institutional role was deemed necessary extension to include in crucial elements of the agenda. Justifications of its inclusion came from its coverage of social and cultural determinants, social and political insight as well as practical experiences of Brundtland commission elucidating the need for key governance, which is not attainable without establishment or inclusion of the appropriate institution. Due to these discoveries, the Commission of Sustainable Development categorized the institutional HSI under seven themes in Agenda 21 (Chapters 8, 23–32, 35, 37–40), accordingly, a total of six HSI was then used to assess the institutional dimension in the final version of the report (Spangenberg et al., 2002). The development or selection of these institutional HSI came with its set of problems. Firstly, these HSI were debated to not adequately cover the institutional dimension. This uncertainty was further strengthened after a pilot study of HSI showed minimal uptake of these HSI when utilized practically in various countries (Spangenberg et al.,2002). According to Spangenberg et al. (2002), this was due to non-relevancy, minimal data availability, lack of clarity and general need for improvement of the associated indicator. In essence out of a 134 HSI only 11% were imbibed or deemed applicable. Hence, this trend has followed all city-wide or Neighborhood sustainability tools developed thereafter, as it is understood that this dimension is reportedly lacking in already existing NSATs (Sharifiand Murayama, 2014; Komeily and Srinivasan, 2015). Currently, the aforementioned properties of Agenda 21 have become the backbone and principles for urban sustainability. These principles have led the development of NSATs and associated linkages in DoS (Alyami and Rezgui, 2012; Haapio, 2012). These separations in dimensions were observed to hide the real world inter-linkages. However, in the practical utilizations of NSATs

as well as indicator development, great strides have been made to identify the hidden traits and interplays. Reith and Orova (2015) demonstrated this by using a model developed by Tanguay et al. (2009) in indicator development to establish environmental and social linkage, termed environmental and social (Liveable), environmental and economic (Viable), social and economic (equitable) and all three were called sustainable. However, the institutional dimension was notably missing in this analysis. This absence of institution limits the analysis of inter-linkages between dimensions, with the shortcomings of not being able to provide a comprehensive picture of the interactions between relevant dimensions and the indicators that answer questions within these dimensions. A more pertinent issue and recent focus of this research is that Africa is plagued with severe institutional lapses with United Nations (UN) identifying the absence of true democracy, respect of human rights and corrupt governance as key institutional hindrances (UN, 2014). As the report highlights several institutional HSI such as science and technology, education, public aware-ness and information, integrated decision making, institutional and legislative framework etc. the reasoning behind these institutional HSI considered is that policies and institution determines who has access to natural resource and who does not, as well as how and when these resources are utilized. It further argues that the rights of people and organizations within Africa varies and can be significantly different and unequal, however, such rights need to be institutionally established and governed if natural and social resources are to be utilized sustainably (UN, 2014). In essence, poor governance and suboptimal resource management facilitates and accelerates environmental degradation, productivity loss and social segregation and disparity. Accordingly, viewing this from the standpoint of the current challenges in Africa, it is obvious that templates as well as tools have to be provided that are bespoke to the unique challenges the region faces. And from this perspective, it would be necessary to completely identify the aspects that require attention with regards to the implementation of sustainability in Africa. In general, introducing sustainability initiatives in some African countries from a policy and regulatory point of view, have been on a rise, however, the implementation of such policies,

coupled with the modification and innovation of these policies to fit the realities of these regions have been plagued with numerous challenges (Arimah and Adeagbo,2000). Accordingly, whilst legislative policies in some developing countries have largely embraced sustainability in different forms, it is hitherto still very difficult to assess how these policies have created tangible effects in the polity (Iwaro and Mwasha, 2010). Along these lines, the investigations done for this study, which essentially views sustainability from the standpoint of neighborhood assessment tools, observed that although these tools are important determinants of how sustainability can be achieved, still it is also relevant and necessary to always appraise them in order to gauge their efficacy at various periods and in different contexts. Such appraisal is not only necessary in improving the deployment of sustainability initiatives in advanced economies, but is also important in the adoption and subsequent deployment of sustainability tenets in the developing world. Fundamentally, it is established that the division of sustainability into four DoS is a productive approach, especially in terms of system analysis, where each dimension represents a complex non-linear, yet self-organizing system (Spangenberg et al., 2002). It is exactly on this premise that the development of this investigative model is being designed, to untangle these complex systems in a systematic and complete manner, utilizing the four DoS.

2.3.2 Neighbourhood sustainability assessment tools

The first building assessment tools, emerged in 1990 in England, named the Building Research Establishment Environmental Assessment Method (BREEAM), followed by the American developed method Leadership in Energy and Environment Design (LEED) which appeared in 1998 and fully deployed in 2000. This was followed by the deployment of BREEAM Australia by 2000 by Sinclair Knight Merz and with the Building Research Establishment (BRE), this was subsequently sold to Australian Green Building Council in 2002, hence the development of Green Star (Nguyen and Altan,2011). Other important tools in Asia were equally developed such as a Japanese equivalent called Comprehensive Assessment Sys-tem

for Building Environmental Efficiency (CASBEE) in 2011 and the Chinese version developed by BEAM in 1996 called HK BEAM (Haapio and Viitaniemi, 2008).The development of these building assessment tools though essential and innovative was plagued by a particular issue. The inability of these tools to address the interaction between buildings and infrastructure and as such could not integrate the DoS into the framework of the tool, which has consequently been identified to be environmentally focused and observed to fall short of fully addressing the economic and social dimensions (Ding, 2008; Komeily and Srinivasan, 2015). Thus, emerged the community focused tool in the form of NSAT which aimed to address all DoS by providing measurable and executable urban and also building based HSI and SI for achieving urban sustainability (Haapio, 2012). They also have the added advantage of shaping policies and are obligatory in some communities (Sharifi and Murayama, 2013).

2.3.2.1 Current gaps in neighbourhood sustainability assessment tools

In order to identify the gaps studies by Alyami and Rezgui (2012), Haapio (2012), Sharifi and Murayama (2013, 2014), Komeily and Srinivasan (2015), Ameen, Mourshed and Li (2015) and host of other literature were consulted to draw out arguments and conclusions on short coming and gaps currently exhibited in these NSATs. Key concepts behind analysing the gaps are the major themes under the current neighbourhood tools and how successful they are in assessing performance. Due to the rather robust definition of sustainability from the Brundtland report, sustainability means different things to different regions. Though, the consensus is to have equity among 3 driver's i.e. economics, social and environment, the analysis of the current tools have shown variation in what is prioritized and what is not (Reith and Orova, 2015). These priorities are addressed during the weighting of an HSI, which is directly proportional to the importance of the HSI in the region it was developed. The weighting system which is present in most NSATs provides a quantifiable gauge for specific HSI, relaying the importance of the HSI in question to the developer and its effects on the urban environment. This is also followed by prerequisite or mandatory HSI which enforce the

selection of non-negotiable HSI important to that region. The inclusion of prerequisites and even weighted credits all together is quite debatable as this renders sustainability to box ticking as opposed to thinking outside the box. This is largely present in third party tools and Garde (2009) also high-lights the tendency for planners to focus on HSI with higher impact and possibly cheaper credit score as opposed to the most ideal sustainable option. This controversy extends to how exactly priorities are truly given and the lack of scientific clarity behind this, with Sharifi and Murayama (2013) emphasizing the negative impact associated with weighting a criteria higher than another and the bias of tools towards environmental issues Notwithstanding, Retzlaff (2009) states, "any assignment of weights is essentially a subjective exercise" i.e. it would be location and context specific and is prone to highlight importance of one sub region but not necessarily another. Cole (1998) and Crawley and Aho (1999) insist that current developed techniques were developed for local purposes and as such cater to a region's varying climatic conditions, geographical characteristics, potential for renewable energy gain, resource consumption (such as water and energy), government policy and regulation, appreciation of historic value, population growth and public awareness. This highly subjective method of sustainability has been deemed inevitable by several authorities, moreover, this is understandable when the aforementioned factors are considered. It has been further described as quite a sensitive issue as each champions a specific level of pride which boasts supremacy over its competitors (Nguyen and Altan, 2011).When we consider the level of industrialization, we further find that developed nations are currently concerned with environmental issues related to sustainability and as such these frameworks have a high environmental drive (Lehmann, 2015). Noteworthy-thy examples are the three BREEAM, LEED and CASBEE certified projects analyzed by Sharifi and Murayama (2013) with major observations being lack of economic and social equity as well as the non-existence of institutional dimension. As addressed earlier, the institutional dimension has been observed to be essential in urban sustainability, yet it is observed to be lacking in most literature on NSAT. Ameen et al. (2015), Komeily and Srinivasan (2015), Reith and Orova (2015) and

Sharifi and Murayama (2014) made notable emphasis on the inclusion to the three pillars based on results from their study, stating that it is an absolute necessity when comprehensively addressing sustainability. The study further explains that institution goes beyond the interaction between government and non-government organization but also involves a set of norms, laws and regulations governing this interaction. We are also reminded by Spangenberg et al. (2002) that institutional capacity cements, compliments and facilitate the linkage between other dimensions. It was concluded in Sharifi and Murayama (2014) study that the NSATs in question did not address this parameters, thus criteria's such as decentralization, legal frameworks and instruments, education, information systems which are potential HSI under sustainability were overlooked. However, Sharifi and Murayama (2014) do not indicate convincingly why this occurs and what specific aspects within the institutional dimension are not covered. Viable reasons have been mentioned earlier, which include lack of clarity to inadequate development of indicators. Sustainability in the urban arena is well founded and the development of various NSATs further propagates ongoing efforts to monitor and quantify sustainability in meaningful ways. This has led to these tools being constantly revised and improved (Komeily and Srinivasan, 2015). A major reason for revision are the gaps in already developed NSATs, a main gap highlighted by various studies is the lack of context specificity (Komeily and Srinivasan, 2015; Sharifi and Murayama, 2014). According to Komeily and Srinivasan (2015), this is due to the high-level rule based measurement system adopted by most developed NSATs irrespective of the contextual characteristics. This contextual conundrum leads to the general understanding that sustainability (in the neighborhood context) and its associated problems are interdisciplinary, complex and quite subjective (Esty, Levy, Srebotnjak, and De Sherbinin, 2005).According to Conte and Monno (2012), context is the most influential aspect of assessment and can be separated into physical aspect such as climate, topography, geography, etc. and the non-physical aspect, which include legislation, local habitats, etc. These physical and non-physical aspects give rise to local adaptability, development type and regional priorities, which are all

necessary in applying the contextual nature of space in the development of an NSAT. The question then, is, what other dynamics exist in the con-textual consideration of NSATs? To answer this, it is important to note that the context of an urban area can be defined differently from different perspectives. For instance, the context of a neighbor-hood can be seen from a socio-economic perspective (Aneshensel and Sucoff, 1996). These include race and ethnicity, birthplace factor, employment, age, poverty rate immigration status, etc. (Reisig and Parks, 2000). However, the basic defining factors of most NSATs primarily consider HSI such as street design, bike lanes, safety and crime, land form and topography. The consensus is that due to the large variables present within the context of a location, a variety of outcomes is thus possible under each specific neighborhood. This contextual consideration has clearly been neglected in current NSATs and other rating tools (Komeily and Srinivasan, 2015).Though context is a major aspect to consider in NSAT development, it is not the only parameter that aids in the comprehensive development of a balanced tool. Komeily and Srinivasan (2015) notes that NSATs have been analyzed from both develop-mental and implementation phase, and has considered over five NSATs and over 115 implemented projects (Berardi, 2012, 2013;Garde 2009; Komeily and Srinivasan, 2015; Sharifi and Murayama,2014). Their conclusion was that these tools lack a balanced approach in their development. Komeily and Srinivasan (2015) synthesized recommendations by Garde (2009) on five key focus point that would improve future development of NSATs.

Table 2.1: Variables to consider in a balanced sustainable assessment

(Source: Komeily and Srinivasan, 2015)

Improvement in balancing sustainability assessment	**Description**
Contextual balance	Focus on the contextual specificities of each region
Procedural balance	Focus on stronger role for all stakeholders, especially the citizens, in process of

	development, revision and implementation of assessment
Integrational balance	Focus on balanced assessment of sustainability by considering all four aspects of Sustainability in an equitable (but not necessarily equal) manner
Relational balance	Focus on cross-scale relationship between neighbourhoods, buildings and infrastructures
Temporal balance	Focus on intra- and inter-generational aspects of sustainability

Table 2.1 provides insight into the key requirement essential to making a more comprehensive and balanced NSAT. Therefore, the development of the sustainability pathway model will help identify the contextual specificity of each region. The study also addresses the Intergenerational balance, by considering all four DoS and showing how these aspects have been distributed in already developed NSATs thereby informing future NSATs developments. Relating this to the development of such a tool in Africa, It becomes essential to consider all DoS especially when the concerns of sustainability are attributed to improving standard of living which will inherently be socially, economic and institution-ally driven (Naess, 2001). One can further add to the debate and say that an inevitable bias is present in all these frameworks as they are based on the bedrocks of industrialized and majorly European and Western civilized cities (Alyami and Rezgui, 2012; Haroglu2013; Fekry, El Zafarany, and Shamseldin, 2014). However, this may have its advantages in the development of this model as it provides ample case studies to learn from and not to simply imitate but as Alyami and Rezgui (2012) recommends, to customize and optimize tools based on already verified and successful principles.

2.2 Methodology and Overview

2.2.1 Conceptual motivation

Concept development is based on the Valentin and Spangenberg (2000) model. See Fig. 2.1. The original concept of this model was the development of indicators to help achieve sustainability. This model conceptualized inter-linkages between four dimensions and assisted in establishing coherence in the visualization of sustain-ability. However, the inter-linkages may have been oversimplified and terminologies seemingly ambiguous for practical use in the development of NSATs. For example, inter-linkages are termed democracy, justice, care, access, and eco efficiency. But these terminologies leave the question of what is democracy or justice? And is justice really the linkage between economy and institution? Since these connotations could be interpreted in different ways by different regions of the world; subjectivity thus becomes a key factor in the Valentin and Spangenberg (2000) model.

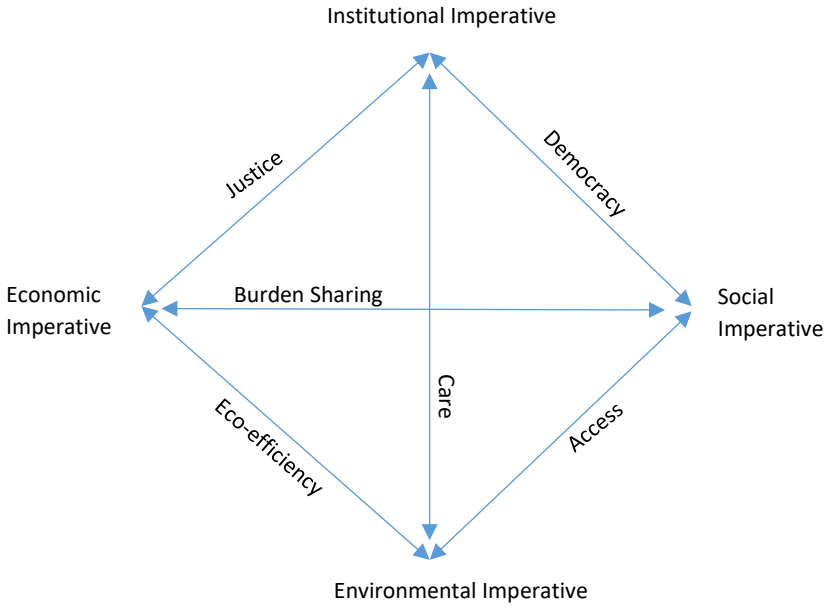


Fig 2.1: Representation of the four dimensions of sustainability

(Source: Valentin and Spangenberg 2000)

The Valentin and Spangenberg (2000) model also stops at two linkages and does not provide linkages for other combinations and possible dimensions, For instance, justice-care or access-justice again does not address the linkage of three or possible four dimensions. Nonetheless, the Valentin model provides conceptual motivation for the development of SPM.

2.2.2 Overview of theoretical model

This formation of the new model disaggregates the Valentin and Spangenberg (2000) model while in tandem utilizing scientific principles to provide a more solid coherence and scientific standpoint between the inter-linkages. This principle is based on theoretical physics i.e. physics and philosophy. The theory adds to the four dimension principle by enforcing the four levels on inter-linkages. The principle operates on the notion that the under-standing and coherence of a physical system is only meaningful when the properties and objects of that system operates relative to other objects (Kineman, 2011; Rosen, 1991). Fundamentally, the very purpose of the model varies greatly from the Valentin and Spangenberg (2000) model. The model places assessed HSI into disaggregated dimensions based on more operational terminologies. The purpose is to investigate which dimensions are the focus of the NSATs in question, invariably informing the decisions of how to plan the development of NSATs through HSI analysis leading to a better understanding of the NSATs in terms of DoS focus and sustainability direction.

2.2.3 Case study testing: overview of NSAT

To validate and draw conclusions from this concept, a case study of four NSATs was utilized. The four NSATs were obtained from developed and developing nations. The reason behind this selection was to give a dynamic comparison of sustainability issues and focuses that are distinct to each location and classification. The information obtained after investigation would then give a clearer and more transparent view of how best to approach indicator development and selection in the African region The selected NSATs are obtained through literature review, which encompassed a number of texts and documents and were

selected based on popularity, importance, regional context to this argument, overall availability and implementation of indicator. Thus, the tools are explained briefly below and highlighted in Table 2.2.

1) **BREEAM Communities:** NSATs evolved from environmental building assessment tools. These tools were established two decades ago on the environmental motivations highlighted in the Brundtland Report, however they have been initially focused on buildings with tools such as BREEAM New Construction and with the Evolutionary extension being BREEAM Communities. BREEAM was actually the pioneering environmental certification scheme for buildings. It was established in 1990 in the UK, initially just for offices but now with a specific scheme for neighbourhoods. BREEAM Communities is an independent, commercial third-party assessment certification standard based on the established BREEAM methodology (BREEAM, 2011). It was developed by BRE Global in 2009 address several urban issues through the use of indicators and point based system to assist planners select the most sustainable option for land development. An additional function based on the point system was to measure and independently certify the sustainability of project proposals at the planning stage of the development process (BRE Global, 2011).

2) **CASBEE UD:** This assessment tool was developed in 2004 by the Japan Sustainable Building Consortium (JSBC), involving committees in academic, industrial, and government sectors. Under CASBEE a range of products exist which include housing scale assessment, building scale assessment, and urban scale assessment. CASBEE – UD originates from the theme and indicator method used to develop CASBEE for buildings. The key guiding concepts is more specifically obtained from the Q3 (Outdoor Environment on Site) and LR3 (Off-site Environment) assessment items of CASBEE for New Construction. It is a commercial and independent assessment certification tool

developed to attain urban sustainability in a given development. It should be noted that the interiors of the buildings are not include in the assessment.

3) **Indian Green Building Council (IGBC):** The IGBC is part of larger organization called the Confederation of Indian Industry (CII) was formed in the year 2001. The aim of the council is to lead India into a sustainable era in the built environment by 2025. Several rating system under IGBC have been created such as IGBC Green New buildings, IGBC Interiors, IGBC Green Campus, IGBC Green homes etc. The most pertinent to the study was the creation of IGBC Township. This is a rating tool was developed to enable designers apply green concepts and criteria to reduce the environmental impact of construction, urbanization, fossil fuels and other man made activities that bring considerable harm to the environment. The tool is focused on large development and is mandatory to include residential development as part of the township.

4) **Green Building Index (GBI):** The GBI is Malaysia's industry recognised green rating tool for buildings to promote sustainability in the built environment and raise awareness among Developers, Architects, Engineers, Planners, Designers". The building based sustainability tool started off under the new construction scheme and later expanded to the assessment of existing building, and township. The focus on this chapter is indicator analysis of neighbourhood or community based tool, GBI; Equivalent of that is a township. A township can be described as "a development of substantial size that contains a community or small neighbourhood". The stages of implementation include the application and registration phase, the design assessment phase and completion verification assessment. Similar to CASBEE UD and BREEAM the tools operate under criterion and sustainability indicators as well as allocated point system.

Table 2.2: NSATs to of developed and developing nations

	Developed nation		Developing nation	
	BREEAM communities (UK)	CASBEE-ND (Japan)	IGBC Township (India)	GBI Township (Malaysia)
Development date	2011	2006 (revised in 2007)	**2010**	2001 - 2004
Rating benchmarks	Under classified < 25 Pass ≥ 25 Good ≥ 40 Very Good ≥ 55 Excellent ≥70 Outstanding ≥ 85	Poor BEE < 0.5 Fairly poor BEE ≥ 0.5 Good BEE ≥ 1 Very Good BEE ≥ 1.5 Excellent BEE ≥ 3	Certified = 110 - 119 Silver = 120 - 139 Gold = 140 – 159 Platinum = 160 – 200	-3 -2 -1 0 1 2 3
Theme	Climate and Energy; resources; place shaping; transport; community; ecology and biodiversity; buildings; business;	Natural environmental quality in urban development; service function for the designated area; contribution of the local community (history, culture, scenery, revitalization); environmental impacts on microclimates; façade; landscape; social infrastructure; management of local environment	Site Selection and Planning; Land Use Planning; Transportation Planning; Infrastructure Resource Management; Innovation in Design and Technology;	Resources and heritage; local environment; diversity; integration; social life

Certification Cost	Registration £808 All developments £7274	Registration - 0 – 5ha = ¥30,000 5 – 20ha = ¥36,000 Over 20ha = ¥43,000	Less than 50 Hectares = 360,000 - 410,000 Rs 51 to 100 Hectares = (3,60,000 - 4,10,000 Rs) + per additional hectare over and above 50 hectares 101 Hectares and above = 675,000 – 725,000 Rs	Registration - 9–16ha =15,000 RM 17–40ha = 29,000RM 41–61ha =40,000RM 62–142ha =55,000RM 142–202ha =90,000RM 203–405ha =135,000RM 405ha = determined by project to project basis

2.3 Results

2.3.1 Introduction to sustainable pathway model (SPM)

The model developed herein utilizes the Valentin and Spangenberg (2000) model, but attempts to develop a qualitative framework through which this model can be objectively and rigorously assessed. The main assumption adopted in the development of this model is that each DoS has a relational interaction with each other. Consider sustainability as a physical system dependent on the four objects which in this case are the DoS (i.e. economy, social, environmental and institutional), then by invoking a general relational model it follows that each of these objects are only meaningful when the properties of each object is viewed relative to the others. Evidently, such an assumption seems coherent given that in practice, for any HSI utilized in a given NSAT, each of this object (DoS) has more scope if it is viewed with respect to its relationship to one or more of the other DoS. For example, assume that providing transport from point A to B is an HSI in a given NSAT. It is well-known that, there could be different reasons to allocate a weight (or to assign some form of sustainability metric to this transport link from point A to B). Let us assume that A is a small urban settlement which is the focus of the NSAT, and let B be some site where about 60% of the residents of a work. Viewed strictly from the perspective of the easy access to livelihood this transport link would provide to the residents of A, one could readily assume that this is a social endeavor. Moreover, if the environmental effect of this social endeavor is considered: e.g. lower emissions (assuming this transport link also comprises of renewable energy powered public transportation which reduces the need for personal transportation); or the influence of the institutional aspects on this endeavor e.g.: willingness of the council authority to construct said transport link (and also provide mass transit), it becomes obvious that implicitly considering the inter-relationship between each DoS in the selection of the HSI induces more scope and functionality to an understanding of this HSI.

Along these lines, it should be noted that the use of this model also envisages the existence of over-laps and/or redundancies. Consequently, by describing a HSI in a given NSAT using this relational model care should be taken in delineating how these HSI are ascribed to an Aspect (the concept of Aspects would be described later). Henceforth, the modified Valentin and Spangenberg (2000) model will be referred to as Sustainability Pathway Model (SPM)

2.3.1.1 Primary and secondary derivatives of SPM

Accordingly, the notion of primary and secondary derivatives to a HSI is introduced. Briefly, a primary derivative of a HSI is a given sustainability metric that would be covered directly by that HSI by virtue of its context in the given NSAT. Referring to the earlier hypothetical example of an NSAT for the urban settlement, when viewed critically, the provision of mass transit from point A to B is a social endeavor, however, making the means of transportation run on renewable energy introduces the environment as a primary derivative of this HSI when measured from the SPM. On the other hand, if the willingness of the council to build this mass transit system is considered in this context, the institutional dimension would be seen as a secondary derivative of this HSI. Simply put, a primary derivative is a sustainability metric that can be linked to a HSI in such a way that it appears to be a direct consequence of the basis for that HSI. Whilst a secondary derivative, is an extraneous sustainability metric to the development of the HSI, by being only indirectly linked to the motivation and contextual basis of the HSI. Following these simple descriptions, it could then be stated that the purpose of this relational model, is to use the "DoS as visualized in the SPM, as a metric to calibrate the attempts of a HSI to attain sustainability within the framework of the NSAT in which it is developed in". Accordingly, the relational model developed in this work is thus aimed at deriving a simple relationship which would describe some important properties of HSIs from the standpoint of the DoS that would lead to what is termed in this work as the sustainability pathway (SP).

2.3.1.2 Aspects of the sustainability pathway

Broadly speaking, the SP essentially describes the methods in which HSI are designed in such a way as to arrive at a template for the introduction of sustainability initiatives in a given situation. Thus, with respect to NSATs, a sustainability pathway could be assumed to be the nature in which the DoS are used as a guide to design HSI with a view to attaining a given set of sustainability goals. By utilizing the SPM in building an inter-relationship between the four DoS, a conceptual framework is introduced for describing the observed SP that a given sustainability assessment tool such as an NSAT possesses. From this framework, three different perspectives (which would serve as the main sustainability metrics) to the relational model can be observed, and they are the Point, Linear and Planar Aspects. A fourth (all-encompassing perspective) called the Summative Aspect can also be visualized, however, as would be described later.

Point Aspect (PA): this aspect of the sustainability dimension only visualizes one DoS, and it can be observed when an HSI only looks exclusively at just one DoS. For example, strict requirements for specific ecological practices in the development of NSATs for cities could be classified as only visualizing the environment. There are four PA that could be visualized from the SPM (see Fig 2.2 and Appendix 2A-1).

Linear Aspect (LA): this refers to HSI that could be indexed to show a link between any two DoS. For example, the requirements for the use of a low impact material for construction purposes, whilst having a strong environmental focus, can also be seen as an economic requirement, and as such could be classified as a *LA* which inter-relates the economy and the environment (which would be the so called econo-environmental). It should also be stated that the LA shows a one-to-one relationship between any 2 DoS. There are six *LA* that could be visualised from the SPM (see Fig. 2.2 and Appendix 2A-1).

Planar Aspect (PLA): this inter-relates any three DoS to one another, and unlike the LA, it shows that a given HSI viewed from one perspective can actually show a marked interrelation-

ship between two others. For example, flood risk assessment as an HSI whilst clearly trying to address an environmental effect, can be evidently linked to the influence it would have on the social as well as the economic dimension, making such an HSI (an enviro-econo-social PLA). There are four PLA that could be visualized from the SPM (see Fig. 2.2 and Appendix 2A-1).

Summative Aspect (SA): It is one that simply pictures the inter-linkages between the four pillars of sustainability as a singular entity. Essentially, this is the broader picture of sustainability in itself. It's subdivisions into the other three Aspects, provides a basis for the metrics used for tracking sustainability. Whilst a visualization of the DoS from this Aspect can show that all the DoS are interlinked, it is quite difficult but not impossible to attain all dimensions under the aspect. In this study, no HSI could attain this level of inter-relationship.

For the purpose of this research and based on the contextual arguments to be discussed, Fig. 2.2 is the conceptual and theoretical illustrations of the above methodology identifying each Aspect of the interrelationship between dimensions (see Appendix 2A-1 for breakdown).

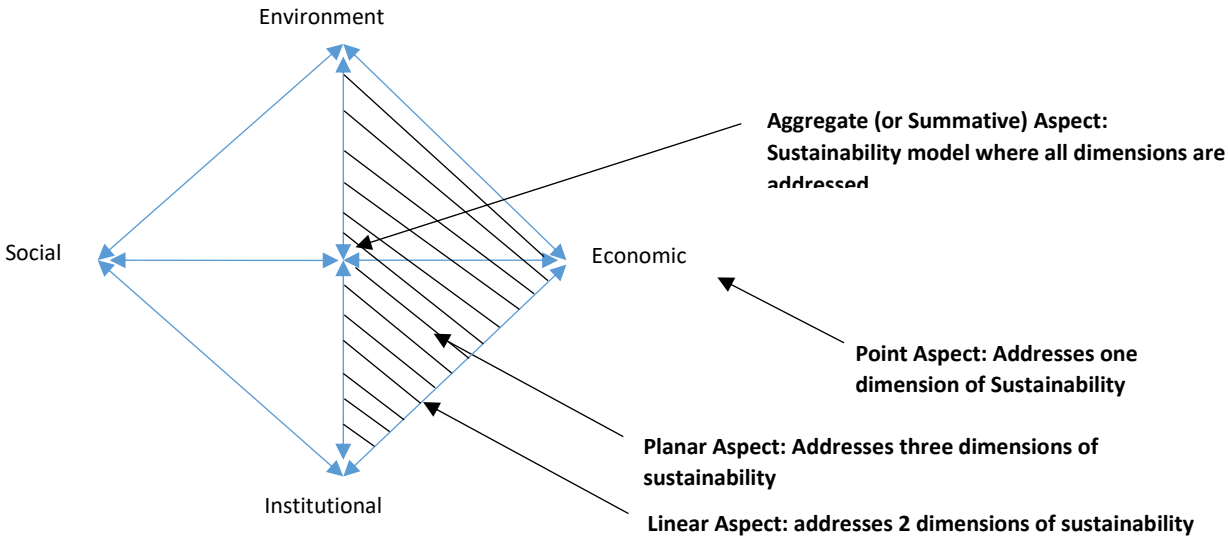


Fig 2.2: Illustration of the ideology of sustainability pathway model

2.3.1.3 Characteristics of indicators within the sustainable pathway

Following the preceding descriptions of the various Aspects that could describe the interrelationship between the DoS, it is necessary to view the use of these Aspects in the analysis of a given sustainability assessment tool. Accordingly, the three Aspects of Point, Linear, and Planar would be compared under four characteristics i.e. TRAC (Tractability, Relationality, Adaptability and Contextuality). These four characteristics of the various aspects would be used to qualitatively describe their properties in the relational model.

1. **Tractability**: this is described to be the ease in which a given aspect can be extracted from an HSI in any given sustainability assessment tool. Thus, when a HSI is described in a given NSAT, the tractability of an Aspect would imply the ease to which it would be able to explain or satisfactorily describe that HSI, without unnecessarily considering redundancies that could be viewed as been primary or secondary derivatives. Thus the tractability of an Aspect is the ability of an Aspect to limit redundancies in its visualization of any given HSI.

2. **Relationality**: simply put, this is the degree of *inter-linkage* that an Aspect consists of. Thus an Aspect that encompasses more DoS in its visualization is assumed to comprise of a high relationality.

3. **Adaptability**: the adaptability of an Aspect is described as the ease with which a given Aspect can be applied in practice in the conceptualization of a HSI in a given NSAT. This property of an Aspect is important when a given HSI is to be developed for the first time, or when an existing HSI is used as a template for the development of an HSI in a new NSAT. For instance, when the requirement for the development of a given HSI is to be assessed, the Aspect that provides a more coherent visualization of its constituent sustainability metric is considered to have a high adaptability. And with respect to already developed HSI, an Aspect with high adaptability would be one which would give a ready gauge to how a given HSI is being implemented. Simply put, adaptability for a planned assessment tool is the ease to which that Aspect can be viewed when the enforcement of that HSI is to be described, whereas

for a ready-made assessment tool its adaptability would be the ease to which that Aspect visualizes the implementation of the HSI. Thus, this characteristic implies the propensity of an Aspect to theoretically lead to achieving sustainability in practical settings.

4. **Contextuality**: this refers to the degree in which a given Aspect can legibly and comprehensively extract the context (or governing assumptions or situations) of a given HSI. Hence in this respect, an Aspect that could be used as an easy tool to clearly elucidate the context of a given HSI is assumed to have a high contextuality. A caveat to this is that for an aspect to have high contextuality it must also be able to clearly delineate redundancies.

With these definitions undertaken, an attempt is forthwith made to characterize the three aspects i.e. Point Aspect (PA), Linear Aspect (LA) and Planar Aspect (PlA) relative to the TRAC framework (shown in Table 2.3)

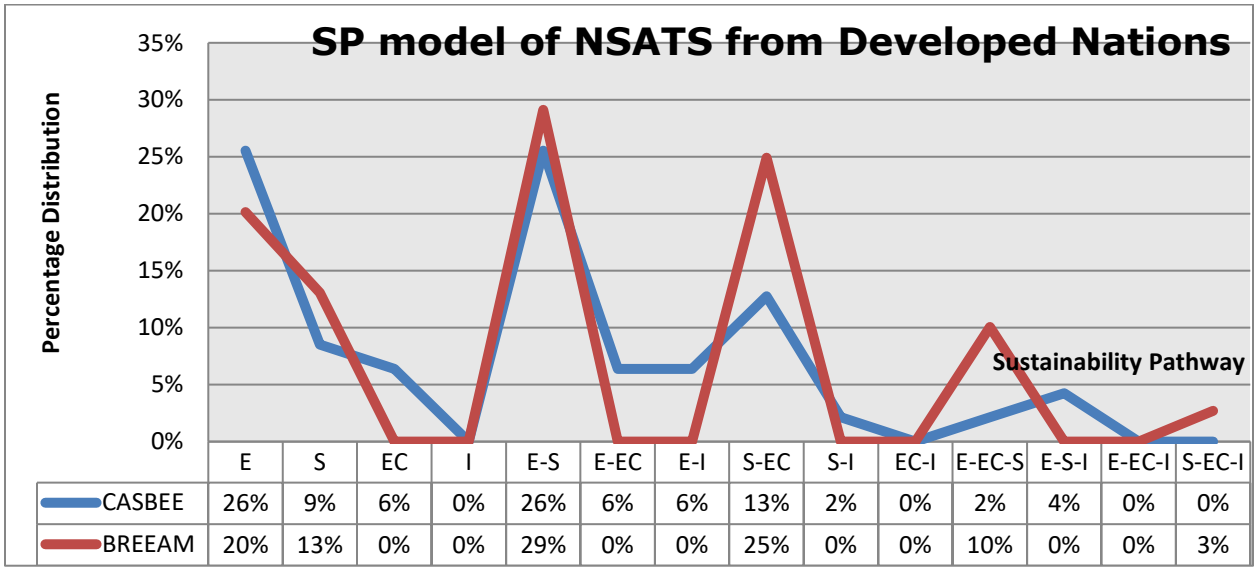
Table 2.3: Characterization of the different Aspects of sustainability metrics as viewed from the SPM

DoS	Tractability	Relationality	Adaptability	Contextuality
PA	Very High	Low	Very High	Low
LA	High	High	High	Very High
PLA	Low	Very High	Low	High
SA	Very Low	Very High	Very Low	Very High

2.3.2 Results from case study analysis

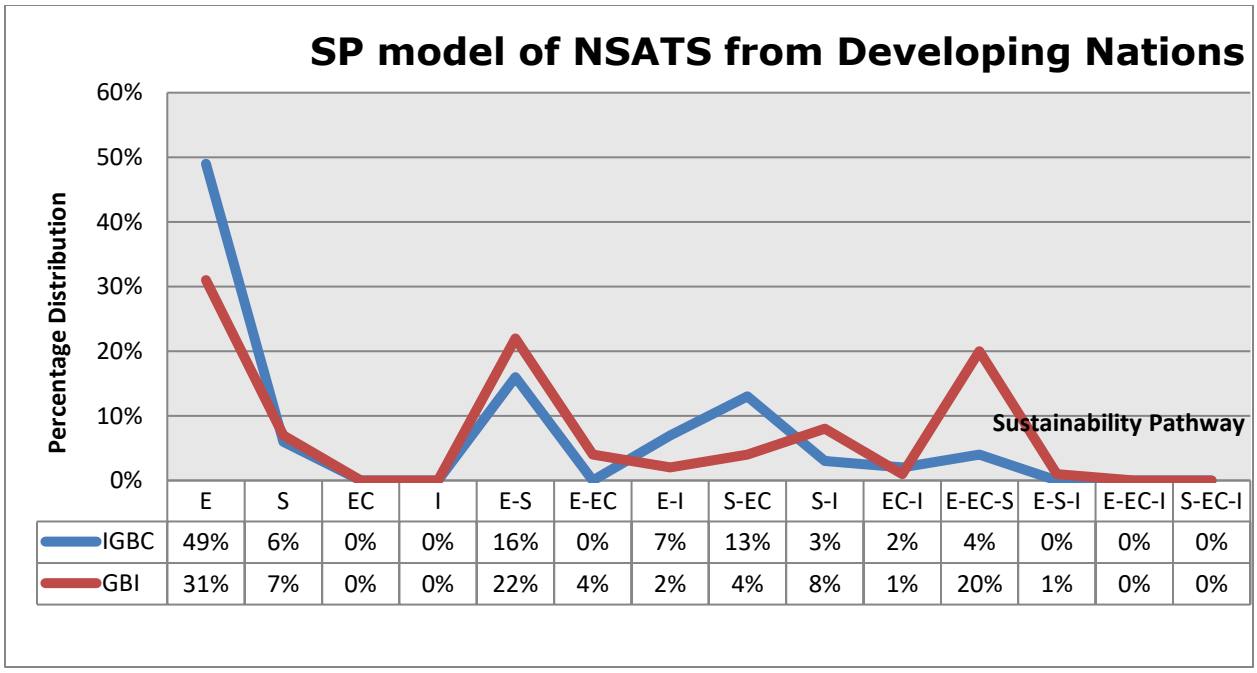
The results were conjointly obtained from: (i) the application of the SPM, (ii) the analysis and categorization of all four NSATs based on their weighting, (iii) the utilization of the first and second derivatives and (iv) the validation of TRAC through the presentation of a case study.

Due to the different weight allocated to each HSI, the quantitative analysis required identifying firstly, which dimensional Aspect each HSI belonged to. This is based on a qualitative review of the HSIs, guided by the utilization of the first and second derivative principles. It should be noted that each HSI is associated with a sustainability point or weight (see 1.4.1). As such, when placed into the 15 different interrelationships under PA, LA and PLA; the associated point is recorded and summed up. Thereafter, statistical data is obtained on the SP that each NSAT analyzed has pursued. Thus, the comparison of the four NSATs is normalized through percentage distribution, as each NSAT has different quantitative metrics for point allocation. Figs. 2.3 and 2.4 illustrate the normalized comparison of all the HSIs and associated points analyzed.



	E	S	EC	I	E-S	E-EC	E-I	S-EC	S-I	EC-I	E-EC-S	E-S-I	E-EC-I	S-EC-I
CASBEE	26%	9%	6%	0%	26%	6%	6%	13%	2%	0%	2%	4%	0%	0%
BREEAM	20%	13%	0%	0%	29%	0%	0%	25%	0%	0%	10%	0%	0%	3%

Fig. 2.3: SP of NSATs of developed nations



	E	S	EC	I	E-S	E-EC	E-I	S-EC	S-I	EC-I	E-EC-S	E-S-I	E-EC-I	S-EC-I
IGBC	49%	6%	0%	0%	16%	0%	7%	13%	3%	2%	4%	0%	0%	0%
GBI	31%	7%	0%	0%	22%	4%	2%	4%	8%	1%	20%	1%	0%	0%

Fig. 2.4: SP of NSATs of developing nations

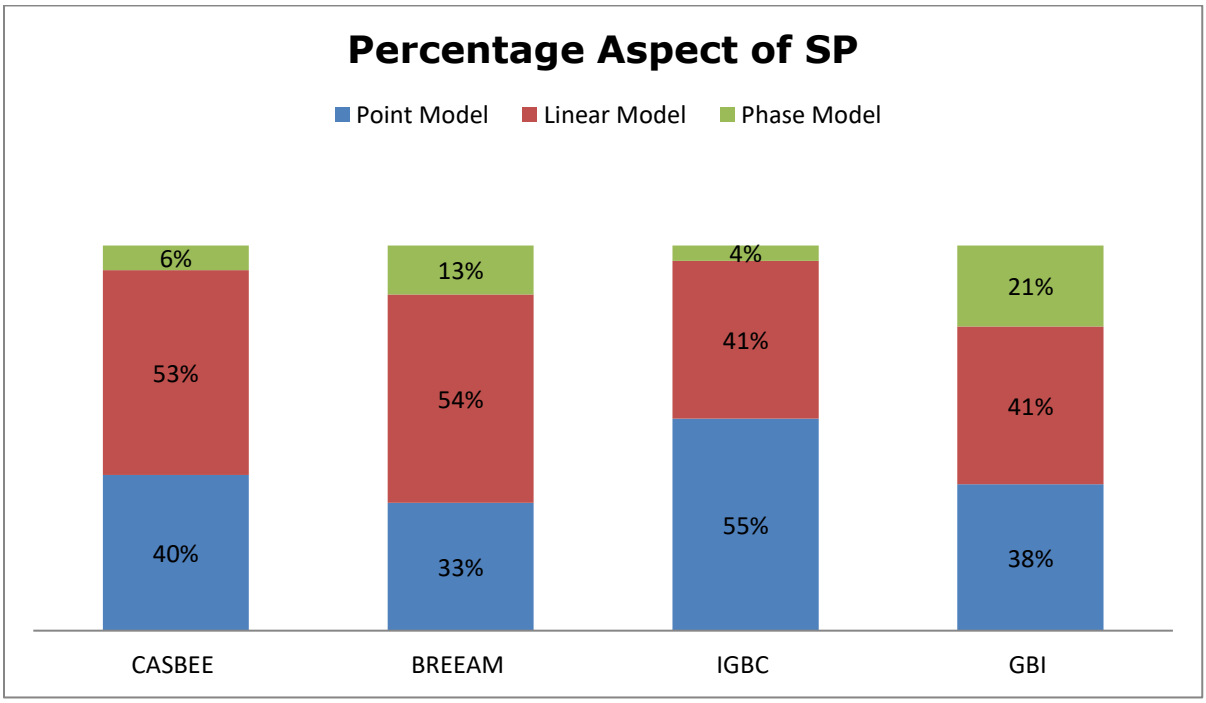


Fig. 2.5: Percentage Aspect of SP

2.4 Discussion

2.4.1 SPM analysis of NSATs

2.4.1.1 CASBEE (Japan)

According to the Sustainability Pathway (Fig. 2.3), CASBEE has an environmentally focused theme which features at 26%, and a Lin-ear Aspect which is enviro-socially focused, in third place comes the socio-economic, leaving CASBEE at 40% PA and 53% LA. The result of CASBEE being environmentally focused is expected, through qualitative analysis of the manual, it was identified that CASBEE had a direct focus on mitigating Urban Heat Island Effect (UHIE) and addressing issues of global warming (CASBEE, 2014). In particular there has been a clear focus on regional safety within the area due to natural disaster such as the great East Japan earthquake (CASBEE, 2014), this is adequately represented in developed HSI such as understanding hazard mapping and disaster prevention of various infrastructure. These focuses essentially formed the basis on which CASBEE was developed, the manual takes into cognizance the regional peculiarities as well as global issues and attempts to mitigate these.

From a social perspective the aspect of security and safety is largely promoted and is directly linked to the effects of natural disasters within the region, this HSI is noted to be very important, as this is a pertinent HSI required in Africa; however, safety and security in Africa is not only environmental, as the case of Japan shows, but largely manmade (CASBEE, 2014). Another aspect of social HSIs is traffic management, which under BREEAM is largely concerned with air pollution reduction, fossil fuel reduction via close connectivity and compact design. CASBEE considers traffic safety as a HSI which is more concerned with providing infrastructure for pedestrians and the disabled and also safety for them, but not necessarily in reducing traffic load. This raises the contextual argument of sustainability within the built environment on how each region has a specific focus when developing HSI.

One of the major arguments in this thesis is the inclusion of the institutional dimension which is an aspect lacking in most NSATs. This arguably stems from a ripple effect of institutional importance not being properly addressed in most sustainability literature, due to the school of thought, which uses institution as an all-encompassing aspect in the three DoS (Komeily and Srinivasan,2015). However in order to identify the missing or added piece in this analysis, the fourth dimension was included and the results yielded some debatable points. Firstly, the institutional dimension is the least considered dimension under CASBEE. Also, when institution is considered under all models, it is from a LA or PLA standpoint. For instance under the HSI of "Compliance", which focuses on abiding by urban and building laws and regulations that "govern wind damage, radio waves, traffic, sunlight, light damage, soil pollution, noise, vibration, odors, air pollution, groundwater withdrawal, and water quality" (CASBEE, 2014). This informs us that the institutional dimension is not effective alone, except by interrelating with other dimensions.

The economic HSI as a PA is weaker compared to other social and environmental dimensions but when used as an LA, CASBEE data indicates it shows better consideration of economic factors within them, especially the socio-economic aspect of HSI, which clearly show strong interdependency. However, it was observed that the economic benefits were seen mainly as an offshoot of either the social or environmental consideration. For instance, CASBEE attempts to preserve and evolve a region's urban identity through the culture HSI. This HSI attempts to preserve or restore historical legacy which in addition to buildings, also includes traditions in the form of festivals and events, and the people in general. This inherently social characteristic, leads to the economic benefit of tourism enhancement.

In essence, there is a strong environmental focus in CASBEE but this is also supported by moderately strong social and economic benefits but with minimal institutional impact. In addition there is stronger LA as compared to other Aspects, indicating a higher level of contextuality, adaptability, tractability and relationality.

2.4.1.2 BREEAM Communities (United Kingdom)

The results from BREEAM vary significantly to its developed nation's counterpart, firstly there is less consideration for PA and more focus on the LA and PLA as compared to CASBEE. Secondly, and perhaps most importantly, BREEAM's focuses are largely socially oriented, with the social dimension rated at 13% to 9% of CASBEE, on the LA level BREEAM's socio-economic dimensions doubles CASBEE by 25%–13% and socio-environmental 29%–26% respectively. This makes BREEAM the leader in indicators displaying socially based interrelationships - compared to any other NSAT. It is quite evident that there is a conscious focus on social inclusion and consideration in the sustainable community development principles adopted by BREEAM. This is evident, when reviewing BREEAM HSI such as consultation and engagement, design reviews, inclusive design etc. These are core socially oriented HSI, with 17 HSI out of a total of 44 being consultation focused.

The second dimension of focus is the environmental dimension, which is just as strong a focus in BREEAM as it is in CASBEE. However, when compared to the developing nations, it is 10%to 20% less. Another important observation is the lack of institutional dimension and its relationships. A school of thought may be that developed nations largely have institutional capacity embedded in its society i.e. policies and regulations have already been inculcated into cities, as such the development of BREEAM could function under this assumption. However, various authors have stated BREEAM's lack of institutional capacity all together which is evident under the manual analysis but authors such as Sharifi and Murayama (2013) fail to recognize the above observations of its embedded nature in highly developed societies for which BREEAM is designed for. Nonetheless, with a certain degree of confidence, it is clear that developing nations especially within Africa do not operate under such umbrella of embedded institutional considerations and cannot simply imitate the indicator focus and methodologies of BREEAM (UN-HABITAT, 2015; UNEP, 2012).

On a PLA level, when considering the generic DoS "socio-econo-environmental", BREEAM considers this quite well in comparison to CASBEE with HSIs such as flood risk and transport assessment being key representation of this dimension. These HSIs are not only mandatory they consider all facets of sustainability bearing in mind the assumption of embedded institutional capacity. For instance, flood risk assessment, which is an extremely important HSI in the UK but also in countries in Africa such as Nigeria; it is noted that in Europe, the UK is more prone to rising water levels. This aspect of flooding and drainage is well considered under the National planning policy guidance documents of the UK (BRE Global, 2012). Still, speaking on guidance, under the HSI of "water strategy", a mandatory requirement is the corroboration and collaboration with appropriate regulatory body i.e. the environment agency of internal drainage board. This is to better plan for water consumption and to also estimate water demand while also considering the effects of climate change. The lessons learned here are that there are recurring themes in various HSIs, one of which is the presence of regulatory or governing bodies pertaining to a specific infrastructural requirement; the other is that, consultation and collaboration should occur frequently between such bodies and the developers as well as the future tenants. How-ever, the major issue as stated in Table 2.3 is the tractability and applicability of the Planar Aspect.

Relating this to an African context such as Lagos city, Nigeria, flooding is seen as a national disaster and occurs due to poor drainage, increased encroachment of urban facilities and climate change (Ajibade, McBean, and Bezner-Kerr, 2013). These detrimental effects are particularly stronger in the slum developments of Lagos. There are also no policy documents that deter flooding unlike in the UK. The comparison illuminates the contextual nature of indicators, as both UK and Nigeria are flood prone areas but the origin, effects and demographics are different (Ajibade et al., 2013; Ozsoy, Haigh,Wadey, Nicholls, and Wells, 2016). This falls in line with the PLA property identified to be prevalent in this flood oriented HSI, due to low adaptability and low tractability, it becomes extremely difficult for HSIs like

flood risk assessment to be achieved without the right policy, guidelines and technical knowhow, which are inherently lacking in African countries. Moving away from the contextual environmental issues, Fig. 2.3 shows that as a PA the economic dimension does not exist, how-ever, as an LA, it is prevalent, with socio-economic dimension being the 2nd most dominant dimension across BREEAM. When com-pared to the 3 other NSAT's it doubles in percentage contribution as Figs. 2.3 and 2.4 show. The analysis of the manual shows that this is due to the high weighting assigned to the HSIs of "economic impact" and "training and skill" (BRE Global, 2012). Great emphasis is laid on these HSIs and covers every economic activity from infrastructure development and job opportunities to mapping of local businesses and complimenting the local economy. In essence, the focus of BREEAM broadly emulates CASBEE or vice versa; however, their weightings vary. Also, it is clear that BREEAM is a socially inclusive framework, when considering all Aspects and dimensions. However, little attention is paid to the specificity of institutional capacity. Nonetheless, this has been defended based on the policies and regulations already in place and embedded on national levels. From an Aspects perspective, the LA is the most dominant leaving PLA largely vacant in indicator consideration. However this is still second highest amongst all NSATs.

2.4.1.3 IGBC Township (India)

IGBC Township, which is an Indian focused assessment tool borrows a lot of its inspiration from developed tools such as BREEAM and LEED. IGBC results vary significantly compared to their developed country counterparts. Firstly, the most outstanding result observed from Fig. 2.4 is the PA covering the environmental dimensions. Compared to the other NSATs, it is the highest Aspect seen on the graph, indicating an environmentally focused Point Aspect. Further investigation shows that the two developing nations focused heavily on this dimension. Second and third to this are the Linear Aspect of enviro-social and socio-economic. This again, suggests the dominance of the environmental dimension but also shows the consideration for the social dimension being included in the NSAT. The result from Fig.

2.4 can be translated to have low relationality due to the heavy focus on PA, this also allows room for higher tractability due to the rather basic and one dimensional nature of the indicators analyzed in the manual (Indian Green Building Council, 2010). In totality, a conclusion would be that due to the large PA; a "one fits all" approach was used in the development of this NSAT, i.e. very low contextual consideration (Komeily andSrinivasan, 2015).

The result is further said to be contradictory, as evidence would point to developing nations like IGBC to be more socially challenged, based on the concept of green versus brown Agenda; with the brown agenda being the primary focus of developing countries (UN-HABITAT, 2015). However, closer inspection of the IGBC manual deciphers the stakeholder involvement in the development of the framework. These stakeholders were identified to be largely professional practitioners and architectural and urban planning companies; little is mentioned of academic, political or public input in the development (Indian Green Building Council, 2010).These results goes against the concept of procedural balance, which was identified as one of the 5 principles to consider when developing a balanced NSAT. This also provides an explanation to the heavily focused environmental dimension, because of the professional's one sided approach and also the partially contextual issues India faces which were identified to range from rapid urbanization and population increase to slum creation, increased pollution levels, traffic congestion and lack of waste management services(Pachauri and Sridharan 1998, Indian Green Building Council, 2010).These issues though contextual are common place for developing nations and bear significant resemblance to the urban sustainability plight facing Africa, thus validating in some respects the effects of PA and its low contextual properties. IGBC further states in the manual its focus on applying green concepts to reducing environmental impact. From these instances there is a direct indication of bias towards a more environmentally focused design. In conclusion, this environmental

focus could be summarized to stem from the common challenges faced by developing nations and professional bias of developers as stakeholders.

Focusing on the institutional dimension, it is clear that IGBC faces the same institutional challenges as BREEAM and CASBEE. However, Unlike BREEAM, IGBC lacks national and local level embedded policies and regulatory bodies that govern sustainable urban planning and environmental strategies (Schmerbeck, Kohli,and Seeland, 2015). For example, in BREEAM, the HSI of "Energy strategy" is governed by embedded national policy and directives. However, in IGBC energy indicators do not comprise of such collaboration with the appropriate body to fully see their potential utilized (IGBC, 2010). Hence, the realization is that though both lack the institutional dimension so to speak, IGBC also lacks the embedded directives and policies to guide and assist its utilization. Investigating this further the major institutional HSI was the Road and Street Network. Hence, for this aspect, the major question about regulatory bodies, policies, laws and incentives come into play and how they will aid IGBC and nations alike, as there is little reference to these in the manual (IGBC 2010).

In terms of the economic dimensions, similar to BREEAM, IGBC is more LA focused with the tendency of HSIs that fall under this to address economic dimension along with another. In the case of IGBC this is largely socio-economic with this dimension being second highest amongst others on the socio-economic range (see Figs. 2.3 and 2.4). Again, this is quite similar to BREEAM and shows the strong synergy and interplay between social and economic indicators. When considering the enviro-socio-economic dimension it is less than both BREAM and GBI, in fact the only HSI under this Aspect is the consideration of local food production. This is a HSi that has been neglected by both BREEAM and CASBEE. Again this highlights the contextual issue that surrounds each framework. Delving deeper in the contextual situation, BREEAM does not recognize the validity of 1st generation biofuels such as those generated from sugar seeds, animal fat etc., due to the biofuel debate on car-bon footprints and global food shortages. However, IGBC makes no emphasis on this potential

limitation and further investigation would suggest that this option may be a valid route to take in tropical areas in Asia and Africa, which are natural habitats for some of these energy crops (Gasparatos et al., 2015; Singh andSetiawan, 2013). Also, when transportation is considered there isa direct national focus on electric infrastructure used in combination with bicycles (Building Research Establishment 2012). This is largely due to the agreed national aim for grid decentralization and large scale renewable energy production (Hammond, Akwe,and Williams, 2011; Ochieng et al., 2014). Again this provides insight to the necessity of the institutional dimension and how it can be utilized contextually to provide sustainable energy strategies on various levels of the built environment.

Another point worth identifying is the focus on mandatory criteria which is utilized in IGBC and BREEAM but not considered in CASBEE, which in essence identifies key non-negotiable HSIs that need to be satisfied before the commencement or during the project (Mourshed et al., 2015). Again these mandatory criteria are subjective but it is argued that it enforces compliance in sustainability led challenges. Although, developers may argue its limitation towards creativity and sometimes impracticable suggestions (Garde, 2009). For example IGBC make a mandatory requirement to harvest 50% rainwater which is understandable given the high precipitation rates in India and the current water scarcity challenges globally and also locally in a highly populated region (Singh, Pandey, and Chauhan, 2006). However noble, the practicability of capturing 50% rainwater as a mandatory requirement comes into play. Developers would ask the question of how economically feasible is this demand as it requires procurement of additional and specialized materials. Reverting back to the TRAC analogy under SP; the tractability and adaptability of the HSIs becomes very important. If the rainwater harvesting were to be viewed from a PLA perspective it becomes harder to achieve the aims of the HSI due to the difficulty in trying to achieve three dimensions under the HSI. However from PA or LA perspective, for instance where rainwater harvesting would consider environmental and economic impact it becomes more achievable

and more tractable especially under the African con-text where funding for infrastructure is a major limitation for investing in sustainable agendas.

The results shown in Figs. 2.4 and 2.5 and a detailed analysis of the NSAT manuals shows that IGBC focuses intently on the PA environ-mental dimension which is minimally supplemented by economic and social dimensions, and has minimal institutional influence in its consideration of its development. The analysis shows a low-level of contexuallity and interrelationships although the indicators within this NSAT were identified to be generic and easily tractable.

2.4.1.4 GBI Township (Malaysia)

Similar to IGBC, results obtained from the analysis of GBI shows an environmental focus in its development. However, unlike other NSATs, there is a stronger PLA in terms of the econo-enviro-social dimensions. This observation gave an indication of not only an environmental focus but also an effort to inculcate as much sustainability coverage or principles within their HSIs.

From the social perspective, when viewed on a PA basis, the two developing nations have lower social considerations in their indicators compared to that of developed nations, (see Figs. 2.3 and 2.4). For the LA, this trend also remains the same for only the enviro-social and econo-social dimensions (see Fig. 2.4). The socio-institutional dimension shows quite different results. Focusing on this aspect, the two HSIs that facilitate this are "Community Thrust" and "Governance". These aspects are quite beneficial when considering tool utilization in Africa, as they not only promote sustainability through building development they also address localized issues and then recommend the establishment of organizations/associations, initiatives and systems that aid in the long term mitigation of the discussed issues. From the "Governance" perspective, it requires planning activities to be in congruence withthe ministry of housing and local government guidelines, where initiatives such as the local agenda 21 programs is promoted and the use of the complaints bureau is

encouraged (GBI, 2011). The high socio-institutional characteristics of some of GBI's HSIs, displays the highest adoption of the institutional dimension in all the NSATs analyzed in this research (Fig. 2.5).

Although, GBI is environmentally focused, it is quite open in its approach to addressing sustainability issues as it also does not have mandatory requirements unlike IGBC and BREEAM. This has obvious limitations, as developers pick and choose according to their preferences i.e. HSI which give the highest points with minimal effort or/and least financial burden thus indirectly boycotting the whole concept and efficacy of NSATs.

The other distinct result addresses the PLA (enviro-econo-social), which at an adoption of 20%, is the highest out of all the NSATs under this aspect. Some of the HSIs include 'Proximity to Existing Infrastructure', 'Services Infrastructure Provision' and Green Transport Master Plan'. The concept here largely focuses on the environmental and social issues of connectivity but GBI also considers the primary derivative which puts into consideration the economic advantages of HSIs such as "connectivity" and "Green master planning" which would result from job creation, increased mobility cargo and people, and also the emissions resulting from such activities in general. This high relationality is what distinguishes this NSAT from its counterpart, in addition to contexuality that comes with complexity of trying to achieve HSIs under this NSAT.

In conclusion GBI bears similarities with its developing nation's counterpart (IGBC), in its environmental focus but exhibits unique-ness in that in addition to considering the institutional capacity (though minor contributions), it also has strong considerations of the PLA (enviro-econo-social). These aspects have not been clearly exhibited by other NSATS.

2.4.2 SPM as a template in the development of NSATs

From the foregoing analysis, the SPM has been used to visualize four different NSATs, and although the utilization of the SPM does not categorically state which NSAT is optimal or otherwise, still it has to be pointed out that it can serve as a template for the development of NSATs or at least as a means of assessing the efficacy of certain HSIs that are to be used in the development of NSATs. In general, most African countries have not yet developed bespoke NSATs, however, there are numerous regulatory codes that are in existence and are employed by town planners, urban designers, architects etc. in the design of neighborhoods. Following these reasoning, although sustainability metrics are not the main tools used in designing these codes, some of these regulations and codes have certain features that encompass certain aspects of sustainability. In fact, for the case of Nigeria, (DaudaDahiru, Abdulazeez, and Muawiyya Abubakar, 2012) have assessed the extent to which the Nigerian Building Code (NBC) can be used as a guideline to achieve sustainability in the built environment of Africa's most populous country. Along these lines, it is envisaged that the SPM can be utilized as a ready tool to formulate plausible trajectories for the deployment of sustainability in a given country/locale. For example, in a country such as Nigeria, were implementation of some sustainability related policies is a huge hurdle (Ogbazi, 2013), it could be theorized that using the Linear Aspect would allow for the Institution as a DoS to be closely anchored to other DoS such as the economy, social and the environment. This is because it is now becoming clear that sustainability in Africa is easily promoted when its deployment does not seem extraneous. What this imply is that sustainability in some parts of Africa has been markedly affected by the effects it has on either the social or the economic DoS, such that if the SPM of certain countries in Africa is to be theoretically modelled, one would notice that Linear Aspects such as Econo-Environmental are already gaining traction in the deployment of sustainability initiatives in Africa. For example, a lot of sustainability initiatives that have gained some level of popularity in some African countries, can be visualized from a LA perspective such as econo-environmental i.e. citizens perceive the

economic opportunities in undertaking some environmental sustainability ventures, cases in point are the waste management initiatives in countries such as Nigeria (Abila, 2014)Kenya (Financial Times, 2013) which have experienced an increase in entrepreneurs whom are taking advantage of the need to man-age urban waste by building successful business models around waste collection and recycling. Accordingly, it could thus be theorized that through detailed contextual analysis and appraisal of African countries, a detailed trajectory of the SPM of a given locale can be designed, in such a way as to guide the development of bespoke NSATs for these locales. This line of reasoning is the basis of an application of the SPM that the authors are currently working on.

2.5 Conclusions

2.5.1 Aspects of sustainability visualization as a map for visualizing the sustainability pathway

Based on the above results and analysis, a rigorous definition of the sustainability pathway is hereby attempted. Simply put, "the sustainability pathway could be defined as the series of steps undertaken to ensure that a given policy, regulation, specification etc. attains sustainability within the purview of the context that the document is expected to cover". Thus, in the case of the development or the critique of a given NSAT, the SP would imply a visualization of how such an NSAT attempts to encompass all the dimensions of sustainability in the development of their indicators. Accordingly, the aim of the chapter was to use the developed relational model as a tool to understanding how to map out the SP of a given NSAT. Along these lines, it is noticed that various aspects of the SPM, have their pros and cons; and as such the utilization of this model is intended to be prescriptive. This implies that rather than stating that a given Aspect of visualizing the DoS is optimal, the TRAC characterization of the Aspects should be used as a con-straining device to select an Aspect that would be used to employ the relational model as a tool for describing or (mapping) the SP of any given NSAT.

Consequently, the SP that would be generated from the use of the SPM would be based on an assumed Aspect of sustainability as implied by the SPM that would not only provide a comprehensive outlook on the indicators of the NSATs investigated, but would also be capable of normalizing the metrics used in the categorization and comparisons of HSIs adopted across a vast number of NSATs. Thus, referring to the TRAC characterization described earlier, although the PLA seem to encompass more DoS and also have a very high relationality (which would appear to be the best fit for the relational model been proposed), critically appraising this Aspect would show that its low tractability and adaptability would make this Aspect relatively difficult to utilize across a broad spectrum of NSATs. On the other hand, the low relationality and contextuality of the PA, precludes it from been a rigorous mapping tool for the SP. Although, it has a lower relationality relative to the PLA, its high tractability and adaptability relative to the PLA implies that the LA could be easily extracted from a given HSI, whilst being practically deployable. It can also be appreciated that since the contextuality of the LA is the highest of all the aspects, this implies that it is a more potent normalization device when a broad-spectrum of NSATs are to be compared.

Africa without a doubt will gain immensely from the development of NSAT as it is clear that their environmental, social, economic and institutional issues needs to be addressed urgently. The development of the SPM with the inclusion of the institutional dimension, in the broader scheme, sets the tone for the development of NSATS in Africa. A deliberate approach was taken in the development of the SPM not to rede-fine sustainability, but to adopt the definition and descriptions of sustainability submitted in the Brundtland report. However, an additional area of innovation occurred with the use of the relational concept to identify and justify 14 different interrelationships. The study of urban sustainability undertaken in this research then began with the development and utilization of the SPM and TRAC in the investigation and identification of the DoS and indicators relevant to Africa. These procedures provided insight to the characteristics or Aspects (PA, LA, PLA, SA) of HSIs which Africa will

need to inculcate. It also provides a practical view about which goals are achievable under specific HSI and which goals still need time to develop. The case studies have illustrated similarities which Africa exudes when viewed from the context of developed and developing nations. It is quite clear that for some specific HSIs to function appropriately, institutional dimension needs to be addressed in Africa and fully implemented as active indicators in the development of NSATs. An addition would also be to improve the embedded nature of institutional directives, however that would be an exclusive function that occurs from the improvement of legislation policy and law, the SPM and NSATs may only help identify these but they cannot be enforced by them. It is also quite clear that the interrelationship within a HSI has a significant impact on its applicability and effectiveness. As such, by fully understanding this relationship one can fully reap the benefits in the application of said HSI.

References

Abila, N., 2014. Managing municipal wastes for energy generation in Nigeria. Renewable and Sustainable Energy Reviews, Volume 37, pp. 182-190.

Ajibade, I., G. McBean and R. Bezner-Kerr (2013). "Urban flooding in Lagos, Nigeria: Patterns of vulnerability and resilience among women." Global Environmental Change 23(6): 1714-1725.

Alyami, S. H. and Y. Rezgui (2012). "Sustainable building assessment tool development approach." Sustainable Cities and Society 5(0): 52-62.

Ameen, R. F. M., M. Mourshed and H. Li (2015). "A critical review of environmental assessment tools for sustainable urban design." Environmental Impact Assessment Review 55: 110-125.

Aneshensel, C. S., and Sucoff, C. A. The neighborhood context of adolescent mental health. Journal of health and social behavior, 1996 293-310.

Arimah, B. C. and Adeagbo, D., 2000. Compliance with urban development and planning regulations in Ibadan, Nigeriaq. Habitat International, Volume 24, pp. 279-294.

Berardi, U. Sustainability assessment in the construction sector: rating systems and rated buildings. Sustainable Development, 2012 20(6), 411-424.

Berardi, U. Sustainability assessment of urban communities through rating systems. Environment, development and sustainability, 2013 15(6), 1573-1591.

Boyko, C. T., R. Cooper and C. Davey (2005). Sustainability and Urban Design Process, Proceedings of the Institution of Civil Engineers 158.

BRE Global, 2012, BREEAM Community: Technical Manual SD202 Version:2012.

Cole, R. J. (1998). Emerging trends in building environmental assessment methods. Building Research and Information

Cole, R. J. (2000). Building environmental assessment methods: assessing construction practices Construction Management and Economics.

Cole, R. J. and M. J. Valdebenito (2013). The importation of building environmental certification systems: international usages of BREEAM and LEED Routledge.

Conte, E., and Monno, V. Beyond the buildingcentric approach: A vision for an integrated evaluation of sustainable buildings. Environmental Impact Assessment Review, 2012 34, 31-40.)

Crawley, D. and I. Aho (1999). "Building environmental assessment methods: applications and development trends." Building Research and Information 27(4-5): 300-308.

Ding, G. K. C. (2008). "Sustainable construction—The role of environmental assessment tools." Journal of Environmental Management 86(3): 451-464.

Esty, D. C., Levy, M., Srebotnjak, T., and De Sherbinin, A. Environmental sustainability index: benchmarking national environmental stewardship. New Haven: Yale Center for Environmental Law and Policy, 2005 47-60.

Fekry, A. A., A. M. El Zafarany and A. K. M. Shamseldin (2014). "Develop an environmental assessment technique for human comfort requirements in buildings." HBRC Journal 10(1): 1-9.

Financial Times, 2013. Kenya's slums turn waste into gold. [Online] Available at: https://www.ft.com/content/c037bd0c-dcdc-11e2-b52b-00144feab7de [Accessed 2 October 2016].

Garde, A. (2009). "Sustainable by Design?: Insights From U.S. LEED-ND Pilot Projects." Journal of the American Planning Association 75(4): 424-440.

Green Building Index, 2011. GBI Assessment Criteria for Township: Version 1.01, Kuala Lumpur, Malaysia.

Haapio, A. (2012). "Towards sustainable urban communities." Environmental Impact Assessment Review 32(1): 165-169.

Haapio, A. and P. Viitaniemi (2008). "A critical review of building environmental assessment tools." Environmental Impact Assessment Review 28(7): 469-482.

Haroglu, H. (2012). The Impact of Breeam on design of building, Proceedings of the Institution of Civil Engineers.

Hiremath, R. B., P. Balachandra, B. Kumar, S. S. Bansode and J. Murali (2013). "Indicator-based urban sustainability—A review." Energy for Sustainable Development 17(6): 555-563.

Indian Green building Council, 2010. IGBC Green Townships; Rating System, Pilot Version

Iwaro, J. and Mwasha, A., 2010. A review of building energy regulation and policy for energy conservation in developing countries. Energy Policy, Volume 38, pp. 7744-7755.

Joss, S. (2015). Eco-cities and Sustainable Urbanism A2 - Wright, James D. International Encyclopedia of the Social and Behavioral Sciences (Second Edition). Oxford, Elsevier: 829-837.

J. Schmerbeck, A. Kohli, K. Seeland, (2015). Ecosystem services and forest fires in India — Context and policy implications from a case study in Andhra Pradesh, Forest Policy and Economics, Volume 50, January 2015, Pages 337-346.

Kineman, J. 2011. "Relational Science: A Synthesis". Axiomathes 21 (3):393-437.

Komeily, A. and R. S. Srinivasan (2015). "A need for balanced approach to neighborhood sustainability assessments: A critical review and analysis." Sustainable Cities and Society 18: 32-43.

Lehmann, S. (2015). Low Carbon Cities: Transforming Urban Systems. London and New York, Routledge.

Nguyen, B. K. and H. Altan (2011). "Comparative Review of Five Sustainable Rating Systems." Procedia Engineering 21(0): 376-386.

Næss, P. (2001). "Urban Planning and Sustainable Development." European Planning Studies 9(4): 503-524.

Ogbazi, J. U., 2013. Alternative planning approaches and the sustainable cities programme in Nigeria. Habitat International, Volume 40, pp. 109-118.

Ozsoy, O., I. D. Haigh, M. P. Wadey, R. J. Nicholls and N. C. Wells (2016). "High-frequency sea level variations and implications for coastal flooding: A case study of the Solent, UK." Continental Shelf Research 122: 1-13.

Pope, J., D. Annandale and A. Morrison-Saunders (2004). "Conceptualising sustainability assessment." Environmental Impact Assessment Review 24(6): 595-616.

Rajbeer Singh, Andri D. Setiawan, (2013). Biomass energy policies and strategies: Harvesting potential in India and Indonesia, Renewable and Sustainable Energy Reviews, Volume 22, Pages 332-345,

Reed, R., A. Bilos, S. Wilkinson and K.-W. Schulte (2009). International Comparison of Sustainable Rating Tools The Journal of Sustainable Real Estate. 1: 22.

Reisig, M. D., and Parks, R. B. Experience, quality of life, and neighborhood context: A hierarchical analysis of satisfaction with police. Justice quarterly, 2000 17(3), 607-630.

Reith, A. and M. Orova (2015). "Do green neighbourhood ratings cover sustainability?" Ecological Indicators 48(0): 660-672.

Rosen, R. 1991. "Life Itself: A Comprehensive Inquiry Into The Nature, Origin, And Fabrication Of Life". Columbia University Press. New York.

Saunders, T. (2008). A Discussion Document Comparing International Environmental Assessment Methods for Buildings. B. Global.

Sharifi, A. and A. Murayama (2013). "A critical review of seven selected neighborhood sustainability assessment tools." Environmental Impact Assessment Review 38(0): 73-87.

Sharifi, A. and A. Murayama (2014). "Neighborhood sustainability assessment in action: Cross-evaluation of three assessment systems and their cases from the US, the UK, and Japan." Building and Environment 72(0): 243-258.

Spangenberg, J. H., S. Pfahl and K. Deller (2002). "Towards indicators for institutional sustainability: lessons from an analysis of Agenda 21." Ecological Indicators 2(1–2): 61-77.

Tanguay, G.A., Rajaonson, J., Lefebvre, J., Lanoie, P., Canada, B., Chabot, R., Thornton, G., 2009. Measuring the Sustainability of Cities: A Survey-Based Analysis of the Use of Local Indicators.

UN-HABITAT (2015). Sustainable Urban Development in Sub-Saharan Africa.

UNEP (2012). Sustainable, Resource Efficient Cities - Making It Happen.

Valentin A, Spangenberg JH. 2000. A guide to community sustainability indicators. Environmental Impact Assessment Review. 20(3):381-392.

Wilkins, G. (2002). Technology transfer for renewable energy : overcoming barriers in developing countries. London, Earthscan.

World Commission on Environment and Development (1987). Our Common Future, Oxford Press.

Yin, K., R. Wang, Q. An, L. Yao and J. Liang (2014). "Using eco-efficiency as an indicator for sustainable urban development: A case study of Chinese provincial capital cities." Ecological Indicators 36: 665-671.

Chapter 3

Is Africa Ready for NSATs: The Institutional Conundrum

"Half education is more dangerous than no education."

~ Chris Ukaobasi

Under review by Cities and Renewable and Sustainable Energy Reviews (Elsevier)

3.1 The institutional conundrum of NSATs

The initial development of these voluntary Neighbourhood Sustainability Assessment Tools (NSATs) occurred in the mid-2000s in Europe and North America before being imbibed worldwide. As mentioned in chapter one and two, NSATs utilize sustainability indicators (SI) and scoring systems as innovative means of providing prescriptive solutions to sustainable development in the urban realm (Berardi, 2015). These indicators, and more specifically headline sustainability indicators (HSI), give procedural, operational and feature-based instructions to developers, planners and engineers. There are generally two types of NSATs, third party tools and embedded tools. Third party based tools are the focus of this study and are tools that originate from building assessment tool and later evolved to NSATs. Embedded tools are decision making tools embedded into neighbourhood planning such as one planet and Eco district.

Aside the pioneering three tools (BREEAM communities, LEED-ND and CASBEE-UD. The next set of tools was developed in New Zealand and Australia in 2006 and 2007 (Enviro-development and Neighbourhood sustainability framework). This was furthered with the development of NSATs mostly in Asian and Middle Eastern cities between 2008 and 2014. The most recent tools 'HKBEAM in Hong Kong was released early 2017". Essentially, these assessment tools are concentrated majorly in Europe, North America and Oceania with newly developed tools created in East Asia and Middle Eastern regions. These observations further add to the narrative and argument brought forward in chapter one, as it illustrates that even within the more recent tools developed, none of these NSATs being considered for the African region. The question is why? After all, they boast several advantages such as, evaluation against a number of pre-defined sustainability criteria, providing credibility for the planning project, they nudge the planning organization to define and use sustainability targets early in the process, the systems can highlight environmental and other sustainability issues that would otherwise be overlooked, certificates can be used for comparison, marketing and for

procurement and they can provide a common language for communication and collaboration between stakeholders.

However, two major gaps in terms of sustainable urban development is that these tools were majorly focused on environmental challenges of the buildings and did not consider institutional directives or indicators, thereby suffering major criticism and setbacks in implementation (Sharifi and Murayama, 2013). The reason for this setback was due to the post Brundtland report, where popular consensus was established on the definition of sustainable development, which meant "*development that meets the needs of the present without compromising the ability of future generations to meet their own needs*" (World Commission on Environment and Development, 1987). From a sustainable urban development perspective, this translated into planning of economic, environmental and social dimensions when dealing with all aspects of the built environment (Berardi, 2015). Hence, in a bid to optimize sustainable urban development, NSATs were developed to consider the three dimensions of sustainability (social, environmental, economics)(DoS) and also reflect the complex interaction between city and various components such as neighborhoods, population, transportation, open spaces, waste management, energy, and etc. (Komeily and Srinivasan, 2015). This invariably led to the omission of the institutional dimension and associated institutional sustainability indicators (Ameen et al., 2015). Why was this omission so important? Because institutions can operationalize, assist and incentivize the other three dimensions (Valentin and Spangenberg, 2000). For example, slum settlements are known to deny residents access to basic services and amenities, such as energy and water; this is mainly due to the illegality status of the residents. This increases the marginalisation of people and reduces the legality in obtaining their basic needs. Therefore, informal settlers need to be re-integrated into the society with their full property rights; and this can only be achieved with the help of policy and institutions (Charoenkit and Kumar, 2014; UN-HABITAT, 2014). This presents a good example of the importance of institutions and policies and how they can

aid in legalising informal setting, thereby providing basic amenities and incentivising sustainability practices through establishment of formal organizations (UN-Habitat, 2014). In view of the importance of the institutional dimension, Komeily and Srinivasan (2015) and Sharifi and Murayama (2013, 2015) mentions the growing desire to include "institution" as the fourth dimension of sustainability. Prior to this, the assumption was that the institutional dimension was embedded within the three DoS, this undermined the integral contribution of this dimension as its functions and significant impacts were unintentionally ignored (Ameen et al., 2015; Berardi, 2015; Komeily and Srinivasan, 2015; Reith and Orova, 2015; Sharifi and Murayama, 2013; Turcu, 2013; Villanueva and Horan, 2018). Recognizing this, the institutional dimension as a separate entity and not an embedded one, was first introduced at the Johannesburg conference. In terms of implementation, this was firstly put into practice by Valentin and Spangenberg (2000) in the development of urban based indicators. In fact, this sentiment is now shared by several researchers in the field of sustainability indicators and NSATs (Ameen et al., 2015; Berardi, 2015; Dawodu et al., 2017; Komeily and Srinivasan, 2015; Sharifi and Murayama, 2013; Turcu, 2013).

Yet, challenges still exist as regards to institutional dimensions and NSATs. Several studies that have investigated NSATs, generally argue a lack of coverage of the institutional dimension (Boyle et al., 2018; Sharifi and Murayama, 2013; Villanueva and Horan, 2018). However, there has not been an explicit mention of the kinds of specific indicators and criteria sought out to make this claim, rather vague terminologies are used: (1) In the study of five assessment tools, Komeily and Srinivasan (2015, p. 35) states that "*Institutional category is the least emphasized category*."; (2) In Sharifi and Murayama (2013, p. 78) study of seven NSATs, the concluding result was that "*the NSATs have failed to address institutional sustainability*", their study further states that "*there is no mechanism for assessment of the performance of governmental and non-governmental institutions in the neighbourhood"* and criteria such as "*governance, decentralization, legal frameworks and instruments, information*

systems, and research and education to institutionalize sustainable development are also overlooked"; (3) Further studies by Sharifi and Murayama (2015) categorizes institutional dimensions and classifies outreach and involvement, transparency, local institutions, monitoring and innovation as Institutional HSI; and (4) Turcu (2013) places local authorities services, community activities and local partnership under institutional sustainability. Their study also states that "community activity" can be placed both under "institutional sustainability" and "social sustainability." These studies show that investigated NSATs generally argue for a lack of coverage of the institutional dimension. However, there has been little consistent and explicit mention of the precise indicators and criterion sought out to make this claim. Secondly, it would seem that a specific institutional HSI can also bear other dimensional traits, as was the case with "community activity". Finally, it is evident that an institutional dimension is largely considered as government and non-government organizations.

Relating this to Africa, it becomes imperative to first and foremost understand how the institutional dimension is viewed and operates within indicators, what indicators are truly institutionally based and how can consistency can be certified in identifying an institutional indicator? Also, studies have not yet contextually identified if these institutional limitations hold when considering the African context, for instance in Lagos, Nigeria. Also, studies have also been generally broad in the discovery of limitations and span HSI such as water issues, material and waste management, transport, public consideration, energy and green consideration, disaster prevention and economy (Dawodu et al., 2017; Sharifi and Murayama, 2013; Xia et al., 2015). A question worth asking is that, do these limitations, hold when a specific theme or issues is solely investigated, for instance "Energy use". To answer these questions this study uses the energy theme under NSATs and relates to African cities. The reason for this focus (energy in Africa) is due to the significant impact of energy use leading to Greenhouse Gas emissions (GHGs), as well as the need for environmental preservation,

which was the initial motivation for the development of NSATs. Energy is largely prioritized as the most important element to consider as a catalyst for growth and development. Yet, in Africa over 60% of urban population does not have access to electricity and are majorly dependent on traditional energy in the form of biomass (Kitio, 2013). IEA further illustrate that energy consumption per GDP in Africa is twice the global average. Statistics also indicate that Nigeria's population share of 45% has access to electricity with 93 million people lacking access. However nations like South Africa have better statistics, with 85% of population having electricity access. Statistically, African homes consumes 56% of electricity generated through the national electricity grid (Aliyu et al., 2018). In larger cities, the energy consumption is 75% of the whole electricity produced, with an annual increase of energy demand of 7%. Hence, accessibility to energy is a key challenge in Africa with the UN secretary general urging all players to strive for all access to power by 2030 which means doubling energy efficiency and renewable energy shares in the global mix (Kitio, 2013). However, several literature point out the key issues that limit energy access, exacerbate energy poverty and limit investment in sustainable energy technologies and techniques, and these generally revolve around; Inadequate policy and lack of implementation of those that do exist, lack of regulations and rules to guide sustainable designs and use of technology e.g. lack of building energy codes and even when policies and regulations are in place there is a lack of enforceable regulations due to nepotism, corruption and poor governance (Siddig et al., 2014; Uyigue and Okuku Archibong, 2010). From the aforementioned, albeit in the context of energy, it is evident that the Africa's main issue which hinders the successful implementation of projects is the lack of 'institutional directives and policies' (Siddig et al., 2014; Uyigue and Okuku Archibong, 2010). It should be noted that this thesis is proposing NSATs for African nations, as this would seemingly be a valid planning approach in attaining effective sustainable development. However, care must be taken to understand the context of its application and also the current gaps in tools. The reason for caution is based on what appears to be conflicting views or the lack of full comprehension of the operations institutional

based indictors by several studies. This could have severe implications on the future development of indicators and invariably NSATs.

Hence, in this chapter, energy as a theme is used to tackle four main issues:

- Firstly, this chapter expands on the role of the institutional dimension by utilizing three institutional classifications, which are organizations, regimes and informal rules.
- Due to vague parameters that determine what is and is not an institutional indicator, this chapter also aims to determine consistent parameters that can be used to determine if indicators bear institutional characteristics with respect to NSATs.
- This chapter also utilizes a multi-dimensional approach (alternatively SPM approach) to indicator analysis to investigate the possibility of multi-dimensional institutional indicators and if such possibilities exist, what are these trends and characteristics.
- Finally, what are the current trends or characteristics of energy oriented headline sustainability indicators (E-HSI) in currently existing NSATs? And do the limitations observed in chapter 2 also apply to Energy based themes and indicators.

The contextual phase follows, with the use of Nigeria as a primary case study to address the following questions:

- What specifically are the institutional limitations that would hinder the implementation of NSATs in Nigeria? And what are the solutions to aid in implementation?
- How can countries like Africa move past these limitations and adopt such tools.

To execute this, 15 NSATs will be investigated and this will be strictly limited to energy-based indicators due to their high institutional potential, strong environmental influence on NSATs and for brevity (Ameen et al., 2015; Reith and Orova, 2015; Xia et al., 2015). This

study will use Nigeria as the primary case studies, which will be cross evaluated with other African countries as the case applies. This would give an optimum understanding of the limitations and how best to move forward with NSATs in Africa under various environmental, social, economic and institutional context.

3.2 Literature review

3.2.1 Understanding the true nature of institution

Valentin and Spangenberg (2000) elaborate on the need for four DoS with institutional dimension being pivotal. Their study adds an additional layer to sustainability principles by emphasizing linkages between all dimensions. Their study also argues for combination of two dimensions, such as socio-economic termed equitable, enviro-institutional termed care, and etc. The point to the ideology is that sustainability indicators are more effective in achieving sustainability when they address multiple dimensional issues. Though isolated issues may address one dimension of sustainability, it should be noted that this level of sustainability is not as effective as higher relationships or linkages. This is because sustainability is the ability to attain parity between all three DoS simultaneously or in the case of this study, four dimensions (Reith and Orova, 2015; Sharifi and Murayama, 2013). This was further investigated in chapter 2 with the proposal of 14 combinations between DoS such as econo-socio-institutional and enviro-socio-institutional. These interrelationships were further categorized as point aspect (one dimension), linear (two dimensions), planar (three dimensions) and super planar (sustainable dimension). Yet, the parameters used to classify institution were not fully explained. Relating this to NSATs and HSI, Sharifi and Murayama (2013) and Komeily and Srinivasan (2015) argue towards the relevance of the institutional dimension. In their studies, they emphasize that institution is not just the interaction between government and non-government organization but is also a set of norms and laws governing such interaction. They clearly brought recognition to the absence and limited consideration of the institutional dimensions. However, they did not highlight various types of institutions

developed through interlinkages with other dimensions. They majorly illustrated the lack of mechanism to assess the performance of government and non-government organization. Additionally, a limitation to their analysis is the fact that they categorize institution as a singular dimension. But by consideration of Maclaren's integration ideology on sustainable assessment (1996), it is stated that indicators should cover multiple issues and cover linkages among them. For the very fact that institutions operationalizes other DoS (Spangenberg et al., 2002), it is intuitive that they would not be able standalone as a single dimension. This means that institution should not be a single entity or identity and should be linked with other types of dimensions e.g. socio-institutional, econo-socio-institutional, econo-institutional, and etc. Hence, it is evident that institution plays a significant role in sustainability indicators, and should be viewed as a multi-dimensional entity that assists the other dimensional functions of an indicator. However, confusion still exists in its definition; i.e. what constitutes an institutional dimension?

Generally, the definition or description of institutional HSI with relation to NSATs is largely catalogued under a broad banner. For instance, HSI such as information systems, research and education, and governance were indicated to be relevant and missing in the institutional HSI in seven NSATs under investigation by Sharifi and Murayama (2013). In another study, HSI such as outreach and involvement, transparency, local institutions, monitoring, and innovation were indicated to be relevant HSI in three NSATs under investigation by Sharifi and Murayama (2015). The issue stems from why and how these are institutional HSI, and further still, the compartmentalisation of the scope of an institution. Compartmentalisation in this context is a major gap, as it would seem as though the selection of HSI are solely organization based as opposed to an invisible entity that guides and supports the implementation frameworks; i.e. regulations, standards, codes, norms, policies, guidelines. The institutional dimension is broader than what the authors have implied in their investigations. The pioneering documents and Agenda 21 meeting, as well the manual on

institutional indicator published in the Brudtlandt report do not define institution specifically (World Commission on Environment and Development, 1987). Hence, Phafl (2005) contends through the study of texts of the Agenda 21 article, that institution is implicitly understood as a political or social organization that are involved in policy making or implementation. Thus, making an organization a legal entity that enforces the rules and implements set goals. However, as stated earlier institution simply transcends organizations; and this becomes evident when the context of the specific institutions is investigated. From a sociologist perspective, it is used as a tool to help individuals facilitate decision making. Gehlen (1964) states that it is only through institution that societal activities becomes effective, normative, permanent and predictable. Parsons (1978) adds that institution do not only guide people's behavior but also lead the society and political community. Their study also argue that the success of institution is based on the need of that institution due to the knowledge and perception and challenges that people face at that point in time. An additional definition and facet of institution is that it is synonymous to being an agent of change. That is to say, since institutions are linked to people when the values or identities of people change the institution has to change otherwise they can no longer be an intermediary element. In mainstream of international relation theory, this is defined as a "*persistent and connected set of rules and practices that prescribe behavioural roles, constrain activity and shape expectations. They may take the form of bureaucratic organizations, regimes (rule-structures that do not necessarily have organizations attached), or conventions (informal practices)*" (Haas et al., 1993, p. 5). These definitions and contextual understanding of institution led to organizational hierarchy categorized by Pfahl (2005). This was divided into three categories and according to the degree of institutionalisation: (1) organization (Legal personality); (2) Regimes, systems of rules (connected set of rules and agreements in specific issue area), mechanisms; and (3) Social norms, traditions (informal rules, property rights, values, normative orientations). Similarly, Valentin and Spangenberg (2000) describe institutions as not only interactions between the governmental and non-governmental organizations involved in the

decision making, but also a set of norms, laws, and regulations governing these interactions. Applying this to modern sustainable urban development, as an example, it provides the impetus to categorize establishments that provide eco-labels to sustainable or green building products, as valid institutions. The popular e-certification has been developed in several counties such as American green seal, Euro eco-label, German blue angel, Japanese eco mark. These labels identify or indicate sustainable products without the ability of the user to necessarily measure its greenness. Energy labels is also very popular in United States with the organization called Energy Star gaining popularity and is sponsored by organizations such as Environmental Protection Agency (EPA), Department of Energy (DOE), and etc. The argument here is that these eco labelling, particularly those energy related is in itself an institution that provides regional and global metric for energy efficient products (Berardi, 2015).

Also, from an internal perspective, the expert or developers of these tools utilize standards, laws and codes from different institutes and organization as a rigorous means of increasing the influence, validity and application of the HSI. This brings forward the argument that the institutional dimension is very much present in HSI of NSATs because, as mentioned earlier, without these institutions, guidelines and codes that validates the level of impact of a specific entity; the indicator cannot be measured or used effectively. More astutely, Lancker and Nijkamp (2000, p. 114) states that, "*a given indicator does not say anything about sustainability, unless a reference value such as thresholds are given to it"*. The threshold in the case of NSATs are the benchmarks given by these HSI and the benchmarks are supported by international or local standards or codes, and guided by organizations such as the Department of Housing and Urban Development (HUD), U.S. Environmental Protection Agency (EPA), department of energy (DOE). A good explanation in the context of energy is energy codes and standards. These are building energy regulations that set design and construction standards for buildings or group of buildings, for the safety and wellbeing of

those in and around those buildings. They also provide a vital role in setting minimum requirements for energy design and construction, thereby promoting energy conservation. More accurately, energy codes specify how a building must be constructed designed and performs. These energy codes are written in mandatory enforceable language. These codes tend to be adopted and enforced by state and local governments within their jurisdiction. Alternatively, energy standards determine or describe how buildings should be constructed to save energy. They are published by the national organization such as EPA, DOE etc. These energy standards are generally voluntary and don't tend to be mandatory but rather, serve as recommendations. These standards in some cases can be used by states to develop their energy codes and some energy standards may be made mandatory (Iwaro and Mwasha, 2010).

To summarize, the debate of three versus four pillars indicate there is a clear gap in the definition, which ultimately leads to how the foundation of NSATs will be developed. Also, there appears to be a narrow view of what is considered to be an institutional indicator leading to possible incomplete or incoherent results of the impact of the institutional dimension. Also, it is evident that codes and standards, which are more of an internal form of the institutional dimension, as opposed to polices and organization which is more external forms of institutional dimension, play a crucial role in the validity and successful implementation of HSI. The clarification of these terminologies and their functions is not only imperative to the optimization of the selection process, it is essential in order to enhance the operation of such indicators in Africa.

3.2.2 Current situation in Africa and Nigeria

Nigeria is a West African country with abundant energy resources. The country is blessed with high levels of solar, wind, biomass and hydro and tidal energy. In 2005, the renewable energy master plan was approved by the government and was drafted by the energy commission of Nigeria, with the help from UNDP. This master plan articulates the framework for renewable energy polices, technologies legal instruments, infrastructure etc., to ensure that visions of increasing energy security, improving access and affordability and mitigating GHG emissions are achieved (Akuru et al., 2017). The renewable energy resources that Nigeria possess range from small hydropower – 3500MW, Large hydropower 11-250MW, solar radiation is 3.5-7 Kwh/m2/day, wind speeds average 2-4 m/s at 10 m height, Biomass – fuel wood is the equivalent of 11 million hectares of forest and woodland, 211 million assorted animals, 28.2 million hectares of arable land for energy crops and agricultural residue. Some of the key goals of the draft include achieving 20% of hydro energy by 2020%, 1% each of wind and solar energy in energy generation, replacing 50% of firewood cooking with biomass technology by 2020 and generation of 1000MW power capacity using biomass resource (Aliyu et al., 2018; Giwa et al., 2017; Ozoegwu, 2018). Nigeria is blessed with hydro energy, which accounts for about 14% of energy generated with the main generating dams being shiroro, kainji and jebba. The estimated capacity of hydro is about 14,750MW but only about 1930MW is generated. Nigeria also has micro and mini scale hydro energy. Nigeria is also the 9th African country with technical an economic feasibility for large amounts of hydro power energy. A 3050MW capacity hydroelectric power station in Mamabila Mountain in Taraba started construction in 1982 and has been neglected. However, it has been slated to be completed in 2018. Similar to South Africa there is a great level of solar energy with the south solar potential being 14.4 $MJ/m^2/day$ and North being 21.6 $MJ/m^2/day$ (Aliyu and Amadu, 2017; Brimmo et al., 2017). Aliyu et al. (2018) estimated that given an average of six hour peak sunlight, 1,850,000 GWH could be generated a year which is a hundred times the energy it currently generates. The aforementioned have described the supply side of

energy and this would naturally improve energy access to all residential, commercial and industrial buildings. There is a stronger focus on supply side management; however demand side management has not been left out. Research, policies and incentives have also focused on the energy consumption in the residential, commercial and industrial sectors. For instance, in combination with Cuban government, Energy Commission of Nigeria (ECN) with the support of Economic Community of West African States (ECOWAS) has distributed millions of Compact fluorescent lights (CFLs) for free to replace incandescent lamps. Current collaborative research on energy efficiency in appliances and lighting lamps has commenced btw the university of Lagos and National centre for energy efficiency and conservation. Also, ECN in combination with UNDP in a project that promotes energy efficiency in Nigerian residential and public sectors aims to introduce energy efficient policies and measures that include standards and energy labels for refrigerators and lighting lamps. Also, the proposed policy measure seen in the REMP draft include, training the public on the use of energy efficiency and saving equipment, enforcement of incentives for consumers that adopt energy saving technologies, providing incentives to retailers of and importers of energy efficient products, replacement of inefficient and environmentally unfriendly equipment and infrastructure (changing 40% of old equipment with new ones by 2020 and maintaining these practices beyond 2030), promotion of local production, development of energy efficient building codes, conducting research by institutions specialized in energy efficiency, fostering partnerships with other local and international institutions/companies and improving public awareness of energy efficient equipment's and stratagem (Aliyu et al., 2018). Unfortunately, these lists are still drafts and proposals and all key component of energy efficiency strategies programs is proposed to be achieved by 2020, then the enactment of all relevant legislation for policy implementation follows on from 2020. This set up is unlike most European countries and recently some non OECD countries and developing countries, which have set up mandatory energy standards. Some countries outside Europe and America that have set up mandatory and voluntary standards for buildings include Singapore and Philippines. These Asian countries

have recently been followed by African countries such as Egypt and Algeria. The table 3.1 illustrates the status of building energy in 60 developing countries (including emerging and new industrialized countries). In this list 42% of the countries do not have codes, African countries being the bulk of that percentage. Nigeria is noted to not have such codes. The lack of codes should not be confused with proposal for energy efficient policies that currently being executed in Nigeria. The reasons given for the lack of codes include a lack of building energy policies, lack of government interest in energy conservation in buildings, limited understanding of advantages of building energy regulations on not just building energy consumption but also the economy. Also corruption, lack of infrastructure and technology and low level economy hindering the ability efficiently develop and execute build energy efficiency and conservation measures (Deringer et al., 2004; Wang et al., 2008). Iwaro and Mwasha (2010) in their study conclude that the major reasons behind the lack of building energy regulation are institutional barriers and market failures.

Table 3.1: Status of building energy standards development and adoption in 60 developing countries (including emerging and newly industrialized countries) (Source: Iwaro and Mwasha, 2010)

Ethiopia	Barbados	Mexico	Morocco	Bahamas
Costal Rica	Kenya	Slovak Rep.	Colombia	Equatorial Guin.
Gabon	Togo	Romania	Brazil	Antigua and Barbuda
Cameroun	Mali	South Korea	Indonesia	Omar
Ghana	Liberia	Slovenia	South Africa	Qatar
Burundi	Tanzania	Czech Rep.	Thailand	Paraguay
Grenada	Ecuador	Finland	Malaysia	Algeria
Burkina Faso	Dominica	Portugal	Egypt	Morocco
Guinea	Cuba	Singapore	Saudi Arabia	Colombia
Nigeria	Bangladesh	Tunisia	Taiwan	

Guyana	Angola Trinidad and Tobago St Vincent Zambia	Bahrain Turkey	Sri Lanka Palestine Pakistan Lebanon Syria Belgium	Brazil Indonesia
No Standard		**Mandatory**	**Mixed**	**Proposed**

From a supply perspective, Africa is making strides to address sustainable energy generation and some key areas of conservation. While each countries polices cannot be represented here due to the scope of the chapter, countries such as South Africa, Ghana , Angola , Kenya, and Ethiopia have national energy policies that range between 5-20 year. South Africa, Ghana and Ethiopia have the most comprehensive set of updated policies. However, other countries are still catching up to this and are still in the drafting and planning phase such as Nigeria. Table 3.2 illustrate recent policies focused on specific energy sectors within Africa, this provides a brief snapshot of the of the activities of the five key regions of Africa (North, East, South, West and Central Africa)

Table 3.2: Recently selected policies in parts of sub-Saharan Africa

Country	Sector	Policies and targets
Angola	Power Access Integration	New power market model implementation with single power purchaser and equal right for both the public and private power utilities. Electrification rate increase form 30% to 60% by 2025 Link transmission lines with Namibia and Congo
DR Congo	Access Power	Electrification rate increase from 9% to 14% by 2015 and 26% by 2020 Declaration of stricter standards for electric motors.
Ethiopia	Renewables Access	New renewables energy capacity targets for geothermal, hydro and wind Distribute 9 million improved coring stoves by 2015

	Oil and gas Efficiency Renewables	Strategy to increase exploration, reduce poverty by utilizing the revenues, maximize local participation and develop a petrochemical industry The transmission lines losses reduce to 18% by 2018 as well as the lightning and air conditioners are well labels and standardized Established feed-in tariff by the Renewable Energy Act in 2011
Kenya	Efficiency Buildings	Set a standards for electrical appliances, energy efficiency obligations for utilities and enforcement of energy efficiency standards – energy bill 2014 provides for the creation of an energy efficiency and conservation agency
Mozambique	Gas Access Renewables	Master plan approved in 2014 for maximizing the value of gas resource Electrification rate increase from 39% to 85% by 2035 Install of 50000, 5000, 2000 of lightning systems, refrigeration and televisions respectively powered by solar PV or wind turbine system in off-grid areas and 10000 solar water heaters by 2025
Nigeria	Oil and gas Power Access Buildings	Draft Petroleum Industry Bill tend to revise various areas of the existing framework. As set up in the Roadmap for power sector reform that continue sectored-wide reforms to allow private investment as such establish a competitive electricity market and achieve reliable power supply Provide reliable electricity available to 75%, 100% of the population by 2020 and 2030 respectively- connect an average of 1.5 million households per year Announced the design and implementation of minimum energy performance standards for appliances and industrial equipment
Rwanda	General Access	Expand the transmission systems network by 2 100 km by 2017 and reduce share of bioenergy in primary energy demand to 50% by 2020 Electrification rate increase from 17% to at least 60% by 2020 and give access to all schools and hospitals by 2017
Senegal	Renewables	20% target of total energy supply from renewable energy sources by 2017
South Africa	Renewables Energy prices	The update of 2014 Integrated Resources Plan sets out a strategy to diversify the power mix, moving strongly towards low-carbon sources of power supply. Electricity prices to be adjusted gradually to better reflect costs and Carbon dioxide CO2 tax under consideration
Egypt	Renewables	Implements new laws to attract foreign investors in the renewable energy sector so as to enable Egypt to meet its target of 20% renewable energy production by 2020

The next phase looks deeper into the classification of institutional dimension for HSI selection and development. It also looks into the implications for Nigeria and how cities such as Lagos can use the understanding of the implications to the benefit of their own NSAT development. Section 3.3 starts this off by briefly explaining the method used to arrive at the results, this is then followed by the result and discussions segment.

3.3 Methodology

This study utilizes 15 NSATs (see table 3.3) with a specific emphasis on energy-based HSI (E-HSI). To achieve this, three key methods of comparison are used to determine characteristics of these tools as relates to the institutional dimension. (I) classification of institution by Pfahl (2005) analogy of organizations, regimes and informal rules (II) utilizing theme, index or HSI based comparison (Dawodu et al., 2017; Sharifi and Murayama, 2013; Wangel et al., 2016); and (III) utilizing the multi-dimension based comparison developed by Dawodu et al., (2017). The procedures are explained below:

Table 3.3: Neighbourhood sustainability assessment tools and region of development

Neighbourhood Sustainability Assessment Tools			
CASBEE UD (Japan)	Green Building Index Township (Malaysia)	Green Mark for Districts (Singapore)	Enterprise green communities (US)
BREEAM Communities (UK)	GSAS District (Qatar)	BEAM Plus Neighborhood (Hong Kong)	Earth community craft (US)
LEED-ND (US)	Green Star Communities (Australia)	BERDE Clustered Development (Philippines)	Star Community Rating System (US)
IGBC Green Township (India)	The Pearl Community (UAE)	Enviro-Development Master planned community (Australia)	

3.3.1 Classification of institutions

The first aspect of the methodology is the classification of the policies, organizations, codes and standards used. This is done by utilizing the definition and classifications of institution developed by Pfahl (2005); Organizations and policies, Regimes, Informal rules. Table 3.4 breaks down the classification. It should be noted that 3rd party assessment tools are classified under Informal rules and organizations due to their emerging role as guiding organizations in the field of urban sustainability.

Table 3.4: Classifications of institutions

Organizations (legal personality)	**Regimes: systems of rules (connected set of rules and agreements in specific issue area), mechanisms**		**Informal rules and organizations**	
Policies and organizations that govern policies	International standards and codes	Guiles (Local governing bodies, codes, guidelines)	Peer reviews journals	3rd party assessment tools

3.3.2 Theme-based comparison

Wangel et al. (2016) describes it best as a rearrangement of the issues, indicators or in this case HSI into a common framework or category. This redistribution of HSI also implies the redistribution of the associate credits or weights. Hence, in this study of 15 NSATs, similar E-HSI are collated together under one terminology, where an overall E-HSI categorization is established (see appendix 3B-2 and Fig. 3.4).

3.3.3 Dimensional analysis

A content analysis via the qualitative review of each E-HSI is done to identify which DoS is possessed by the E-HSI under investigation. Fig. 3.1 gives an example of how this is done by illustrating via the LEED-ND HSI of "Historic preservation and adaptive use". Though not E-HSI related, it illustrates how the DoS were obtained for the energy based indicators. Further examples can be seen in studies by both Dawodu et al. (2017) and Villanueva and

Horan (2018). Invariably, each E-HSI is placed under a specific identified DoS. This was via a review of all HSI and the associated guidelines, aims, intent and assessment criteria. Note these aims, intent and assessment criteria's can be either qualitative, quantitative or both. The strategies used to identify the dimensions of each HSI followed two instructions termed primary and secondary directives (see chapter 2 methodology); (1) The primary derivatives: implies the identification of explicitly stated or obvious dimension(s) of sustainability that is directly shown within the text of the HSI. It should be noted that the primary directive could include 2 or 3 interrelationships i.e. E-S-EC or E-I or E-S etc. (2) the secondary derivatives: this is an extraneous sustainability metric to the development of the SI, by being only indirectly linked to the motivation of the HSI under analysis. The following are the dimensions given based on the four pillars of sustainability and their relationship: 'E, S, I, EC' relationship are known as point aspects, those with two interrelationships such as 'E-S-EC, E-S-I, EC-S-I, E-EC-I' are known as linear aspects, and those with three inter-relationships 'E-EC, E-S, E-I, EC-S, EC-I, S-I' are defined as planar aspects.

Example: In Fig. 3.1, two dimensions are explicitly mentioned which uses primary derivative (S-I) and the second uses secondary derivative (E). The first primary derivative is the mention of "to respect local and national landmarks and to conserve cultural resources". Also throughout the "requirements section" the protection of cultural landscape is emphasized. This would make this social (S). Also using the second derivative "the conservation of materials" which is linked to preservation of landscape, thus linking this indirectly to environmental dimension. Finally, the second primary derivative is institution. As can be seen various institutional, policy and guideline oriented bodies need to be contacted for approval and verification before buildings can be demolished. This is explicitly stated under the "requirements section. Hence the dimension would be (E-S-I).

HISTORIC RESOURCE PRESERVATION AND ADAPTIVE REUSE

Intent

To respect local and national landmarks and conserve material and cultural resources by encouraging the preservation and adaptive reuse of historic buildings and cultural landscapes.

Requirements

ND PLAN, ND (GIB)

This credit is available to projects with at least one historic building, contributing building in a historic district, or cultural landscape on the *project* site.

Do not demolish any historic buildings or contributing buildings in a historic district, or portions thereof, or alter any cultural landscapes as part of the project.

An exception is granted only with approval from an appropriate review body. For buildings or landscapes listed locally, approval must be granted by the local historic preservation review board, or equivalent. For buildings or landscapes listed in a state register or in the National Register of Historic Places (or equivalent for projects outside the U.S.), approval must appear in a programmatic agreement with the state historic preservation office or National Park Service (or local equivalent for projects outside the U.S.).

If any historic building or a contributing building in a historic district in the project site is to be altered (rehabilitated, preserved, or restored), use one of the following approaches for each building, as applicable.

- *Building subject to local review.* Obtain approval, in the form of a certificate of appropriateness, from a local historic preservation commission or architectural review board for any exterior alterations or additions.
- *Building subject to state or federal review.* If the building is subject to review by a state historic preservation office or the National Park Service (or equivalent body for projects outside the U.S.), the alteration must meet the Secretary of the Interior's Standards for the Treatment of Historic Properties (or equivalent for projects outside the U.S.).
- *Listed or eligible building not subject to review.* If a building is listed or determined eligible but alteration is not subject to local, state, or federal review, include on the project team a preservation professional who meets the U.S. federal qualifications for historic architects or architectural historians (or a local equivalent for projects outside the U.S.). The preservation professional must confirm adherence to the Secretary of the Interior's Standards for the Treatment of Historic Properties, or a local equivalent for projects outside the U.S.

If a cultural landscape is to be rehabilitated, restored, or preserved, do so in accordance with the Guidelines for the Treatment of Cultural Landscapes or local equivalent for projects outside the U.S. whichever is more stringent.

Fig. 3.1: Example of HSI for LEED-ND NSAT

3.3.4 Procedural, feature and performance categorization

According to Wangel et al. (2016) indicators can be categorized into various types and these types include:

Procedural indicator: the indicators assess activities and processes particularly environmental and social based indicators such as flood risk or noise impact assessments. This process is geared towards the process and not the outcome. The approach is also details how's the procedure or task should be executed. Also, differentiating between social and procedure featured indicators can be difficult. Hence, for this study the procedure process occurs during the developmental process and social feature occurs after the development has concluded (subsidized public service)

Feature indicator: these type of indicators determine or assess if measures, equipment, solutions are or will be put in place. For instance high efficiency lighting or specific lighting device or provision of cycle storage. Or socially oriented such as establishing funding schemes, training initiatives. These indicators tend to be quantitative and easy to measure. This type of indicator tend to work as a design brief for planners, developers and architect. This tends to make decision process easier but context sensitivity and creates the confusion of equating the presence of feature to increased sustainability. In sum feature indicator asses if a specific feature, physical or social will be in place at the end of the developmental process or outcome

Performance indictors: these determine how well development performs in terms of environmental, social impacts. It should be noted that NSATs have been developed for ex-ante purposes (guiding development), no consideration is given to ex post procedures (Feedback and post assessment procedures). Performance indicators here consider commitment to achieving a certain level of performance such as onsite renewable energy. Also, performance measurement is not necessarily quantitative. Ideally performance indicators are objective driven in methods (e.g. Y% of Z must be X). However, on the demand side, there may be requirements for minimization, optimization and energy efficient approaches but with no clear definition of the aforementioned terms.

The above-mentioned process provides the context for data acquisition to determine what style of indicators currently exist among all E-NSATs and what would be the implication for its use in African nations

3.4 Results

3.4.1 Classification of Institutional Dimension of Sustainability

Table 3.5 shows the result of the classification of 93 E-HSI and appendix 3B-1 provides the nomenclature for each organization and code. Out of those 93 E-HSI, 49 were considered institutional indicators under informal considerations (considers informal institutions – see section 3.3.1). However, the E-HSI becomes 37 under business as usual (business as usual does not consider informal institutions - 3rd party assessment tools and peer reviews journals) (see Fig. 3.2). Based on the theme, E-HSI was placed in similar brackets, based on the qualitative review of the NSATs. They were further placed into any of the five categorizations of institutions. Take for instance, minimum building energy performance (categorized under energy strategy), the E-HSI references Commercial Energy Services Network (COMNET), which is a quality assurance program involved in energy performance in commercial buildings. They also provide accreditation to energy software. The direct quote from the manual is "*Alternatively, use the COMNET modeling guidelines and procedures to document measures that reduce unregulated loads*" (U.S. Green Building Council, 2014). Also, from a standards and codes perspective, achieving the points for this E-HSI requires compliance with a specific ASHRAE code (ASH_1) (American Society of Heating, Refrigerating and Air-Conditioning Engineers). ASHRAE is classed as an international organization due to its international recognition and use in majority of non-American countries. They have several energy guidelines and codes (Ciulla et al., 2010; Melo et al., 2014). Alternatively, American National Standards Institute (ANSI_1) and Illuminating Engineering Society of North America (IESNA_1) is classed under local bodies due to their local and context specific use (Fan et al., 2015; Lo et al., 2012). The direct quote from the manual is "*Demonstrate an average improvement of 5% for new buildings, 3% for major building renovations, or 2% for core and shell buildings over ANSI/ASHRAE/IESNA Standard 90.1–2010*" (U.S. Green Building Council, 2014, p. 56). This demonstrates how these organizations and codes were classified for all E-

HSI. In terms of informal rule or organizations, assessment tools and journals were placed under that banner as it was discovered that newly developed tools made reference to these journals and assessment tools as a point of reference. Bear in mind that Berardi (2005, P.520) in their description and selection of NSATs for their study states that "*The considered systems were selected for their established worldwide diffusion and resonance with the help of institutions and organizations actively involved in promoting their use*". Hence, it can be understood that these tools have been and can be classed as informal institutes or developing institutes. In the same vein, peer review journals are classed under various academic and research institutes that govern quality and distribution of academic research.

This leads to the dimensions of sustainability, with the use of the multi-dimensional method also termed sustainable pathway (SP), table 3.5 shows all the associated dimensions to each of the E-HSI, Fig. 3.2 draws the SP and illustrates the dimensional characteristics of each E-HSI that have institutional dimensions. It shows that E-I has the highest interlinkage. E-I here means how the guidelines that determine human interactions, influence the environment and also the response or modifications to these guidelines to create a particular effect on the environment. Also, results from Fig. 3.2 shows the weaknesses of the other two and three dimensional interlinkages. It is worth noting also that the US-based tools have a huge reliance on international standards and local codes than other regions where the tools were developed. Also, overall observations showed that five E-HSI under Energy Efficient Lighting required organizations, codes or guideline. This was the highest out of any E-HSI category, this was followed by district heating and cooling, which also had informal organization of LEED-ND and Green Mark District (GMD) as institutional references. The result section has pointed out the stratagem, methods and logic behind the characterisation of E-HSI. In addition, this has shown that institutional dimension can be viewed explicitly. It also illustrates how institutional dimensions can be characterised. The next section briefly discusses the implications of the results in detail.

Table 3.5: Results of the classifications of institutionally oriented headline sustainability indicators

E-HSI	**Organizations (legal personality)**	**Regimes: systems of rules (connected set of rules and agreements in specific issue area), mechanisms**		**Social norms, traditions (informal rules, property rights, values, normative orientations**	
	Policies and organizations that govern policies	International standards and codes	Guiles (Local governing bodies, codes, guidelines)	Peer reviews journals	3rd party assessment tools
Energy Strategy Minimum building energy performance (E-I) - LEED	CNT (LEED)	ASH_1 (LEED)	(1) COMG (2) ANSI_1 (3) IESNA_1 (LEED)		
Energy Infrastructure Energy Efficiency for Infrastructure and Public Amenities (E-I) - GM		ASH_2 (GM)	(1) SS_530 (2) SS_553 (3) CP_13 (4) AHRI (GM)		
Certified Green buildings					LEED, EGC, ECC, SCRS, BEAM, NHK, BERDE, GBIT, GMD, CASBEE, IGBC, TPC, GSASG, EDM, GSC, BREEAM
Renewable Energy: Offsite (E-I)	GCO (Pearl)				
Passive energy design Additional Reductions in Energy Use (E-I) – Enterprise Natural ventilation (E-I) – BERDE Passive Design (E-I) - BEAM	(1) DET (Enterprise) (2) HKP (BEAM)	CIBSE (BERDE)	HKC_1 (BEAM)		
Renewable Energy: Onsite	(1) HKE (BEAM) (2) USDE				

Renewable Energy (E-I) – BEAM Renewable Energy(E-I) – Enterprise	(Enterprise) (3) ASES (Enterprise) (4) FSEC (Enterprise) (5) NREL (Enterprise)				
Urban Heat Island Effect (UHIE) Reduced UHIE and paving (E-I) - Enterprise Urban Heat Reduction (E-I) – Pearl Intra Urban Temperature and Urban heat island effect (E-I) -BEAM	(1) USEPA (2) CRRC (non-binding)(Enterprise) (3) ENERGY STAR (partnered with EPA) (Enterprise) (4) LBNL (Partnered with EPA) (Enterprise)	(1) ASTM_1 (2) ASTM_2 (3) ASTM_3 (4) ASTM_4 (5) ASTM_5 (6) ASTM_6 (PEARL)	[1] CNC (BEAM)	J1, J2, J3, J4, J5 (BERDE)	
Energy Efficient Lighting Efficient Street and Park Lighting (E-S-I) - GBI Efficient Infrastructure: Lighting (E- I) - PEARL Energy efficient lighting (E-I) - BERDE Lighting (E-EC-I) - Enterprise Efficient Site Lighting (E-S-I) – ECC	(1) ENERGY STAR (partnered with EPA) (Enterprise) (2) IDA (Enterprises)		(1) PNS (BERDE) (2) IESNA_2 (PEARL) (3) IESNA_3 (PEARL) (4) MS_825_1 (GBI) (5) MS_825_2 (GBI) (6) IESNA_4 (ECC) (7) IESNA_5 (Enterprise)		
District Heating / Cooling Energy Efficient Infrastructure (E- I) - BEAM Energy efficient equipment (E-I) - BERDE Sizing of Heating and Cooling Equipment (E-I) - Enterprise District heating or cooling (E-I)– LEED	(1) ENERGY STAR: Duct sealing (partnered with EPA)(Enterprise)	ASH_3 (LEED)	(1) USAC_1 (Entire) (2) USAC_2 (Entire) (3) ASH_5(chapter not specified) (Entire) (4) DOE_1 (BERDE) (5) ANSI_2 (LEED) (6) IESNA_6 (LEED)		(3)LEED-ND (BEAM) (4) GMD (BEAM)

Energy efficient improvement in performance of buildings Optimize Building Energy Performance (E-I) – LEED Energy efficiency improvement (E-EC-I) - BERDE		ASH_4 (LEED)	(1) IESNA_7 (LEED) (2) ANSI_2 (LEED) (3) DOE_2 (BERDE)		
Energy efficient building envelope **E**nergy efficient building envelope (E-I) – BERDE Neighborhood daylight access (E-S-I) - BERDE			(1) DOE_3 (BERDE) (2) HKC_2 (BEAM)		
Reduction in greenhouse gas emissions (E-S-I) – (Enviro)	ABC				
Nearing net zero (E-I) – Enterprise	(1) USDOE (2) PHIUS (supported by US DOE) (3) LBC (Alliance with USGBC)				
ENERGY STAR Appliances (E-I) – Enterprise	ENERGY STAR products (Partnered with EPA)				
Photovoltaic/Solar Hot Water Ready (E-I) – Enterprise	(1) RERH (2) DSIRE		NREL		
Resilient Energy Systems: Island-able Power (E-I) – Enterprise		USGBC	USGBC		
Earth Craft Builder Training (E-I) – ECC	SEI (Partnered with ECC, Atlanta, Georgia etc.)				
Renovation of Existing Commercial (E-I) – ECC			ASH_6		

Clean Emissions Protocol for Heavy Equipment (E-I) – ECC	EPA: National Clean Diesel Campaign and verification		EPA		
Industrial Sector Resource Efficiency (E-S-EC-I) - STAR					

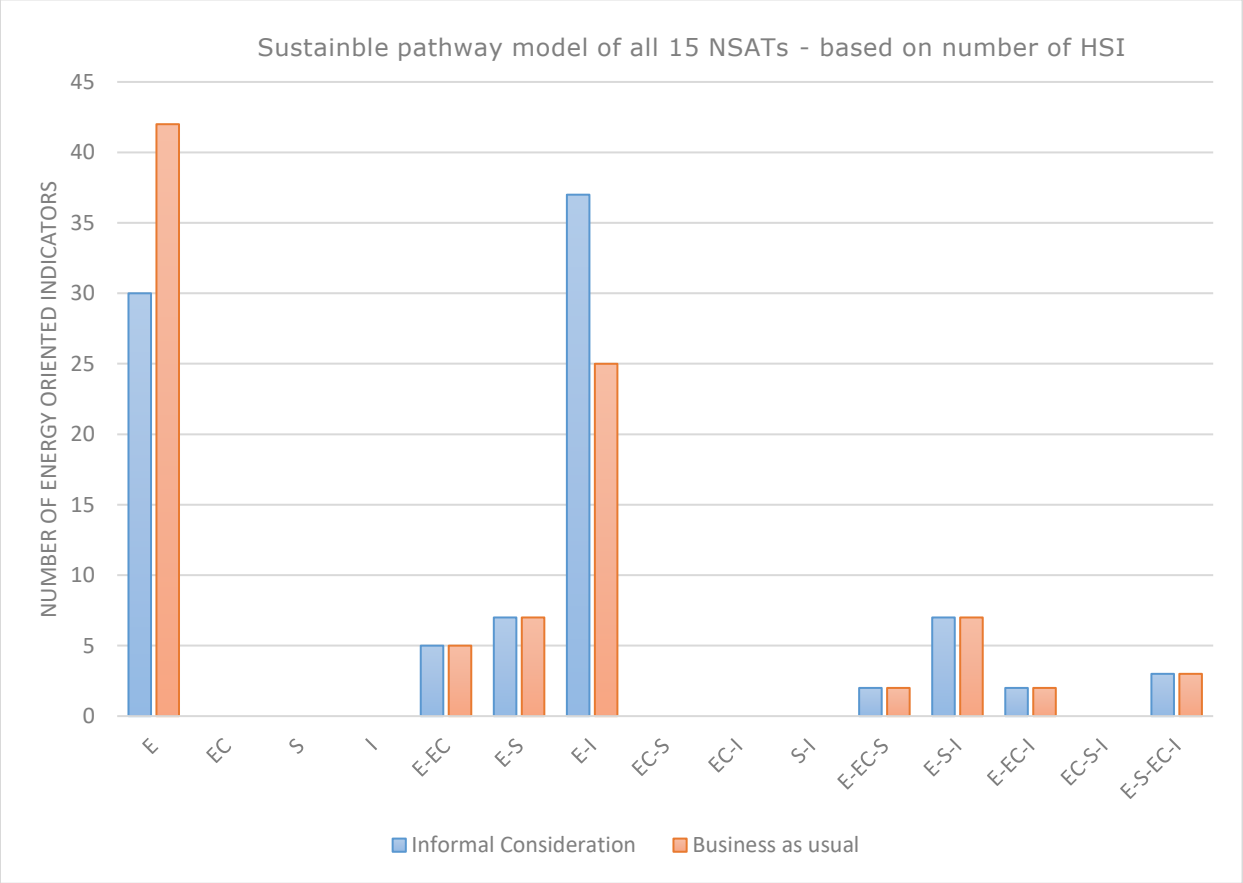


Fig. 3.2: Sustainable pathway of all 15 NSATs (Energy)

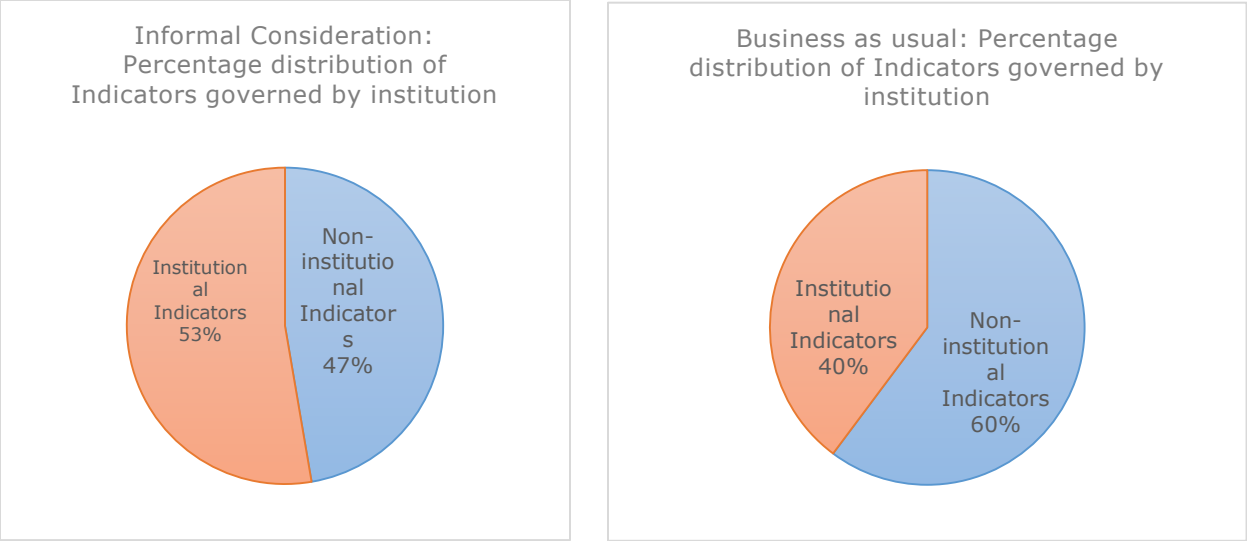


Fig. 3.3: Business as usual indicators versus indicators that consider informal institution

3.4.2 General statistics on E-HSI

Fig. 3.4 illustrates the total number of E-HSI and frequency of distribution from supply and demand side. Fig. 3.4 also illustrates that some E-HSI cover both demand and supply initiatives (hybrid side). This is also shown percentage wise in Fig. 3.5. As can be seen in Fig. 3.4 and 3.5, frequency and percentage distribution of the demand side E-HSI are considered more than the supply side.

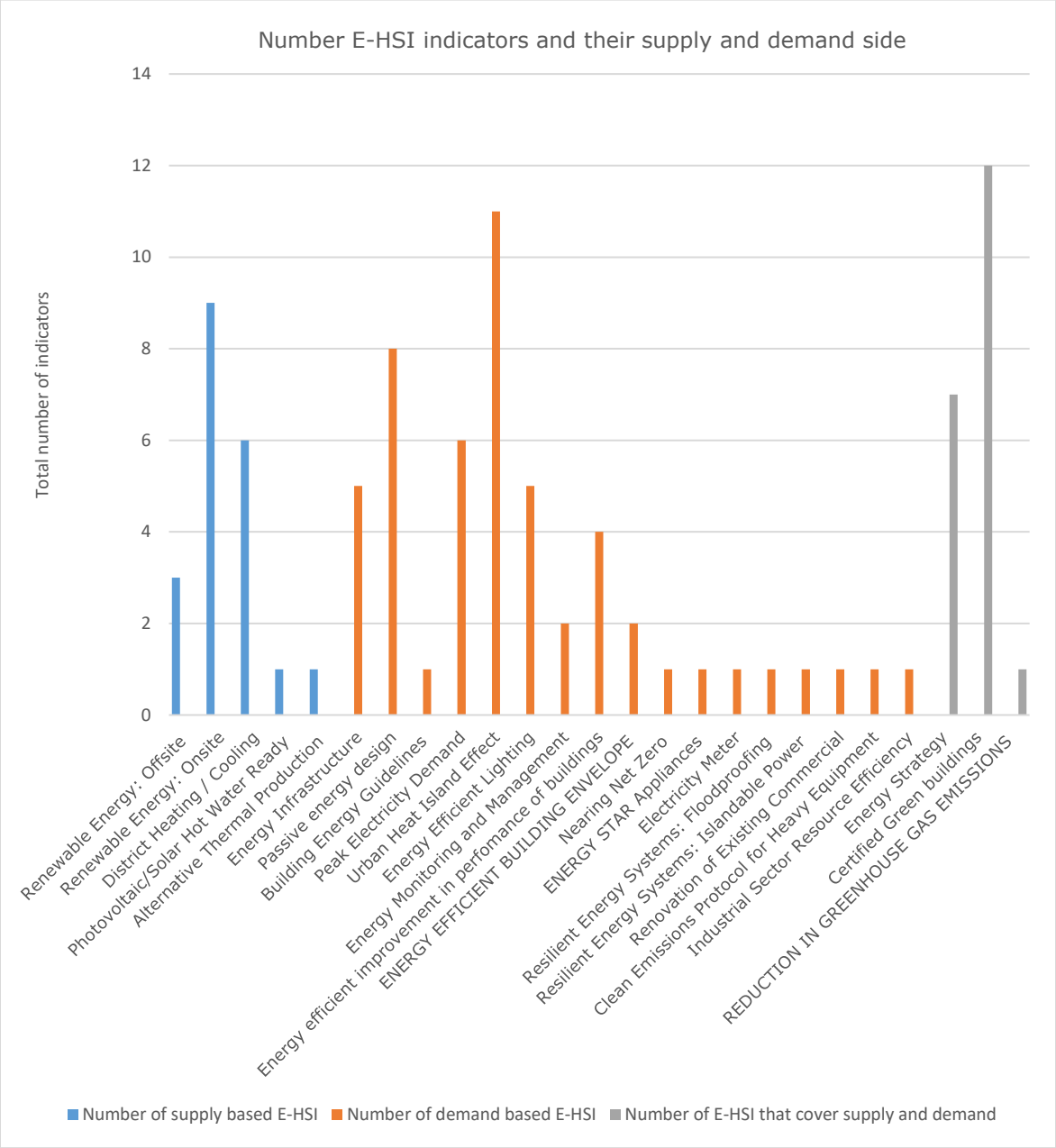


Fig. 3.4: Energy based headline sustainability indicator and frequency from supply and demand side

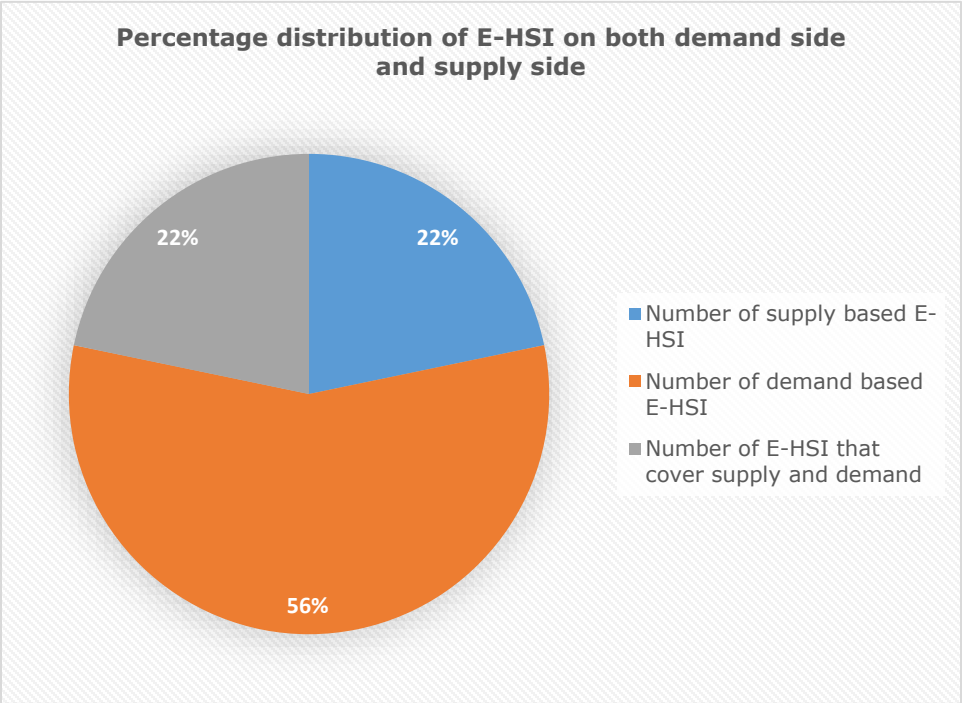


Fig. 3.5: Percentage distribution of E-HSI from supply, demand side and hybrid side

Fig. 3.6 demonstrates the result of analysis according to procedural, feature and performance categorization. A Comparison all E-HSI from the 15 NSATs is made against that of the E-HSI that have been shown to possess institutional dimensions. The results equally show strong links towards feature based E-HSI. Interestingly, institutional based E-HSI are more linked to procedure based HSI (31%) as compared to when all E-HSI are reviewed (22%). See Appendix 3B-3 for full break down of categorization

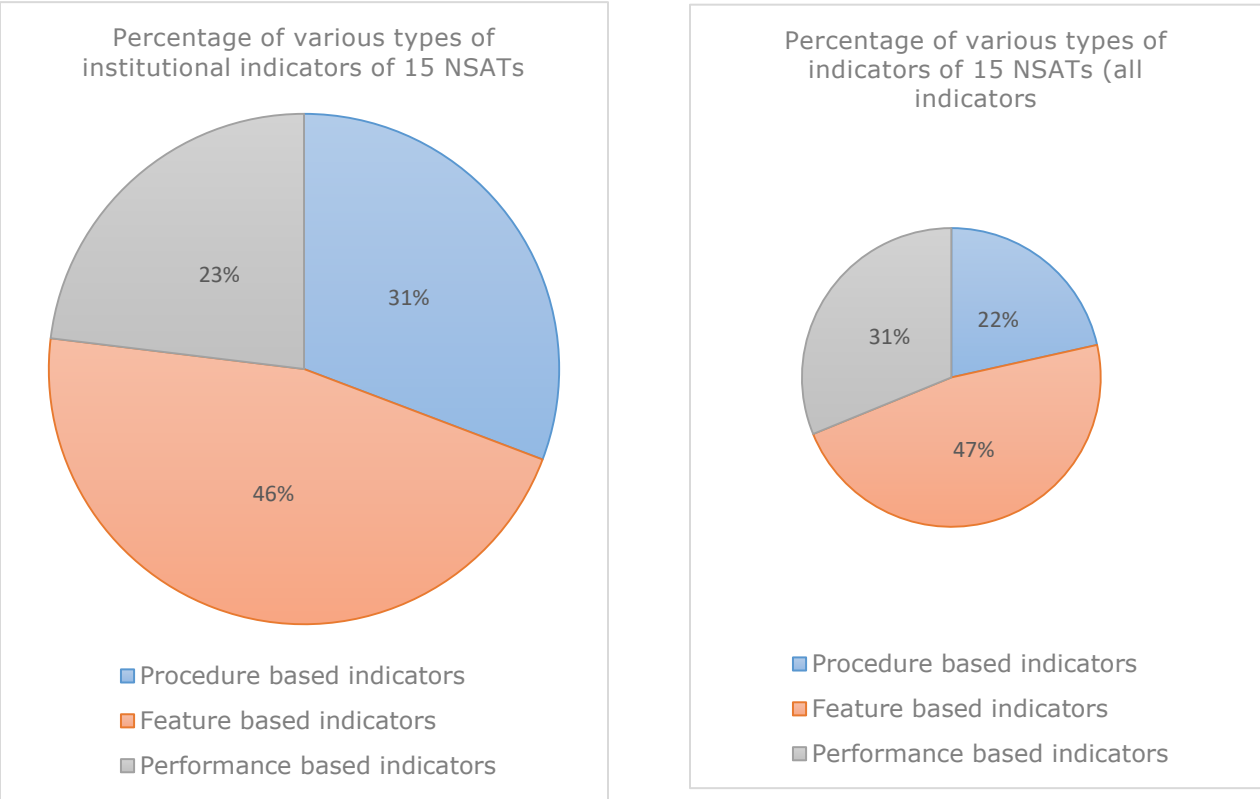


Fig. 3.6: Procedure, feature and performance based indicators of all indicators in the 15 NSATs and of only institutional based indicators (Energy)

Fig. 3.7 illustrates the percentage distribution of institutional based indicators based on tool developer, specific locations and also based on the region in which they were developed. The top three tools are EGC (US), ECC (US) and the Pearl Community (UAE). Also, the top two regions where institutional dimension based indicators are most prevalent are America and Asia. Furthermore, Fig. 3.8 illustrates the number of E-HSI of each tool, with the top three being Pearl Community (UAE), EGC (US) and ECC (US).

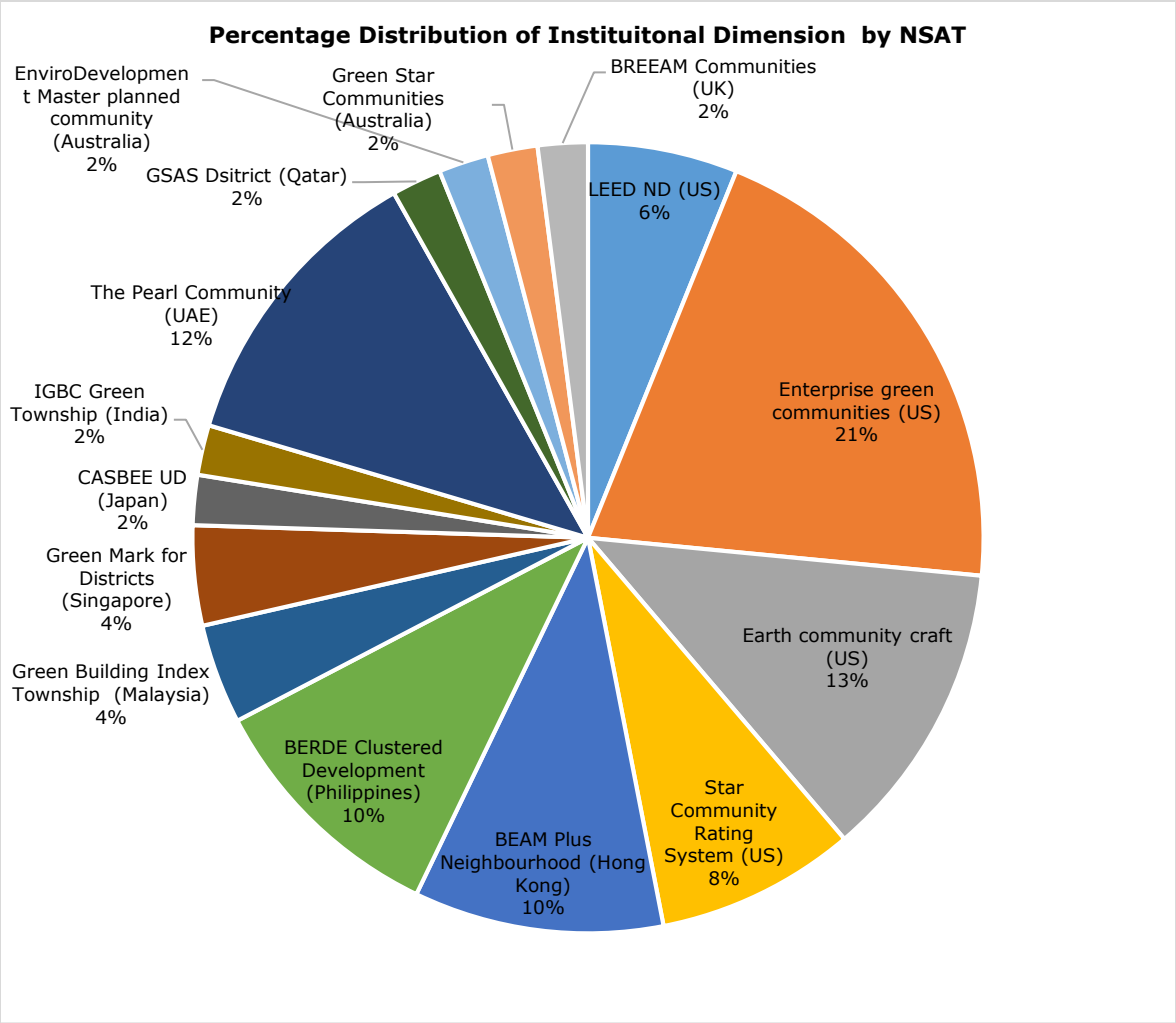


Fig. 3.7: Number of E-HSI according assessment tool developers

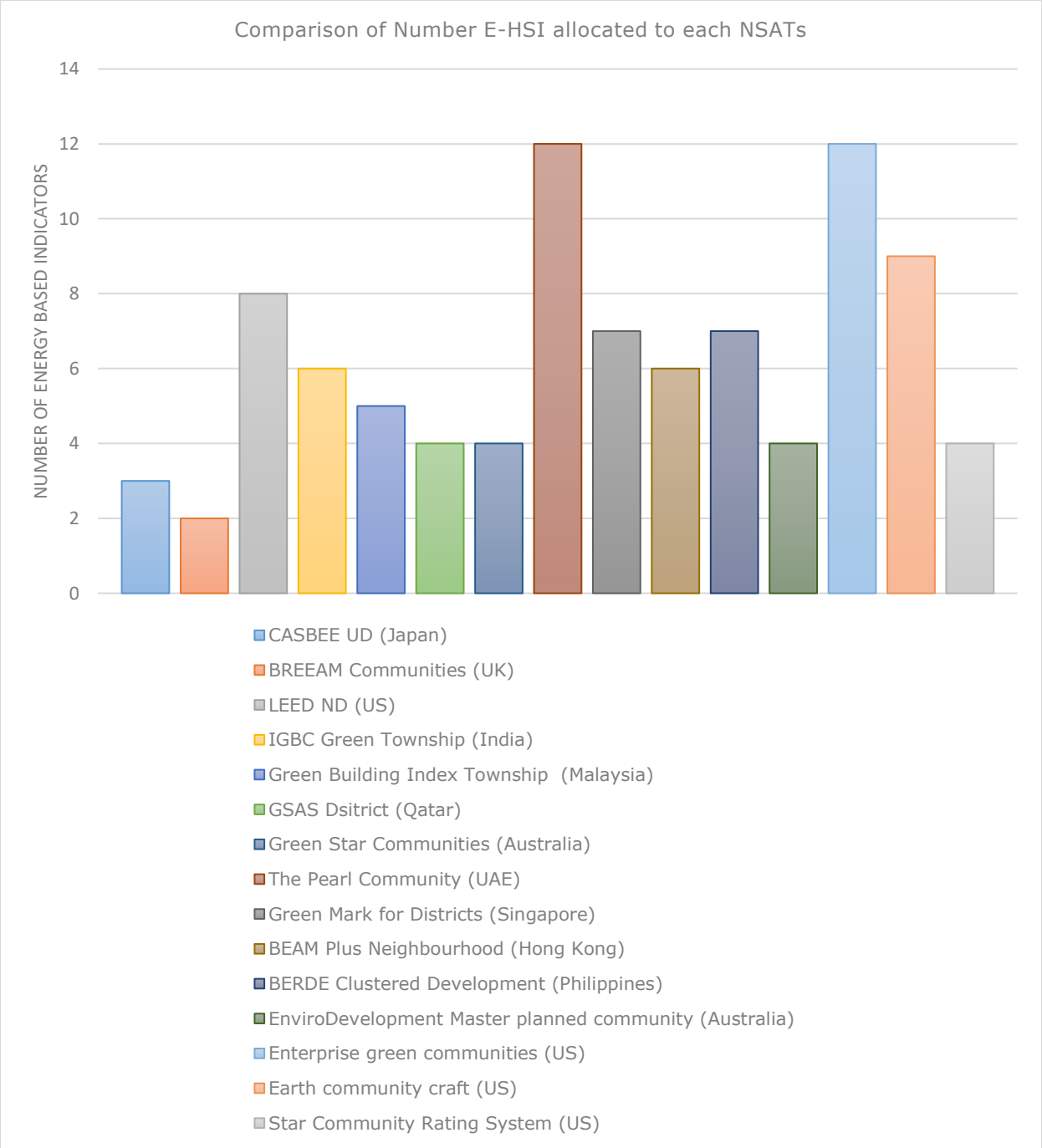


Fig. 3.8: Comparison of number of E-HSI allocated to each NSAT

3.5 Discussion

3.5.1 Trend, characteristics and implications of Energy oriented sustainability indicators in currently existing NSATs

The multi-dimensional approach was utilized in this study, mainly because by separating HSI into four dimensions and by further establishing the relationships within each dimension, it is easier to describe the behavior characteristics of a specific HSI. To that end, the results in Fig. 3.2 provides an overall snapshot of the SP. The SP indicates the current status and frequency of all 93 indicators of the 15 NSATs. Currently, certified green buildings, passive energy design, renewable Energy: onsite and UHIE are the highest occurring E-HSI (see Fig. 3.4). This illustrates globally, what all tools prioritize in terms of achieving sustainability from an energy perspective. Figs. 3.2 and 3.3 shows two cases, which are business-as-usual and informal consideration – in the methodological analysis of each E-HSI. These were placed into dimensions depending on their sustainability focus. Business-as-usual shows that E-HSI are more environmentally-driven, which would seem understandable; though there is a secondary emphasis on E-I as opposed to other DoS. The significance of this observation is that in terms of the prior criticism of being E focused, E-HSI do exactly that; though this should not be surprising due to the strong links between energy and environment. Alternatively, from the "informal consideration" perspective, Figs. 3.2 and 3.3 also demonstrates that E-I dimension is actually considered more than the E dimensions. The question is what do we mean by informal consideration? The explanation is that while NSATs were being studied some E-HSI under NSATs actually referred to earlier and more established tools and journals. These tools and journals were used as a point of reference or guide to establish best practices, such an example is BEAM (Hong Kong developed NSAT). Under BEAM, the E-HSI of "energy infrastructure" classed under "District heating and cooling" alludes to LEED-ND and GMD as institutional reference points. BEAM, due to lack of figures and ability to obtain such data locally, quote LEED-ND district cooling efficiency of COP 4.4 and Green

Marks value of 4.7 as the range performance needed by a system to score the necessary points under this E- HSI. This argument along with the fact that NSATS are a decade old, leads to the establishment of a new type of informal or semi-formal institution. Hence, from this new perspective (dimensional perspective) and as Fig. 3.3 illustrates, in terms of E-HSI, there are more institutionally based E-HSI than previously reported in prior studies. Also, when informal institutions are considered there actually are more institutionally-based indicators than non-institutionally-based indicators. From an applicability perspective, the lack of code and standard was mitigated by newly developed tools utilizing codes and institutions from other regions. Majority of African countries as well as many other developing nation also lack base line data on energy consumption, and this becomes problematic in measuring the success of certain E-HSI, as success of some E-HSI in hinged on the presence of the institutional dimension, which is hinged on the knowledge of baseline energy consumption. The method used by BEAM to mitigate this was to use values of previously established tools. However, if the values are not adapted for local differences, this may still lead to inefficient results. The second method of mitigation is to simply develop the necessary standards. Though Nigeria currently lacks such codes, development of building codes has already occurred in Egypt, South Africa and also Tunisia. For example in Egypt current codes have minimum performance levels for Air-conditioning but enforcement of these code by legislation was still needed. Hence, compliance to developed codes might still be difficult if not made mandatory. This implies that the future development of these codes and standards should be supported by a combination of policies and incentives, subsidies or awards. Also, unlike South Africa which uses mixed standards for building energy efficiency, Tunisia has taken a step further by making their standards mandatory (Iwaro and Mwasha, 2010).

The second observation is on the implications of the characterization of E-HSI. For instance, the E-HSI of "Photovoltaic/Solar Hot Water Ready", which is guided by the organization of EPA Renewable Energy Ready Homes (RERH) and regulated by National

Renewable Energy Laboratory - Solar Ready Buildings Planning Guideline. Thus classifying the aforementioned E-HSI as E-I. The result of the characterization of E-HSI improves upon Sharifi and Murayama (2013) studies. In their analysis, it was made clear that sustainability includes institutional aspects as its fourth dimension and this was missing in NSATs. But there was no explicit mentioning of the kinds of specific indicators and criteria sought to make this claim. Hence, the use of the SPM approach identifies the institutional-based HSI and by doing so the results achieved supports the previously-mentioned argument made in chapter 2 that institutional indicators cannot be standalone. Essentially, they have to be an institutional of "something", which can then be interpreted into specific dimensions (E-I, E-S-I, E-EC-I). This also gives a better explanation to why Turcu (2013) argues that HSI of "community activity" was classed under both social and institutional dimensions. Based on the SP method, it would be classified as a socio-institutional HSI. The classification of dimensions also showed the limitations of currently developed E-HSI to consider other dimensions (e.g. E-S-I, E-EC, E-EC-I). This has significant impact if applied in Nigeria, where the economic dimension may play a stronger role in the implementation of an indicator. In such cases, the specific E-HSI (e.g. ENERGY STAR Appliances) may not be implementable because it may not be affordable. Putting this into perspective, about 70% of Nigerians live below $2 per day (Gyamfi et al., 2018).This is well below the poverty mark and makes it even harder for the use of energy star equipment. Nonetheless in the case of lesser evils, which would be more affordable to a typical Nigerian; installation of LED and energy star appliances based on the implementation of the feature based Energy star appliance indicator or the purchase of solar panels and inverter system based on the performance based renewable energy onsite indicator. The answer would still be the use of energy efficient equipment but based on the current economic situation this would be needed to be supported by incentives and subsidies.

Viewed from another perspective, Out of the 15 NSATs investigated, Fig. 3.8 investigates how many energy based indicators are allocated to the NSATs of various

countries. NSAT from UAE has the highest set of indicators which we would call 'coverage', both CASBEE and BREEAM communities have lower E-HSI coverage, enterprise community also ties with pearl community for the highest indicators that cover Energy. Hence, it is far likely that energy based indicators under pearl community and enterprise community would cover a larger range of supply and demand side energy based indicators. Though for instance the energy indicator such as Energy Strategy under BREEAM communities constitutes a number parameters that include both supply and demand it is still placed under one HSI and the methodology behind the point allocation demonstrates that points are given based on how much CO_2 emissions are reduced i.e. two points are given to emissions reductions that is 9.9% below base line levels, three points to emission reduction of 17.7% below baseline levels etc. Hence, the reduction can occur through passive techniques, shading, solar orientation, and feasibility studies of energy demands of infrastructure but also through sustainable and renewable energy generation. The problem here is that as long as the reductions of GHG emissions is achieved, not all these methods of achieving sustainable energy needs to be addressed. This means that if a location can reduce GHG by 50% with renewables then points will be given irrespective of the economic feasibility, which we have certified to be an issue in African nations. With higher coverage (i.e. with more specific HSI) separation of HSI into key sections is advantageous, particularly to African cities because key issues can be addressed specifically and in some cases can thereby be made mandatory i.e. passive design, solar orientation, solar renewable energy production and electricity meter represent four separate issues. This ensures that economic issues may be addressed more specifically, without overly focusing on the GHG emission, as is the case with BREEAM communities. It should be remembered that nations such as Nigeria, Ghana, Egypt, Morocco, and Rwanda are majorly motivated by socio-economic issues not environmental. Hence the use of GHG reduction as a sole metric or sustainable indicator may not necessarily be the best. Credits or points given to indicators should transcend just reducing GHG, specifically for African nations because of the affordability and economic impetus that would undoubtedly affect how stakeholders view

the technology. Why? Because no matter how educated or aware a citizen may be about a specific clean technology, if it is not affordable it would certainly not be appealing to stakeholders, especially within the African context

Also, Sharifi and Murayama (2013) addressed a maximum of seven NSATs but this study looks into 15 NSATs. Even though limited to energy-based HSIs, the results still indicate a higher consideration of institutionally-based indicators. As argued in the above literature review, this study delves deeper into the meaning of institution. This brings out the next point of interest with respect to NSATs studies that have made claims of institutional limitations (Komeily and Srinivasan, 2015; Reith and Orova, 2015; Sharifi and Murayama, 2013, 2015; Turcu, 2013). The scope of previous studies focused on the organizations and presence of an institute to represent the given HSI, e.g. education institute. However, as phfal (2005) establishes, institutions are not just organizations but laws, policies, regulations and guidelines. In this study, these regulations and organizations came in the form of building codes and international standards as well as organizations. This provided a broader scope to the definition of institution. This further led to categorization of formal and informal institutions. Under these categorization and interpretations, it became evident that a lot of E-HSI requires these codes in order to promote best practices and have reliable reference of what works thereby ensuring duplication of successful results in other regions. It also showed that policies go a long way in determining the success of a HSI. The best example is the UAE Pearl NSAT, which from the beginning of their NSAT, center their development of numerous indicators to master plans and policies that are bounded by their urban laws (Abu Dhabi urban planning council). This council developed the following policies and plan; Capital 2030 Master Plan, Al Ain 2030 Master Plan, Al Gharbia 2030 Master Plan, UPC Community Facility Requirements, Abu Dhabi Urban Street Design Manual, Coastal Development Guidelines and Abu Dhabi Development Code (Abu Dhabi Urban Planning Council, 2010). These plans and regulations were all linked to various HSIs (energy-based HSI included). For BREEAM

communities, this is slightly different due to the embedded nature of their institution in a number of their environmental initiatives; hence, institutional support is generally not explicitly mentioned but implicitly intended. There policies act like silent partners in actuating energy strategies selected. Hence, in BREEAM communities, the institutional support or dimensions are not specifically highlighted, thus making it harder to identify and categorize. For instance, the E-HSI "energy strategy" under BREEAM communities cannot been seen to possess E-I but rather E. However, the literature shows that energy policies are in place to support their energy-based indicators (Charoenkit and Kumar, 2014; Reith and Orova, 2015; Wangel et al., 2016). LEED-ND, on the other hand, focuses on guidelines and building codes, also most of the other American developed tools are governed by building and energy codes (see Fig 3.7). As mentioned earlier, these codes and standards provide a threshold or best practice reference value that a given HSI operates under. For example, under the LEED-ND E-HSI of 'Energy efficient improvement in performance of buildings', the guiding codes utilized to establish best practices are IESNA Standard 90.1–2010, Appendixes B and D (appendix from ISENA manual) and ANSI Standard 90.1–2010. This demonstrates how the institutional dimension guides effective implementation of the HSI, if used on a project. Finally key E-HSI showed particular affinity to institutional dimension such as 'efficient lighting', this is because lighting organizations have a long and strong lighting research background, which allows them to provide reputable threshold values that can be adhered to under various contexts and used for best practice procedures. The same can be said for E-HSI indicators generally, as table 3.3 and Fig. 3.3 shows; it is evident that they are heavily reliant on codes, standards and organization in order for the indicator to be effective.

3.5.2 Impact, limitations and solutions to the adoption of existing HSI

In categorizing the 93 E-HSI of energy management and energy productions (demand and supply side) of the 15 NSATs, this involved gathering all the HSI, sorting similar HSI under one title while noting its frequency of occurrence. For instance certified green building

was utilized by 12 out of the 15 tools and energy star appliances only occurred in one NSAT. The results of the approach is represented in Fig. 3.4. The results in Fig. 3.4 illustrates the level of occurrences of HSI that are more commonly used or vice versa. For instance E-HSI of certified green buildings, onsite energy, energy infrastructure, UHIE, energy strategy and passive houses were quite popular. This shows that in terms of the E-HSI considered for NSATs, firstly, there are more E-HSI that considered demand side approach to energy sustainability. More specifically, when the number of indicators are broken down and deconstructed, the number of indicators associated with demand side management is 53 and the number associated with the supply and hybrid side are 20 and 20 respectively. This implies a strong focus of NSATs on demand reduction strategies. This is validated by the fact that even the united nation has placed emphasis on energy reduction as the primary approach needed for climate change to be fully achieved, as well the fact that buildings codes and standards are developed with the ideology of conservation (Adom and Adams, 2018; Iwaro and Mwasha, 2010). In addition, IEA states that energy efficient polices alone can reduce energy related greenhouse gases by 15%. For this reason, energy conservation initiatives has become the basic pillar of EU policy in recent decades (Collado and Díaz, 2017; Gyamfi et al., 2018). A study by Zhou et al., (2011) illustrated that continued efficiency projects of products under the China labeling program stands a chance of cumulatively saving 9503TWh and 3.851 billion tomes of CO_2 emission by 2030 (Zhou et al., 2011). However, results from a separate study showed that this was high is most areas but lower in less economically developed areas (Khanna et al., 2013).

Should this then be the route to take for African based countries such as Nigeria who have clearly shown ineptitude towards demand side management and clearly favor supply side management due to their motivation to improve on a lack of energy access? Indeed for African countries passive design energy infrastructure, onsite and offsite renewable energy generations are all targeted approaches that countries like South Africa and Nigeria envision

to attain. However among African countries, South Africa and Egypt would be in better position to assimilate these current E-HSI, due to their developed policies and proactive approach to energy management. In fact, Ghana has also recently started giving energy efficient use of appliances serious attention as the country moves towards middle income status (Diawuo et al., 2018). Gyamfi et al. (2018) study further expanded on the energy efficiency focus by showing the strength and weaknesses of the implementation of CFLs and energy efficient air-conditioners. Firstly, since 2003, import duties and VAT was removed of CFLs. secondly, in 2005 a minimum standard was imposed for fluorescent light. Thirdly, as of 2014, Ghana became one of two countries in the sub- Saharan region to adopt energy standards and labeling of electrical products. Finally and more recently, air-conditioner rebate was enacted for using energy efficient air-conditioners. Regrettably, the cons behind these attempts were market distortion of price energy efficiency prices, affordability, suitability to local issues, regulation and behavioral issues. Though, the highest challenge was finances. As such, the success was hinged on the incentive provided to mitigate financial issues. Nigeria on the other hand, has weaker regulations to support demand but rather stronger incentive to support supply side management due their current policy focus and need to improve energy access to 45% of their population that currently lacks energy. It might be worthwhile for Nigeria to base initial policy and regulatory focus on supply side indicators, while building up the technical capacities for the demand side. This is even evident as results from Fig. 3.4 show through consensus of the 15 NSATs that the common E-HSI which can be translated to more universally accepted issues that need to be addressed or techniques that need to be used, these include energy strategy, renewable onsite energy, passive design and urban heat island are the most common reoccurring issues and approaches. These four issues shows that policies addressing both supply and demand side indicators cannot be avoided. It also suggests that practically, in the development of NSATs and selection of E-HSI these indictors cannot be neglected due to current situation of Energy.

Correspondingly, considering Fig. 3.6 it shows great emphasis being placed on feature based E-HSI, as mentioned earlier this refers to indicators that determine or assess if measures, equipment, solutions are or will be put in place. Such E-HSI identified in this study included solar orientation (LEED-ND), efficient street and parking lighting (GBI), energy star appliance (EGC), and electricity meters (EGC). These type of E-HSI focus on the fact that if the feature or design is installed it would automatically improve energy performance. As mentioned earlier, in some cases this is due to the fact that some institutions are trusted and have executed several research in field such as energy star appliance. This is also due to the function of the equipment in question, for instance the E-HSI of electric meter, by installing this feature it becomes quite easy to monitor electricity expenditure and limit energy demand. However, as basic as some of these equipment would seem to be, in Nigeria, several communities are noted to not have such electric meters, and bill are given to them by estimates (Adhekpukoli, 2018; Akuru et al., 2017; Oseni, 2012). The feature based focus also illustrates the direction which E-HSI under the energy theme operate and this then becomes the point of attack to improve the efficacy of indicators for African nations. However, certain parameters that relate to the context of Nigeria needs to be understood. Nigeria is in a poor state when it comes to infrastructure especially, in energy and transport. This will make it very difficult for NSATs to thrive. The consistent power outage (highest in sub-Sharan Africa) bear not only social consequences but economic and environmental ones, as investment in standby diesel generators is one of the highest in the region (World Bank, 2016). This limit monies that could be spent for more environmentally friendly energy equipment. Moreover, Nigeria current technology and equipment economy runs on second hand equipment. These second hand equipment have often been used beyond there lifespan making them severely energy inefficient. In fact, in a majority of developing nations, imported used equipment and goods account for significant share of the machinery used in their respective regions. Sander and schilling (2010) identified Nigeria and Ghana as the main hub for electronic goods and scraps, with Nigeria importing as much as 70%. Even though the standards organization in

Nigeria introduced a third party certification process this has been to no avail as the problem still pursues. The implication to NSATs is that feature based HSI, in not just the theme of energy but any other theme (transport, ecology, waste management etc.), needs to carefully consider the origin of procurement of certain equipment, as the likelihood of second hand equipments is quite high in Nigeria. This would render a well-intended feature based HSI inefficient, subsequently exacerbating the problem. A solution is the creation of more performance based indicators that include ex post analysis. For instance, after the installation of energy efficient lighting, ensuring that the energy consumption of the lights are checked months later for level of performance. In addition, it is not enough to simply install these devices, the users need to be educated and trained towards their significance and impact, as this is an issue known to affect Nigerians. Habits such as use of inefficient cooling equipment, setting appliances on standby mode, leaving outdoor light on during the day or lights on when out, and increased use of incandescent bulb are traits that Nigerian exhibit regularly (Adom and Adams, 2018). Also, in the 93 E-HSI reviewed no energy indicator that covered educating and training users was developed. When putting this into context in Nigeria, this would have severe impacts on the efficacy of the NSAT as such a learning and training HSI would be needed to ensure the understanding feature based indicators, thereby improving results of implementation. Again, to support training and education could also involve the use policies and attractive schemes. In the Refrigerator energy efficiency project of 2012, Ghanaians were encouraged to replace old inefficient and power consuming refrigerators with new energy efficient ones. The project was reported to save 400 GWH of electricity and 1.1 million tons of carbon dioxide. The target was to replace 15,000 refrigerators but only 10,000 were changed and the scheme was subsequently scrapped. The reason for scrapping was not due to failure of meeting the targets but because Ghanaians had started to embrace the idea absent government incentives (Gyamfi et al., 2018).

Though policies that create incentives and subsidies are welcome strategies to support the success of indicators, care should be taken on how this is implemented. Generally, there is a poor market for renewable energy products in Africa due to the lack of right policies that would develop an efficient market for sustainable technologies and planning strategies. This poor market for renewable energy for example has been linked to inefficient policies on energy subsidies and approach to the countries energy supply and primary energy fuel. Empirically, Koplow and Dernbach, (2001) argues that fuel subsidies contributes to more than 90% gross GHG emissions, and Jones (1989) estimated that in 2008 GHG emission increased by up to 10% due to $550 billion worth fuel subsides. Nigeria in one of the top countries in the region that subsidizes its fuel prices and it is relevant to this argument to understand that government subsidies on petroleum products and electricity in region of the Middle East and North Africa have led to high energy inefficiencies (World Bank, 2009). Section 3.5.1 emphasizes the relevance of the internal policies in the form of regulatory practices and this section briefly highlights the impact of the wrong external policies. In line with this, energy subsidies can promote corruption, obstruct investment plans for cleaner and efficient approaches to energy production, distort pricing mechanisms and negatively affect consumer behavior. Distortion can occur in the form of smuggling of fuel to neighboring countries where prices of energy is high invariably taking undue advantage of the subsidies. This was the case in 2011, when the subsidized price of fuel in Nigeria was less that the neighboring African countries of Benin, Cameroun, Chad and Niger, which led to smuggling of petroleum (Akinyemi et al., 2014; International Monetary Fund, 2012). These finding are also consistent with Akinyemi et al., (2014) study that asserts that lack of capital investment can suppress development and commercialization of renewable energy technologies. In Nigeria these subsidies are noted to substantially drain the fiscal budget. Unfortunately the solution is not so simple, due to the socio-economic and equity issues plaguing the citizen of Nigeria. Withdrawing and reducing government subsidies has always been met with public outcry. In 2012, the subsidies on petrol was abolished in Nigeria, but this was met with protest and led

to it being reinstated two weeks later. A postulation is that the withdrawal favors the rich more than the poor and the fear of the inflation affects the prices of goods and products. After all, it is well established in Nigeria that a rise in petroleum prices causes inflation and reduction of economic welfare (Adom and Adams, 2018). Additionally, Siddig et al., (2014) illustrates that this removal or reduction in policy decreases the income and spending power of the typical Nigerian families. In essence, the utilization of the right external policies is a strong determining factor in the successful implementation of E-HSI.

A brief point worth mentioning that also has severe consequences on efficacy of NSATs is the high level of corruption in Nigeria. How does this affect NSATs and HSI? It does so because the resources that would otherwise be invested in energy efficient technologies is spent on the payment of bribes to obtain documentation and complete unnecessarily long licensing processes (Adom and Adams, 2018). This is because of the complex and draconian nature of the regulatory frameworks, which invariably delays registration and licensing of new products. This is also reiterated differently in a study by Ogunmuyiwa (2012), whose study expounds on the negative effects of corruption on FDI in Nigeria. The study shows through FDI how corruption is responsible for opportunities lost in the technology transfer of energy efficient technologies. This negative impact makes Nigeria vulnerable and susceptible to losing businesses easily to more energy efficient neighboring countries. Also, there is tendency for government and investors to develop large scale instead of small scale renewable energy due to the economic benefits. This is further exacerbated if there is a monopoly in the decision making process by individuals or groups of powerful political figures who stand to gain substantially or have personal agendas (Aliyu et al., 2018; Monyei et al., 2018).

What is evident in this section is that the institutional support in terms of policy direction, regulation formation, incentive and especially technology awareness play key roles to the success of any of the NSAT as a whole and the related E-HSI. Another conclusion is that policies need to well and strategically thought-through by considering the economic,

social, infrastructural and technological landscape. This is line with Adom and Adams, (2018) argument that an energy inefficient state will persist in an environment with poor institutional structures in place, undeveloped markets, inefficient infrastructures and inefficient regulatory systems. In the context of NSATs this would severely hinder its efficacy. In essence, aside internal policies such as regulatory systems for guidance, the current state of Nigeria also requires external policy support, incentives and schemes for NSATs to be fully effective and these policies and regulations need to be corruption free. The table 3.6 summarizes the list of issues that hinder the success of NSATs in Nigeria and possible methods of mitigation.

Table 3.6 Issues and the solutions for successful implementation of E-HSI and HSI in Nigeria

Issues related hindering Nigeria's adoption	Potential solutions	Applies specifically (or more specifically) to the Energy theme	Applies to all themes (water, waste management, disaster prevention, energy etc.)
Codes and standards			
Lack of codes and standard (not just limited to energy and building codes)	• Temporarily adopt codes and standards from well-established institutions. • Develop local codes and standards while relying on international codes in the interim. • Develop regional or state owned standardized institutions that can develop regulations for all urban themes and issues (e.g. urban Ecology, Housing, transport.).		x
To develop codes baseline data for energy or any other theme is question is	• Utilize baseline data from regions with similar context.		x

needed, which Nigeria generally lacks	• Invest in data monitoring systems and simulation software's for predictive calculations of baseline values. • Develop accurate, reputable and consistent national database for all sectors (energy, transport, health, waste management etc.).		
Lack of enforcement of codes via utilization of the right fiscal instruments and incentives	• Codes should be made mandatory, however, due to state of the economy and possible social backlash relative time should be given for transition. During such period's codes and standards for equipment, technology, buildings etc. can be voluntary. • Incentives, energy efficient subsides, rebates, awareness raising, tax exemptions, awards and grants, attractive loans should be used to push for more energy efficient and sustainable technologies and practices. This would help further help the success of HSI. • Fiscal instrument incentives and subsidies must be carefully considered.	x	x
Policies and practices			
Lack of policy diversity	• Based on results, policy focus in Nigeria is currently centered on supply side, particularly energy access. However, demand reduction policies should also be considered simultaneously, Due to the popularity in NSATs and affordability relative to supply side. • Since policy is centered on supply of energy, this should not be limited to large scale production, which tend to be for financial benefits for large private firms	x	

	and the government. Small scale renewable energy production should also be considered.		
Archaic policies	• Archaic and draconian policies in existence should be reviewed and updated.		x
Limit the Importation of second hand equipment	• More specialized certification schemes should be developed and enforced to limit substandard second hand goods form coming into Nigeria. • Local production of equipment and incentives for new technologies should be promoted. • Enforcement of certification standards should aim at weeding out corrupt practices that allow substandard good to come into the country.	x	x
Corruption	• Avoid mismanagement and misappropriation of funds. • Personal interests of powerful individuals with self-interest should be mitigated through policies, law or any other means. • Irrelevant bottle neck processes should be removed in obtaining permits for the development of clean technologies (e.g. power plant development, as this often leads to corrupt practices to speed up the process. • Standardization of institutional and regulatory departments and authorities to a single agency that may regulate all the institutional and regulatory bodies. • Nepotism should be avoided and professionals that have gone through the right training should be placed in positions		x

	that govern polices, certification and there implementation thereafter.		
Headline sustainability indicators			
The impact or lack of social and economic dimensions needs to be considered in the selection E-HSI and HSI of NSATs	• Whichever indicator is chosen especially feature based HSI, affordability and social response to the technology or equipment needs to be considered while developing the criterion (or SI) for the HSI.	x	x
Local adaptation of most prominent E-HSI is needed Note prominent E-HSI here Certified green buildings, passive energy design, renewable Energy: onsite and UHIE are the highest occurring	• The most common E-HSI cannot be assumed to be automatically implementable in Nigeria but has to be locally adapted. • Local adaptation may come in the form of policy augmentation, data review and augmentation or the local relevance of the prominent E-HSI or HSI.	x	x
Higher coverage of indicators	• So that distinct issues can be specifically tackled based on local context, hybrid forms of indicators should be avoided (i.e. mixing supply and demand E-HSI). • By separating distinct issues, it becomes easier to make some context specific issues mandatory e.g. electric meters in the case of Nigeria	x	
Performance versus feature indicators	• The current trend suggest the popularity of feature based indicators, however to truly optimize E-HSI and other HSI, feature based indicators should be followed up by post performance evaluation. Especially,		x

	due to the second hand practices in Nigeria.		
Lack of explicit dimensions	• DoS of each HSI should be explicitly shown		x
Collaboration			
Lack of Nation or state Plans	• Urban master plans should be developed for each state and this should help support the implementation of NSATs • National sustainability planning frameworks should also be developed to support NSATs. • Both local and national plans should be used to develop and/or aid the selection E-HSI and HSI.		x
Lack of training and awareness	• Awareness should be raised on energy efficiency as well as other sustainable practices. • Polices that can support raising awareness should be put in place. Program types include counselling, consumption feedback, elementary school programs and mass media motivational campaigns on how energy standard. • After local or international codes are introduced, information and training to architects, planners and engineers need to be given so professionals understand an implement competently energy and other relevant regulation and codes.		x
Lack of partnerships	• Due to the current pressures on national budget, higher upfront cost for efficient technologies and the economic state of individuals, international financial partnerships that can provide grants to		x

	assist in providing financial incentive may be a viable approach. • There is a lack of the technical know to produce energy efficient and cost effective products, thus partnerships should be formed with international and local institutes to develop technical knowhow.		

3.6 Conclusions

This chapter has shown that expanding the understanding of institution is essential to improving indicator development of assessment tools. Indeed, when viewed from a multi-dimensional perspective and expanding the spectrum of understanding of what can be called institutional indicators, the study indicates that there are actually more institutionally linked indicators. The chapter argues for the inclusions and recognition of informal institutions, which include previously-developed assessment tools and peer-reviewed journals. Under the two scenarios, the results demonstrated that there are more institutionally-based indicators than previously reported in prior studies. Also when informal institutions are considered, there are actually more institutionally-based indicators than non-institutionally based indicator. This chapter also shows how institution via linkages and relationships can be used to operationalize and incentivize in practice the other three dimensions. In fact, the institutional dimension is so essential that certain indicators lose their functionality and effectiveness without the dimension being present. For instance, the lighting indicator, which is heavily dependent on lighting codes or energy star appliance indicator, is heavily dependent on the functionality of the organization. Their absence would lead to a lack of trustworthy data and lack of pre-established best practice procedures and performance values.

This chapter also demonstrates that the institutional dimension cannot be a single entity or identity and operates under the linkage of the other dimensions (E-I, E-S-I, E-EC-I). With this in mind, this study, albeit via energy-based indicators corroborates the

environmental denominated perspective of NSATs, though this is to be expected of energy-based indicator due to its strong environmental linkage. However, a significant recommendation should be the inclusion of other types of dimensions to make such indicators more implementable. For instance, the economic dimension linked with both institution and environment would improve the success of implementing such indicators in developing regions of the world. Studies also showed that institutional dimension can be explicitly stated or implicitly intended. 'Explicitly stated' refers to NSATs such as LEED-ND and PEARL that point out via text the institutional body and their role is influencing the given indicator. 'Implicitly intended' refers to BREEAM communities tools, due to the UK's strong environmental governance and institutions. It is also often implied that BREEAM in some form or way will utilize these institutions without explicitly stating or identifying them. For NSATs, a suggestion would be that the institutional dimension needs to be visibly and explicitly mentioned as a parameter of the indicator, not only for clarity but to account for successes, failures and trends of the given indicator. Finally, future studies and development of NSATs should look into the explicit application of institutional dimension in indictors; these indicators could span various urban themes and issues. This could be a significant and alternative development to NSATs, particularly for regions that are just developing their own assessment tools. In sum, a clear definition of an institutional indicator is one that

> *"An institutional indicator is one that explicitly bears the institutional dimension (i.e. policy, regulations, incentives, organizations, codes and standards) within the instructions of how to implement the given HSI. The dimensions cannot be a single entity or identity and must operate under the linkage of the other dimensions."*

Also, the idea of HSI considering multiple dimensions is to raise the efficacy of the HSI if implemented in a society such as Nigeria. In the context of Nigeria, the results show that 1) HSI or E-HSI are too environmentally focused and do not consider enough of other important factors such as the economics and affordability behind the application of these HSI.

2) By expanding the understanding of an institutional dimensions it is clear that a significant amount of indicators requires the institutional dimension to thrive. This would pose a problem for a country like Nigeria which though has drafted proposals for codes and standards for energy and buildings are yet to implement them. Yet South Africa, Egypt, Morrocco, Ghana have already developed stronger energy institutions with regards to regulations, codes and policies. Thus such regions are fully ready to receive NSATs. 3) Result also showed dominance for feature based indicators, however when considering Nigeria's external policies, an improvement in infrastructure and technology would be needed for feature based indicators to have a positive impact. It also showed that external policies cannot be carelessly and ineptly developed as this could have significant effect on the success of E-HSI such as renewable energy, energy equipment etc. Hence, in Nigeria's current state of weak institutions, poor infrastructure, poor regulatory framework, endemic corruption and underdeveloped market, not only would energy based indicator struggle to be implement but NSATs as a whole. This means that other themes such as waste management, disaster prevention, ecological impact, which all rely on policies and regulations and operate under the same principles would find it difficult to be implemented in Nigeria. Nonetheless a brief prescription of how certain issues may be addressed to improve its reception in Nigeria and indeed other African countries was developed (table 3.6).

References

Abu Dhabi Urban Planning Council, 2010, The Pearl Rating system for Estidama 1.0.

Adhekpukoli, E., 2018, The democratization of electricity in Nigeria: The Electricity Journal, v. 31, p. 1-6.

Adom, P. K., and S. Adams, 2018, Energy savings in Nigeria. Is there a way of escape from energy inefficiency?: Renewable and Sustainable Energy Reviews, v. 81, p. 2421-2430.

Akinyemi O, Alege PO, Amaghionyeodiwe LA, Ogundipe AA. Fuel Subsidy Reform and Environmental Quality in Nigeria; September 1; 2014. Available at SSRN: ⟨http://ssrn.com/abstract=2489904⟩ or http://dx.doi.org/10.2139/ssrn. 2489904).

Akuru, U. B., I. E. Onukwube, O. I. Okoro, and E. S. Obe, 2017, Towards 100% renewable energy in Nigeria: Renewable and Sustainable Energy Reviews, v. 71, p. 943-953.

Aliyu, A., and L. Amadu, 2017, Urbanization, cities, and health: The challenges to Nigeria - A review: Annals of African Medicine, v. 16, p. 149-158.

Aliyu, A. K., B. Modu, and C. W. Tan, 2018, A review of renewable energy development in Africa: A focus in South Africa, Egypt and Nigeria: Renewable and Sustainable Energy Reviews, v. 81, p. 2502-2518.

Ameen, R. F. M., M. Mourshed, and H. Li, 2015, A critical review of environmental assessment tools for sustainable urban design: Environmental Impact Assessment Review, v. 55, p. 110-125.

Berardi, U., 2015, Chapter 15 - Sustainability assessments of buildings, communities, and cities A2 - Klemeš, Jiří Jaromír, Assessing and Measuring Environmental Impact and Sustainability: Oxford, Butterworth-Heinemann, p. 497-545.

Boyle, L., K. Michell, and F. Viruly, 2018, A Critique of the Application of Neighborhood Sustainability Assessment Tools in Urban Regeneration: Sustainability, v. 10.

Brimmo, A. T., A. Sodiq, S. Sofela, and I. Kolo, 2017, Sustainable energy development in Nigeria: Wind, hydropower, geothermal and nuclear (Vol. 1): Renewable and Sustainable Energy Reviews, v. 74, p. 474-490.

Charoenkit, S., and S. Kumar, 2014, Environmental sustainability assessment tools for low carbon and climate resilient low income housing settlements: Renewable and Sustainable Energy Reviews, v. 38, p. 509-525.

Ciulla, G., V. Lo Brano, and A. Orioli, 2010, A criterion for the assessment of the reliability of ASHRAE conduction transfer function coefficients: Energy and Buildings, v. 42, p. 1426-1436.

Collado, R., and Diaz, S., 2017. Analysis of energy end – use efficiency policy in Spain. Energy Policy, 436 - 446

Dawodu, A., B. Akinwolemiwa, and A. Cheshmehzangi, 2017, A conceptual re-visualization of the adoption and utilization of the Pillars of Sustainability in the development of Neighbourhood Sustainability Assessment Tools: Sustainable Cities and Society, v. 28, p. 398-410.

Deringer, J.,Iyer,M.,YuJoeHuang,Y.J.,2004.Transferredjustonpaper?why doesn't the reality of transferring/adapting energy efficiency codes and standards come close to the potential? In: Proceedings of the 2000 ACEEE Summer Study on Energy Efficiency in Buildings, Pacific Grove, CA, August 2004.

Diawuo, F. A., A. Pina, P. C. Baptista, and C. A. Silva, 2018, Energy efficiency deployment: A pathway to sustainable electrification in Ghana: Journal of Cleaner Production, v. 186, p. 544-557.

Fan, J., K.-C. Yung, and M. Pecht, 2015, Predicting long-term lumen maintenance life of LED light sources using a particle filter-based prognostic approach: Expert Systems with Applications, v. 42, p. 2411-2420.

Giwa, A., A. Alabi, A. Yusuf, and T. Olukan, 2017, A comprehensive review on biomass and solar energy for sustainable energy generation in Nigeria: Renewable and Sustainable Energy Reviews, v. 69, p. 620-641.

Gyamfi, S., F. Amankwah Diawuo, E. Nyarko Kumi, F. Sika, and M. Modjinou, 2018, The energy efficiency situation in Ghana: Renewable and Sustainable Energy Reviews, v. 82, p. 1415-1423.

International Monetary Fund. Regional economic outlook, October: sub-Saharan Africa. Maintaining growth in an uncertain world. African Department; 2012.

Iwaro, J., and A. Mwasha, 2010, A review of building energy regulation and policy for energy conservation in developing countries: Energy Policy, v. 38, p. 7744-7755.

Khanna, N. Z., N. Zhou, D. Fridley, and C. Fino-Chen, 2013, Evaluation of China's local enforcement of energy efficiency standards and labeling programs for appliances and equipment: Energy Policy, v. 63, p. 646-655.

Kitio V. Promoting energy efficiency in buildings in East Africa. UNEP-SBCI symposium Paris. Global action towards resource efficieny and climate mitigation in the building sector. Nov; 2013. p. 1–27.

Komeily, A., and R. S. Srinivasan, 2015, A need for balanced approach to neighborhood sustainability assessments: A critical review and analysis: Sustainable Cities and Society, v. 18, p. 32-43.

Lo, Y.-C., K.-T. Huang, X.-H. Lee, and C.-C. Sun, 2012, Optical design of a Butterfly lens for a street light based on a double-cluster LED: Microelectronics Reliability, v. 52, p. 889-893.

Melo, A. P., M. J. Sorgato, and R. Lamberts, 2014, Building energy performance assessment: Comparison between ASHRAE standard 90.1 and Brazilian regulation: Energy and Buildings, v. 70, p. 372-383.

Monyei, C. G., A. O. Adewumi, M. O. Obolo, and B. Sajou, 2018, Nigeria's energy poverty: Insights and implications for smart policies and framework towards a smart Nigeria electricity network: Renewable and Sustainable Energy Reviews, v. 81, p. 1582-1601.

Ogunmuyiwa MS. An econometric analysis of the impact of corruption on fdi in Nigeria. J Afr Macroecon Rev 2012;2(1):148–59.

Oseni, M. O., 2012, Households' access to electricity and energy consumption pattern in Nigeria: Renewable and Sustainable Energy Reviews, v. 16, p. 990-995.

Ozoegwu, C. G., 2018, The solar energy assessment methods for Nigeria: The current status, the future directions and a neural time series method: Renewable and Sustainable Energy Reviews, v. 92, p. 146-159.

Reith, A., and M. Orova, 2015, Do green neighbourhood ratings cover sustainability?: Ecological Indicators, v. 48, p. 660-672.

Sander K, Schilling S. Optimierung der stewerung und kontrolle grenzuberschreitender stoffströme bei elektroaltgeräten, elektroschrott: förderkennzekhen 370893300, UBA-FB 001331. Texte/umweltbundesamt. Umweltbundesant; 2010.

Sharifi, A., and A. Murayama, 2013, A critical review of seven selected neighborhood sustainability assessment tools: Environmental Impact Assessment Review, v. 38, p. 73-87.

Sharifi, A., and A. Murayama, 2015, Viability of using global standards for neighbourhood sustainability assessment: insights from a comparative case study: Journal of Environmental Planning and Management, v. 58, p. 1-23.

Siddig, K., A. Aguiar, H. Grethe, P. Minor, and T. Walmsley, 2014, Impacts of removing fuel import subsidies in Nigeria on poverty: Energy Policy, v. 69, p. 165-178.

Spangenberg, J. H., S. Pfahl, and K. Deller, 2002, Towards indicators for institutional sustainability: lessons from an analysis of Agenda 21: Ecological Indicators, v. 2, p. 61-77.

Turcu, C., 2013, Re-thinking sustainability indicators: local perspectives of urban sustainability: Journal of Environmental Planning and Management, v. 56, p. 695-719.

U.S. Green Building Council, 2014, LEED version 4 for Neighbourhood Development.

UN-HABITAT, 2014, A practical Guide to Designing, Planning and Executing Citywide Slum Upgrading Programmes.

Uyigue, E., and E. Okuku Archibong, 2010, Scaling-up renewable energy technologies in Africa: Journal of Engineering and Technology Research, 130-138 p.

Valentin, A., and J. H. Spangenberg, 2000, A guide to community sustainability indicators: Environmental Impact Assessment Review, v. 20, p. 381-392.

Villanueva, D., and E. Horan, 2018, A Diversity of Eco-Developments: An Overview and Comparison of Sustainability in Six Eco-Developments, Sustainable Development Research in the Asia-Pacific Region: Education, Cities, Infrastructure and Buildings: Cham, Springer International Publishing, p. 237-252.

Wang, G.,YunXia, Wangb,Tao, Zhao, 2008. Analysis of interactions among the barriers to energy saving in China. Energy Policy 36,1879–1889.

Wangel, J., M. Wallhagen, T. Malmqvist, and G. Finnveden, 2016, Certification systems for sustainable neighbourhoods: What do they really certify?: Environmental Impact Assessment Review, v. 56, p. 200-213.

World Bank, 2009, Tapping a Hidden Resource: Energy Efficiency in the Middle East and North Africa. Sustainable Development Network, Middle East and North Africa Region, Energy Sector Management Assistance Program (ESMAP), Washington, D.C. 20433, USA.

World Bank, 2016, Doing Business. Measuring regulatory quality and efficiency: comparing business regulation for domestic firms in 189 economies, 13th edition.Washington DC: International Bank for Reconstruction and Development/World Bank.

World Commission on Environment and Development, 1987, Our Common Future, Oxford Press.

Xia, B., Q. Chen, M. Skitmore, J. Zuo, and M. Li, 2015, Comparison of sustainable community rating tools in Australia: Journal of Cleaner Production, v. 109, p. 84-91.

Zhou, N., D. Fridley, M. McNeil, N. Zheng, V. Letschert, J. Ke, and Y. Saheb, 2011, Analysis of potential energy saving and CO2 emission reduction of home appliances and commercial equipments in China: Energy Policy, v. 39, p. 4541-4550.

Chapter 4

The systematic selection of headline sustainable indicators for the development of future neighborhood sustainability assessment tools for Africa

"*After climbing a great hill, one only finds that there are many more hills to climb*."

~ Nelson Mandela

Published under Sustainable Cities and Society (Elsevier)

https://doi.org/10.1016/j.scs.2018.05.033

4.1 The pathway to the selection headline sustainability indicators

Chapters 2 and 3 have examined the DNA of currently existing Neighborhood Sustainability Assessment Tools (NSATs). During the examination, their shortcomings, generally and as applies to Africa, in particular Nigeria was discussed. With this in mind, this chapter leverages of the lessons learned and begins the process of developing a procedure to optimize the selection head sustainability indicator (HSI) during the early stages of NSAT development.

Currently, African cities suffer from a high degree of urban sprawl, in which unplanned settlements run rampant. This issue is aggravated by having to house one of the highest levels of urban dwellers in the world. Consequently, infrastructure is stretched to its limits, with basic amenities such as water, electricity, waste management and sanitation, being relative luxuries in these climes (UN-Habitat 2009). Historically, in more industrialized countries, urbanization and industrialization have gone hand in hand as such economies were perceived to not only grow but be more sustainable (Lehmann, 2015; UN-HABITAT, 2014). However, the African setting does not boast such trends as most countries within the sub-Saharan region are undergoing a rapid urban shift associated with negligible or low level of growth, societal upheavals and endemic corruption (i.e. urbanization without industrialization). For instance, Nigeria epitomizes such population increase and urbanization. Nigeria has a rapidly increasing urban sprawl, where cities and unplanned settlements have grown and engulfed rural lands, forming a chain of continuous settlements (Adewole, 2009; Ajibade and McBean, 2014; Elias and Omojola, 2015). Lagos alone boasts 20 local governing units, with an estimated population of about 20 million. Largely metropolitan, Lagos has a high population density. Moreover, Lagos is additionally challenged by security, governance and infrastructural issues such as transport, water, energy, disaster prevention, land use, waste management (Afon, 2007; Ajibade, McBean, and Bezner-Kerr, 2013; Elias and Omojola, 2015; Sanusi and Owoyele, 2016). Accordingly, Lagos typifies the sustainability

challenges that plague sub-Saharan Africa as a whole (Hove, 2013). How then can African cities, manage this increase in urban population, land use, infrastructure constraints, and social inequity while simultaneously introducing and maintaining sustainability principles?

The first step in most literature subscribes to the rules and regulations set in the 1992 Brundtland Report. This has led to the identification of the three dimensions of sustainability (DoS) namely: environment, economic and social dimensions. These three dimensions have been the driving force for numerous urban sustainability frameworks, geared towards tackling the social, environmental and economic issues plaguing the society. This led to the second step, which is the development of NSATs. These tools were noted to be quite effective in achieving the three-dimensional balance of sustainability (Komeily and Srinivasan, 2016; Reith and Orova, 2015; Sharifi, 2016; Xia, Chen, Skitmore, Zuo, and Li, 2015)). However, studies by various authors (Dawodu, Akinwolemiwa, and Cheshmehzangi, 2017; Komeily and Srinivasan, 2015; Pedro, Silva, and Pinheiro, 2017; Sharifi and Murayama, 2013; Spangenberg, Pfahl, and Deller, 2002; Valentin and Spangenberg, 2000) identified some shortcomings, thereby recommending a fourth dimension, i.e. the institutional dimension. Viewed from the sub-Saharan African perspective, Dawodu et al. (2017) argues that the failure to include institutional dimension would result in a failure to identify and deploy effective solutions to context-specific or regional issues faced by a particular locale.

The third step, involves the development/selection of HSI which is a major component of NSATs. Another important component of HSIs are sustainability indicators (SI). In the field of urban sustainability, SIs is essentially an identification and performance measurement of sustainability directives or initiatives with the aim to implement them, also, these directives are such that they cover the environmental, societal, institutional and economic characteristics of a given location (Berardi, 2015; Cappuyns, 2016; Clarke and Wilson, 1994; Hiremath et al., 2013; Kouloumpi, 2012; Singh et al., 2012; Spangenberg et al., 2002;

Valentin and Spangenberg, 2000; Whorton and Morgan, 1975). These SIs are also generally categorized or grouped into HSIs that agglomerate a collection of measurement parameters under itself (Cappuyns, 2016). Thus, SI is synonymous to assessment criteria's while HSI is synonymous to the overarching theme of the SI.

Additionally, Clarke and Wilson (1994) opined that it is nearly impossible for a single HSI to highlight the full extent of a problem – this phenomenon is observed in already developed NSATs. Additionally, it has been observed that universal HSI are a rarity within literature, which means that HSI conception generally originates from national and local origin making them inherently context specific (Ameen et al., 2015; Dahl, 2012). Moreover, the efficacy of NSATs and other urban sustainability tools are largely determined by the robustness and transparency of the methodology and conceptual framework utilized to develop them (Hák, Janoušková, and Moldan, 2016; Turcu, 2013). This implies that a framework of NSATs to be developed for any region in sub-Saharan Africa would be severely hindered by irrelevant and poorly defined SI and criteria, which may mislead decision makers. It is clear that there is still the need to investigate how HSI for NSATs can be developed and/or selected, particularly under the African context. By doing so, the African region would have a more holistic, methodological and rigorously thought-out process in the selection of HSI for its NSAT, which till now is yet to be developed. Therefore the main aims of this chapter are;

1) To develop a transparent methodology that can be used in enhancing the early selection process of common sets of HSI which a newly developed NSAT should possess, as a prerequisite for its development in African countries.

2) To investigate if obtaining universal HSI is realistic and to identify context-specific HSI and discuss its significance in an African context.

4.1.1 Significance of this study

The significance of this study is that; with clarity on the role of HSIs in the development of NSATs, it would be easy to develop NSATs that are bespoke for specific contexts. Furthermore, by utilizing a coherent and transparent methodology which involved the detailed analysis of existing NSATs, it would be easy to track discrepancies between the context-specificity of various NSATs, and understand how this can be adjusted to suit the African context. Of further importance is the issue of organic upgrade: which refers to the development of NSATs that can be easily adjusted or improved to meet the changing needs of the context to which it is developed for. This latter concept is pertinent for the African case, because whilst in other developed or advanced countries, NSATs can simply be adopted as manuals that can be incorporated within existing systems, in the African context, the NSAT developed would require a higher level of rigor, with clear-cut definitions and directives. This is because, it might not necessarily have structures to which it can be incorporated into, but instead would have to define and characterize its components and rigorously articulate its contexts, in order for it to be easily implemented (see chapter 3). In this vein, the objective of establishing the methodology presented in this work is to create a foundation for the development of implementable NSATs in developing countries, particularly in Africa. Section 4.3 provides an extensive review of the key challenges and requirements of HSI development in order to achieve urban sustainability. Thereafter the methodology and results will be introduced, and described. Additionally, a test of the developed conceptual framework which takes into account both universal and context specific SI, would be presented. The results are then analyzed and interpreted in the discussion section with key recommendations for future developmental studies of NSATs in Africa.

4.2 Literature review: motivation and challenges of sustainability indicator development

4.2.1 The Importance of the four dimensions of sustainability in achieving sustainable development

Several HSI already exists globally, making it reasonable to assume that more will still appear (Bandura, 2008; Hiremath et al., 2013; Jørgensen et al., 2010; Tasaki et al., 2010). The schools of thought concerning HSI support both number of indicators and the quality and sustainability value a specific SI represents (Hák et al., 2016; Hiremath et al., 2013). After the United Nations summit on Sustainable Development, where governments agreed on the importance and utilization of SI to achieve sustainability goals, the challenge was to define the measurement framework and strategies to select relevant indicators (Hák et al., 2016; Spangenberg et al., 2002). The aims were to structure indicators as policy goals and targets, and enhance their standardization (Moldan, 1997). Standardization in this context refers to the continuous use of indicators as a means to effect decision making. This led to the development of general and industry specific frameworks which had themes primarily revolving around environmental accountability, linked to various sectors such as, energy, transport, health (Joss, 2015; Xia et al., 2015). Similarly, while the aforementioned sustainable development goals inspired the development of NSATs (Haapio, 2012; Sharifi and Murayama, 2015; Singh et al., 2012), earlier developments of NSATs were influenced by an environmental perspective, which often neglected the institutional drivers that actuate or aid in the deployment of urban SI (Sharifi and Murayama, 2013, 2014). Recently, studies have recognised this concept and recommendations have been made to include more institutionally oriented dimensions in NSATs (Dawodu et al., 2017; Sharifi and Murayama, 2013; Valentin and Spangenberg, 2000). As previously stated, the institutional dimension is key in the development of African oriented HSI for NSATs (United Nations, 2014). This will allow proper and equal consideration of sustainability issues, especially when considering practical

implementation in African countries, some of which are known specifically for weak institutions (Spangenberg et al., 2002; UN-Habitat, 2009). Weak in the sense that policy, regulations and laws in some African countries, which are usually quite broad in their scope are in most cases non-responsive to the challenges they were formulated to tackle. Furthermore, the tendency for African nations to prioritise socio-economic agendas are usually met with impediments particularly during the implementation stage, and this is mostly due to the lack of adequate structures such as robust socio-political institutions. Thus, sustainability as a long term pursuit, is usually neglected by African nations which struggle with more 'pressing' or immediate concerns. This has been termed the 'green-versus-brown' agenda by the UN, with Green representing environmental pursuits, and brown being socio-economic pursuits (UN-habitat, 2009). Additionally, it can be averred that the method and context to which an assessment tool is developed and deployed respectively, is critical to the quantity and quality of HSI in the development of any given NSAT (Braulio-Gonzalo, Bovea, and Ruá, 2015; Turcu, 2013; Xia et al., 2015).

4.2.2 Identification of the fundamental principles in sustainability indicator development

The United Nations Statistical Division (2015) (UNSD) agrees that indicators should be structured into usable and coherent frameworks, so as to ensure the completeness of indicator sets and to foster linkages among several indicators, limiting arbitrary development and selection of indicators (UNSD, 2015). Additionally, studies by Hák et al. (2016) identify two key approaches in the categorization and development of indicators. The first is policy driven and the second is conceptually driven. The former is usually directed at strategic issues that are governed by a nation's policy document, legislative direction and sustainable development strategies. Conceptual development is independent of political priorities and is based on sustainable development principles (Hák et al., 2016). These two approaches has several implications in the African context wherein the dissatisfaction in the government and a lack

of citizen involvement in the formulation and deployment of government policies regarding the prevailing socio-economic challenges has also permeated into broader urban issues (UN-Habitat, 2009; United Nations, 2014). Therefore, by basing a philosophy or framework on this principle leaves SI susceptible to public disapproval and a potential dissonance between what the people want and what is being prioritised by the government (UN-Habitat, 2009; United Nations, 2014). For example, for waste management in Lagos Nigeria, studies has shown that the sustainable practice of recycling waste is largely handled by informal waste pickers, who are not recognised legally or by environmental agencies of Lagos (Afon, 2007; Oguntoyinbo, 2012). Additionally, the activities are deemed illegal and unhygienic due to lack of supervision and regulation. This process has led to further corruption, as informal waste pickers do not have registered locations for waste disposals, this has thus resulted in the exploitation of these waste pickers by some unscrupulous officials whom receive bribes in exchange for waste disposal in registered dumpsites (Adewole, 2009; Afon, 2007; Oguntoyinbo, 2012). This problem points again to the weak institutional dynamics, and also shows that the sustainable systems which promote recycling and re-use of material in Lagos are being financially exploited at the expense of the health and safety of the people and the degradation of the environment (Abila, 2014; Adewole, 2009; Oguntoyinbo, 2012). Consequently, the lack of an institutional dimension to facilitate recycling and reuse of materials, creates unwarranted detriments to the social and environmental dimension. Conversely, although countries such as the UK, Germany, and France face similar issues wherein the available institutions fall short in enforcing the rules and regulations, still the reality of the sub-Saharan Africa perspective is more adverse. In fact, in advanced countries, the institutional dimension is known to be embedded in the system, thus making its role in addressing sustainability related issues seamless (UN-Habitat, 2009, 2015). Thus, a more theoretical approach which focuses on sustainability strategies in particular explicit recognition of the institutional dimension is a viable approach when in the development of NSATs operable in African nations. However, the processes to be undertaken to achieve these aims, provides a new set of challenges.

4.2.3 The Existence of global sustainability indicators

Another challenge is the characteristics of HSI, in terms of global or regional utilization. There are myriad of methods that can be utilized to attain sustainability. The large collection of literature on this subject, does not suggest a single method to through which sustainability can be achieved within each sector (Bell and Morse, 2003; Berardi, 2013). While there lacks a universal definition of sustainability (Bond, Morrison- Saunders, and Pope, 2012; Pope, Annandale, and Morrison-Saunders, 2004), Zeijl-Rozema and Martens (2010, p. 8) offers a relatively apt description, by opining that: 'sustainability is not a single well defined concept but rather various positions and perspectives exist, whichever definition is pursued entails a normative choice'. Another constraint is the fact that though many HSI exist, none has been observed to have universal appeal (Singh et al., 2012; Turcu, 2013). Some HSI are specifically designed for particular cities and communities while others may be universally applied over specific areas (AtKisson, 1996; Dahl, 2012; Hak, Kovanda, and Weinzettel, 2012; Pope et al., 2004; Tasser, Sternbach, and Tappeiner, 2008). Similarly, in analysing NSATs, Ameen et al. (2015) highlighted that HSI can be context-specific due to its local origin or focus but may also share common goals which are more global in nature. A common thread in the literatures generally reveals a situation in which no unique set of indicators can be used to suit the requirements of all communities or countries (Ameen et al., 2015; Hák et al., 2016; Singh et al., 2012). However, there are global SIs or HSIs, which are seen to have international significance and legitimize repetition of HSI in various sustainability frameworks, mainly by being relevant in similar ways across a broad collection of contexts. These include HSI such as energy, climate change, greenhouse gas emission and employment, which all have national and international common interests (Ameen et al., 2015). Shen et al. (2011) elaborates further, positing that this concept of global indicators is essential to urban sustainability and ensures that formulations to attain urban sustainability does not remain an abstract conceptualisation. It does so by ensuring the promotion and the sharing of common goals between communities or cities, and by guaranteeing the replication of successful concepts

and measures utilized by sustainability frameworks. Ameen et al. (2015) and Dahl (2012) mention that most of the developed indicators are established nationally, moreover, some recent ones have been based on community level analysis. The study proposes that more needs to be done on a globally accepted NSAT. Furthermore, only a few indicators have been developed or assessed on a universal scale with most of them relating to environmental and carbon emissions (Dahl, 2012).

4.2.4 Systematic selection and clarity in sustainability indicator selection

There are numerous assessment and indicator tools for urban sustainability. Hundreds of various HSI have been suggested and recommended for different users and purposes. According to Hák et al. (2016), though the actualization and development of HSI in itself is a positive step towards sustainability, weaknesses still exist within the development of the whole process. Many professionals employ a rather ad-hoc checklist for the development of HSI and SI without any clear methodological approach (Barton, Grant, and Guise, 2003; Bell and Morse, 2003). The major issue identified is the inefficiently developed conceptual framework (Hák et al., 2016; Maclaren, 1996). Furthermore, such approaches which do not possess clear-cut methodologies would lead to complacencies on conditions developed, unnecessary use of data and the implementation of ill-conceived indicators that turn out to be ineffective. It is postulated that instead of having an increased number of HSI to address a multitude of issues, it would be more productive to focus on a theoretical and transparent methodological approach to enhance quality, quantity and operations of the HSI (Tanguay et al., 2009). Controlling the number and quality of HSI becomes a key aspect a conceptual framework should possess. An example of such control is an urban indicator study in Spain, which utilized 13 urban sustainability tools in the development of 73 HSI from an initial 786 HSI. Out of the 13 urban assessment tools analysed, five were locally developed tools from various regions and provinces in Spain. This was combined with other international tools such as BREEAM communities, LEED-ND and CASBEE-UD. The procedure utilized studies from the

HSI categorization techniques by Sharifi and Murayama (2013), the sustainability principles that govern categorization proposed by Luederitz et al. (2013) and the context specific quantitative SI given by Bourdic, et al. (2012). The HSI were reduced to 73 and this reduction was based on the fact that these selected HSI had a track record of being tested and implemented. Fundamentally, the reduction process was based on the history and certainty of implementation of notable HSI in the past (Braulio-Gonzalo et al., 2015). The pitfalls of this approach can be linked to the side-lining of recently developed HSI, which may have been developed to address recent concerns in certain regions. Another impact is that all DoS and inter-relationships may not be covered within this methodology. Tanguay et al. (2009) addresses this in their methodical approach to HSI selection. The model devised by Tanguay et al. (2009) used the Survey-Based Selection Strategy for HSI (SubSelec) method, where HSI were grouped according to three DoS. Thereafter, inter-linkages between the three components were developed: viable, equitable, liveable and sustainable. All these directly referred to the Brundtland report (World Commission on Environment and Development, 1987). The strategy then consists of "A selection of HSI based on a review of studies intended to minimize the number of HSI selected from among those compiled, subject to the following constraints: 1) choose the most cited indicators; 2) cover the components of sustainable development and the pertinent predetermined categories and 3) choose the simplest HSI to facilitate data collection, understanding and dissemination" (Tanguay et al., 2009, p. 19). However, Tanguay et al. (2009) in their model also disregarded HSI related to institutions. This dimension not only plays an important role in modern HSI implementation, but in terms of context it is more relevant to African societies which have setbacks in terms of the implementation of regulations and directives, which at its fundamental can be made possible by a critical consideration of the institution as a dimension. To summarise, there is the need for a conceptual framework that methodologically determines the relevant HSI in an urban settlement. The section also highlights the need to investigate possibilities of global HSI, where similar parameters may be used as a yard-stick to measure and compare the success

of indicator initiatives of different sub-Saharan nations. Thereafter, within the context of NSAT, the next section will develop a methodological framework based on the conceptual ideas of the four DoS. In doing so, two key elements will be investigated: 1) procedures which will result in the enhancement and effectiveness of the selected indicators whilst limiting the creation of unnecessary and sporadic indicators; and 2) a development process aimed at identifying a method of establishing global SI coupled with an investigation of role context plays within this discovery.

4.3 Research methods

This chapter develops a methodology or strategy that can be used for the early selection of urban or neighborhood HSI by addressing the optimum number and common set of HSI a newly developed HSI should cover, whilst also investigating the certitude of the existence of global HSI. The study also aims to identify and investigate context-specific indicators within NSATs and its implication in the African context. This process is in pursuit of the development of NSATs for African communities and cities, nine NSATs are analyzed with specific focus on the dynamics of HSI. Thus, a new approach was developed to achieve this aim, one built on the SuBSelec method developed by Tanguay et al. (2009) and modified with the use of the Sustainable Pathway Model (SPM) developed in chapter 2. These series of procedures are all explained in the subsequent sections.

4.3.1 Qualitative and Quantitative Content Analysis

1) **NSATs for Selection and Justifications**: Currently there are a total of 20 NSATs recognized globally (Berardi, 2015; Charoenkit and Kumar, 2014; Komeily and Srinivasan, 2015; Sharifi and Murayama, 2014), of which nine were used for this study. The analyzed NSATs originate from all continents except Africa (see Table 4.1). Due to the unavailability of the manuals or the confidentiality of the NSATs, only these NSATs were evaluated (Berardi, 2015). Therefore, these NSATs serve as case studies illustrating the procedure that can be used to obtain optimum number of HSI that

cover all DoS and also determine the validity of global indicators. Optimization in this study refers to the enhancement or improvement of the selection process to consider all relevant DoS, thereby strengthening the reason behind the selection of the related HSI. Essentially, the result of this study is in the critical analysis of the process in which urban HSI are obtained and not in the HSI themselves. The main characteristics of the nine studied NSATs are provided in Table 4.1.

Table 4.1: NSATs and basic properties

NSATs	Version year	Country	Number of Headline Sustainability Indicators (including prerequisite indicators)	developers				
				Gov	**Non-gov**	**Industry**	**Academia**	**Citizens**
BREEAM Communities	2012	UK	42		x			
LEED Neighbourhood	2012	US	55		x			
Green mark for Districts		Singapore	38	x				
Green Building Index (GBI)	2011	Malaysia	45		x			
Global Sustainability Assessment System (GSAS): District	2013	Qatar	38	x				
The Pearl Community	2010	UAE	64	x				
Green Star	2015	Australia	37		x			

Green Township	2010	India	36		x	x		
CASBEE Urban Development	2007	Japan	39	x		x	x	

2) **Motivation and selection of sustainability ideology**: A sustainability outlook or ideology needs to be chosen, to best represent the method of categorizing the HSI of various NSATs. The concept chosen is the modified version of the three DoS, which is based on the four DoS and includes the dimensions of environment, economy, society and institution (Spangenberg et al., 2002; Valentin and Spangenberg, 2000). The three pillars are generally behind most urban sustainability initiatives, however, recent arguments cite the addition of a fourth dimension in the development of NSATs. This is premised on the chosen outlook. Firstly, in an African context, institution and rule of law is a serious concern and severely lacking in various urban departments. UN-HABITAT (2009) identified a lack of organizations, standards and codes to aid in the development of sustainability principles in the built environment, this is compounded by an unwillingness to enforce those that do exist due to misplaced priorities and the lack of requisite tools available to professionals in leadership roles. Accordingly, the institutional dimension from the standpoint of the realities in Africa, needs to be placed in the forefront to better consolidate the concept of sustainability and to make HSI under this comprehensive outlook to be readily more implementable in Africa. Secondly, the WCED report was unable to address the driving forces that are necessary to tackle environmental and developmental problems This raised, for the first time, the need to include the institutional dimension to aid in operationalizing sustainable developmental activities and indicators created under the three-pillar approach (Spangenberg et al., 2002). Thus, the importance of the institution was officially introduced a decade later in Johannesburg at the World Summit for Sustainable

Development, where the focus was the review of the implementation of Agenda 21 (Spangenberg et al., 2002). Valentin and Spangenberg (2000) then argue in their study of the development of SI that the institution transcends the interactions of government and NGOs but involve a set of norms and laws and regulations that govern this interaction. Based on this, Valentin and Spangenberg (2000) held that the institution dimension complements and support linkages and implementation of other DoS. An additional reason to consider the fourth dimension is based on the discovery by Sharifi and Murayama (2013, 2014). They studied seven NSATs and revealed a largely one-dimensional environmental focus of HSI used in the NSATs. These NSATs focused less on the economy and social dimension of associated HSI and even further neglected the role of institution. Thus, urban HSI such as decentralization, building codes, education, disaster prevention policy and other related sustainability principles were overlooked. Due to this, Reith and Orova (2015) attempted the use of the DoS to explain the characteristics of urban HSI. Using the strategy put forth by Tanguay et al. (2009), they placed Urban HSI into the various dimensions and linkages such as environmental and social linkage termed livable, environmental and economic (viable), social and economic (equitable) and all three were called sustainable. Again, the institutional dimension was omitted, thus limiting the linkages within dimensions, and not providing a complete picture of the interaction of Urban HSI between these dimensions. Therefore, by neglecting the institutional dimension, the opportunity to thoroughly investigate the pitfalls and advantages of NSATs is lost, and in the case of our current study, if such an approach were adopted, the opportunity to investigate the properties and enhance the selection of Urban HSI to include all continents particularly Africa would also be lost. Thus, the four-pillar approach was selected based on the importance of the institution as a dimension and the relevance of identifying linkages.

3) **Merger of similar HSI**: A content analysis of the nine NSATs was conducted, where HSI with similar characteristics, information and aims were merged together. For example, the HSI of Quality in Construction, Responsible Sourcing of Materials, Sustainable Products for Infrastructure and Public Amenities was represented by the title of Responsible Sourcing of Materials. Hence, the HSI titled 'Responsible Sourcing of Material' will be recorded three times. This is done for all 351 HSI represented in all nine NSATs, thereby reducing the urban HSI to 120 (see Table 4.3 and Fig. 4.5). In principle, repetitive HSI that cover the same functions and intentions are grouped together under one title. Themes or categories are also formed to better consolidate the HSI, a total of 13 categories or overarching themes were developed based on the classification of these HSI (see Table 4.4). Additionally, the number of HSI with similar characteristics and information within the specific theme was recorded in order to determine the frequency of occurrence of the HSI in the nine NSATs studied. This exercise allowed HSI to be separated into 9 levels of reoccurrences, where HSI was observed to repeat themselves anywhere from two to nine times. This led to the categorization of 351 HSI from 9 NSATs, into 120 HSI at various frequencies. Based on Fig. 4.5, the frequency of the number of indicators occurrences were assessed, with about 50% being identified as HSI occurring once or twice out of the nine NSATs analyzed. As such, 1 or 2 occurrences for any HSI was considered contextual due to its higher likelihood of being location specific as a result of the low levels of repetition. Henceforth, these types of occurrences shall be termed "contextual occurrences". Also very few HSI occurred more than 7, 8 or 9 times. These levels of occurrences were also grouped together as the 'most widely used HSI'. It should be noted that a total of 394 HSI exist but mandatory indicators were neglected because most had similar HSI under the selective or non-mandatory list.

4) **Allocate sustainability dimension to HSI**: The next step involved a second concept developed by Dawodu et al. (2017), i.e. the Sustainable Pathway Model. This technique modifies the concept of Valentin and Spangenberg (2000). The theory behind this concept is the emphasis on interrelationships within the four DoS. The fundamental idea was that the effectiveness and characteristic of the object (e.g. HSI) within each dimension is determined by the number of interrelationships between dimensions; higher interrelationship would seemingly yield a stronger HSI or an HSI with greater dimension coverage when implemented in a community (Dawodu et al., 2017; Valentin and Spangenberg, 2000). However, the higher the combination the harder the implementation of such HSI. Each HSI was identified with a specific dimension or combination of dimensions (see Appendix 2A-1). The methodology to execute this was through the review of all HSI and the associated guidelines, aims, intent and assessment criteria. Note that these aims, intent and assessment criteria can be either qualitative, quantitative or both. The strategies used to identify the dimensions of each HSI followed two instructions termed primary and secondary directives;

a. The primary derivatives: the identification of explicitly stated or obvious dimension(s) of sustainability that is directly shown within the text of the HSI. It should be noted that primary derivatives could include 2 or 3 interrelationships i.e. E-S-EC or E-I or E-S;

b. The secondary derivatives: this is a sustainability metric extraneous to the development of the SI, only indirectly linked to the motivation of the HSI under analysis. The regional materials and transport assessment can be examined to describe these notions. (See chapter 2 for full explanation of method)

Figs. 4.1–4.3 represent regional materials for GBI and GSAS, and transport assessment for BREEAM Communities respectively. Fig. 4.1 can be interpreted as Enviro-Economic (E-EC), due to the clear environmental statement of intent i.e. "reduce the impact of carbon emissions". Secondly, the assessment criteria "support(s) the use of indigenous material", which indicates that the local economy is increasing the business of lumbering within the region. Hence, the application of the primary and secondary derivative is used here. For the GSAS in Fig. 4.2, this can be interpreted by viewing intent again where environmental and economic intentions are made clear. Also under the credit requirement section in Fig 4.2, GSAS highlights the importance of cost to achieve the credit for regional materials. Looking further at Fig. 4.2, the application of only the primary directive used as the dimensions are explicitly mentioned with no underlying hints to additional dimensional coverage. Finally, Fig. 4.3 investigates another HSI called transport assessment under BREEAM communities; the aims of this HSI make it clear that there is an environmental and socially focused HSI. However, when the assessment criteria is reviewed under one credit criteria, the secondary derivative is utilized due to an emphasis on reducing the length of trips and need to travel by car, while also ensuring access to jobs and other facilities. Subsequently, the economic dimension can be inferred. This would thereby make this an enviro-socio-economic dimension (E-S-EC). In sum, these examples illustrate how each of the 351 HSI were reviewed and placed into various dimensions according to their interpretation. The sustainability outlook thus consists of 14 dimensions with 10 interrelationships which operate under the notion that the true efficacy of SI lies in its interrelationships with other dimensions. The process of identifying these interrelationships is done through the qualitative review of each NSAT manual, identifying the primary and secondary derivatives of the DoS when analysing the compliance directive of each indicator. It should be noted that the dimensions which have no 'E', 'S', 'I', 'EC' relationship are known as point aspects, those with 2 interrelationships such as 'S-I, E-S' are known as linear aspects, and those with 3 inter-relationships 'E-EC-I, E-S-

EC' are defined as planar aspects (see Appendix 2A-1). Also, Fig. 4.4 provides a clear picture of this concept

REGIONAL MATERIAL		1 POINT	
INTENT	Reduce the impact of carbon emissions from transportation of regional material		
ASSESSMENT CRITERIA		POINT	SCORE
Use building/construction materials that are extracted and manufactured within the region, thereby supporting the use of indigenous resources and reducing the environmental impacts resulting from transportation: 1. Use building/construction materials that have been extracted, harvested or recovered, as well as manufactured, within 500km of the project site for ≥ 70% (based on cost) of the total material value. Mechanical, electrical and plumbing components shall not be included. Only include materials permanently installed in the project.			

Fig. 4.1: Headline sustainability indicator extracted from GBI titled Regional Materials (Source: Green Building Index 2011)

REGIONAL MATERIAL		
INTENT	To encourage the selection of materials that reduces transport impacts and promotes regional economies.	
CREDIT REQUIREMENTS	Demonstrate that the transport distance travelled by materials, representing a proportion of the material cost, is not greater than 500 km from the furthest point of origin to the project site. • 1 Credit Point: Cost of regional materials equivalent to 10% of Total Material Cost. • 2 Credit Points: Cost of regional materials equivalent to 20% of Total Material Cost. Any materials sent by airfreight at any point during their transport do not qualify for this credit. This credit only applies to materials used in the construction of infrastructure and public realm (including urban furniture).	
AWARDING CREDIT POINTS	CREDIT POINTS	REQUIREMENTS
	2 (maximum)	Design Rating
	1	Cost of regional materials specified equal to 10% of Total Material Cost
	2	Cost of regional materials specified equal to 20% of Total Material Cost
	2 (maximum)	Construction Rating
	1	Cost of regional materials installed equal to 10% of Total Material Cost
	2	Cost of regional materials installed equal to 20% of Total Material Cost

Fig. 4.2: Headline sustainability indicator extracted from GSAS titled Regional Materials

(Source: Abu Dhabi Urban Planning Council 2010)

Transport assessment – Mandatory Standards (Yes - criteria 1 to 3)	Credits - 2
Aim	
To ensure transport and movement strategies reduce the impact of the development upon the existing transport infrastructure and improve environmental and social sustainability through transport.	
Assessment Criteria	
Mandatory requirements 1. A transport assessment or transport statement is developed following scoping discussions with the local authority and the highway authority (and other bodies where relevant). 2. A travel plan(s) is developed by a travel plan coordinator for the site outlining the design methods used to encourage and implement sustainable transport and movement. One credit 4. Criteria 1 to 2 are achieved. 5.The transport assessment/statement and travel plans positively influence the environmental sustainability of the development and wellbeing of future residents. This is achieved through recommendations or plans to: a. reduce the need for travel (especially by car) b. reduce the length of trips c. promote multi-purpose or linked trips d. promote a more sustainable pattern of development e. reduce the physical separation of key land uses f. reduce distances from buildings to public transport nodes g. improve sustainable transport choices through actions such as increased or improved walking/cycling and public transport infrastructure and facilities h. ensure safe and easy access to jobs, shopping, leisure facilities and services by walking, cycling and public transport. i. consider transport capacity to ensure there is sufficient provision Two credits 6. Criteria 1 to 4 are achieved. 7. The transport assessment/statement confirms that there is spare capacity to meet the demands of the proposed development. OR 8. Where development is phased, public transport services will be subsidised to ensure residents occupying the early phases of development can use these services from the outset	

Fig. 4.3: Headline sustainability indicator extracted from BREEAM Communities titled Transport Assessment (Source: Bre global 2012)

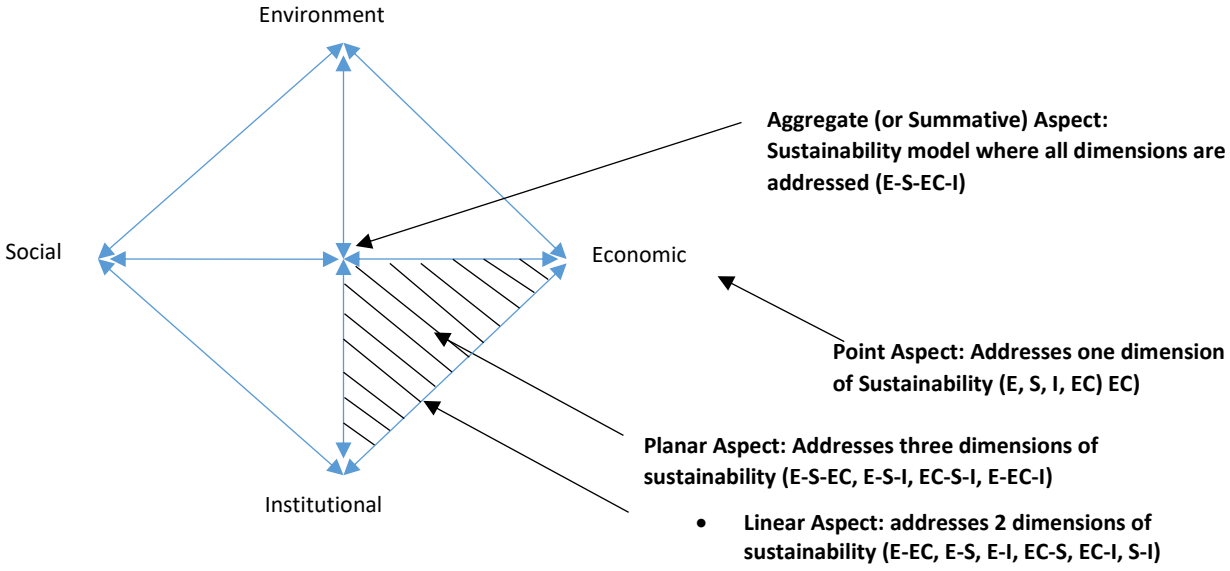


Fig. 4.4: Concept of the sustainability pathway model

- **Identify the frequency of occurrence and dimensions of all merged HSI**:

  This involves categorizing the reoccurring HSI of the nine NSAT under review thereby determining the number of reoccurrences of similar HSI. This was explained in step three of the methodology and process of tabulation is shown in Table 4.2 and 4.4. Additionally, by using step four of the methodology, dimensions of each HSI are assigned (Table 4.2). For example, Table 4.2 is extracted from Table 4.4 to further elucidate the process. The HSI of Disaster Prevention of Various Infrastructure (analyzed to be E-S), Adapting to climate change (analyzed to be E) and Adaptation and Resilience (analyzed to be E-S) was merged into "Disaster Resilience and Climate Adaptation" under the theme "Disaster Prevention" and occurred three times under the NSATs of CASBEE UD, BREEAM Communities and Green Star Communities. This method is used to record the information of all HSI. Fig. 4.5 summarizes the results, with the horizontal axis describing the number of times an HSI occurs and vertical axis representing the number of HSI (See Section 4.4.1 for further explanation).

Table 4.2: Dimensional analysis and number of occurrences of disaster resilience and climate adaptation

	occurrences	E	EC	S	I	E-EC	E-S	E-I	EC-S	EC-I	S-I	E-EC-S	E-S-I	E-EC-I	EC-S-I
Disaster Prevention															
Disaster Resilience and Climate Adaptation	3	1					2								

- **Classification of HSI into point, linear and planar aspect of sustainability**:

  The next step now involves placing each HSI into aspects; this is a critical step in the selection of the number of indicators, and it was done through the use of the point, linear and planar aspects shown in Fig. 4.4. Point aspects considers all HSI with no relationships (E, S, EC, I), thus only visualising one dimension of sustainability. Linear aspect considers HSI that can be indexed to show interrelationship between two DoS; e.g. Fig. 4.1 and 4.2. There are also six combinations that can be obtained from this identification (E-EC, E-S, E-I, EC-S, EC-I, S-I). Planar aspect inter-relates any three dimensions to one another, and unlike the linear aspect, it shows that a given indicator viewed from one perspective can show a marked interrelationship between two others. Four combinations of the planar aspect exist (E-S-EC, E-S-I, EC-S-I, E-EC-I) and example is shown in Fig. 4.3. The purpose and use of these classifications will be explained in step six and Section 4.2.

5) **Selecting a common set and optimizing number of HSIs:** the next step is to select an optimum number of urban HSI which not only covers the four DoS and interrelationships but also encompasses all the themes presented. This is done by

taking the maximum number of occurrences (nine occurrences) and counting backwards to locate the point where all the 14 dimensions and themes are covered. This means that all 14 dimensional combinations need to be covered by at least one HSI. Also, all themes created within the nine NSATs needs to be covered to also address a complete scope of urban sustainability issues within the purview of the selected NSATs (Tanguay et al., 2009). The themes include Water Management; Waste Water; Sustainable Material Use and Solid Waste Management; Sustainable Transport; Sustainable Site and Urban Form; Sustainable Sustenance; Inclusive Design and Public Consideration; Sustainable Energy (Design, Technology, Building and Infrastructure); Sustainable Urban Ecology; Disaster Prevention; Economic Prosperity; and Innovation (see Section 4.2 for details). It should be noted that economic (EC) and institutional (I) are missing from the analysis in Table 4.3. Similarly observed in the analysis of Dawodu et al. (2017), when four NSATs tools were investigated, no point based economic dimension was observed in the analysis due to the dependency of this dimension on other dimensions. Hence, it was more common to identify socio-economic or enviro-economic dimensions. In the same vein, for the institutional dimension, Institution was not functional alone but is actuated when in operation with a specific dimensional agenda such as Enviro-Institutional or Socio-Institutional. For this reason, these two point based dimensions are neglected during analysis. This is the reason why the selection stops at the fourth occurrence, because all HSI within 14 dimensions have been satisfied excluding these two (EC and I). Essentially, this mean that only 12 dimensions need to be satisfied in the selection process (see section 4.2 detailed 4.2).

6) In some cases, it is possible that a theme or category is not covered during the selection process. Hence, an additional step would be required to amend such a

situation. Table 4.5 shows a chart which could be used in the optimization process of step five, through the classification of point, linear and planar aspects undertaken in step four. Table 4.5 illustrates the results utilized in Section 4.4.2. The calculation needed for the optimization step is shown below: The optimization step requires a percentage calculation of point, linear and planar coverage: The dimensions are grouped into three various aspects and categorized according to the occurrences. For aspect coverage, the calculation is as follows:

$$\textbf{Percentage value of point, linear or planar aspect of X number of occurrences}$$

$$= \frac{\text{summation of point, linear or planar aspect of a range of occurrences}}{\text{Total number of HSI for the given range of occurrences}}$$

$$\text{For example, , for point aspects of fourth to ninth occurrence } = \frac{\Sigma 4\text{th} - 9\text{th (E + S + EC + I)}}{220}$$

The total number of HSI from fourth occurrence to ninth occurrence = 220 HSI, it can also be seen in table 4.3 that:

$$= [(9\text{x}3) + (8\text{x}3) + (7\text{x}1) + (6\text{x}8) + (5\text{x}10) + (4\text{x}16)] = 220$$

Also,

$$\Sigma 4th - 9th\ (E + S + EC + I) = (11 + 9 + 6 + 14 + 29 + 15) + (3 + 9 + 3 + 3) + (0) + (0) = 106$$

$$Percentage\ value\ of\ point\ aspect\ from\ fourth\ to\ ninth\ occurrence = 102/220 = 46\%$$

This procedure is repeated for linear and planar and for various ranges of occurrences. This procedure will be used to optimize selection process in the case where all themes are not covered at the end of step 5. Table 4.5 then illustrates when HSI are grouped and their percentage distribution in each category of point, linear and planar. These are fully detailed in section 4.2

7) **Universal HSI:** the process of following steps 1–4 will indirectly separate HSI that occur most frequently (7, 8 and 9 occurrence) and those that occur rarely (1 or 2 occurrence). They would also be represented by their dimensional focus of each HSI. Section 4.3 details the results.

4.4 Results

The above steps provide the methodological selection process in optimizing the number selection for HSI and obtaining a common set of HSI, as well as separation parameters for universal and context specific HSI. Sections 4.4.1 and 4.4.2 provides further insight into how this is done. This is followed by discussion in Section 4.5 which appraises the reasoning behind the methodology, importance of its practical implementation, constraints and parameters that need to be observed.

4.4.1 Optimized selection of sustainability indicators

Fig. 4.5 graphically illustrates how the HSI were merged together from 351 in order to obtain 120 HSIs. This was carried out by combining reoccurring HSI under one heading or title. It also illustrates the most widely reoccurring HSI (see section 4.3 for details) and the lowest reoccurring HSI, identified as contextual. Fig. 4.5 serves as reference for both methodology and discussion section to highlight important processes in the selection of HSIs.

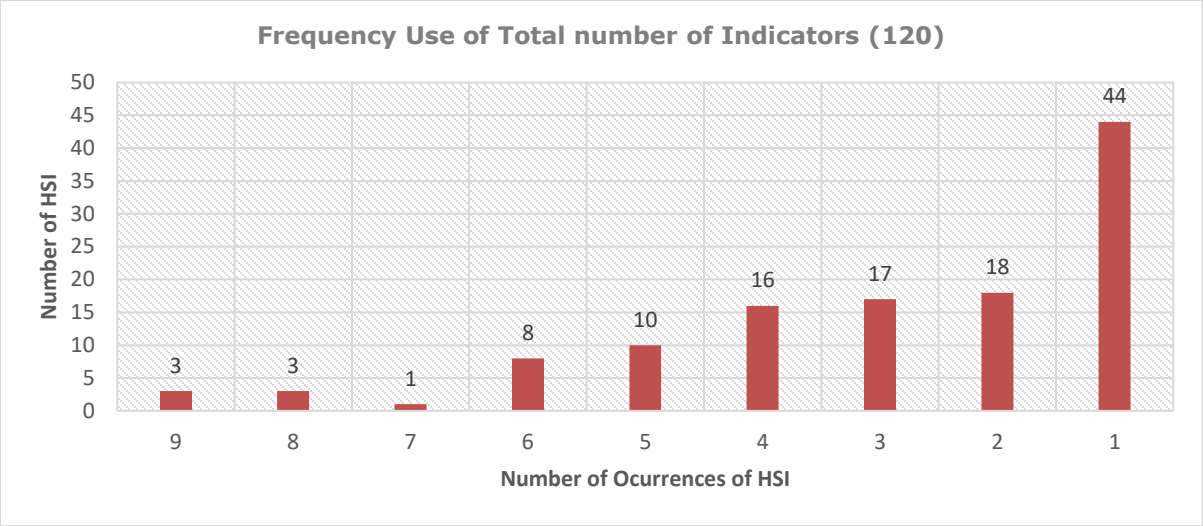


Fig. 4.5: Frequency use of total number of indicators

4.4.2 Selection of common set HSI and number optimization

One of the major aims of this study is to achieve an optimum and implementable number of common HSI from the list of 120 indicators. The final step was to improve sustainability coverage of as many relevant urban issues as possible. This was done by identifying which associated number of occurrences cover the most dimensions out of the 14 DoS by adopting the SPM (see Tables 3 and 4). Though 120 urban HSI could be rigorously selected, this was considered too simplistic and inefficient, creating redundant or non-applicable indicators (Bell and Morse, 2003). In essence, each number of occurrences are reviewed from the highest number (nine) to the number of occurrences where all DoS are covered, which is the fourth occurrence, this is identified by the asterix four (4*) (see Table 4.3). When the first rule is followed the selection of HSI occurs from the ninth occurrence to fourth occurrence. This range identifies a total of 41 HSI (see Table 4.3, number of HSI=3+3+1+8+10+16). It should be noted that EC, I and EC-I from all occurrences are missing, hence are not required in the analysis.

A second criterion for selection is that all themes must be covered, which mirrors the directive in the models by Tanguay et al. (2009). By viewing the occurrence column in Table

4.4, closer observation highlights the absence of one of the themes in the list of thirteen themes. By viewing the occurrence column in Table 4.4, closer observation highlights the absence of one of the themes in the list of thirteen themes – "disaster prevention". The theme of disaster prevention has two HSI (disaster resilience and flood avoidance) that occur three times (see Table 4.4) but it should be remembered that the selection stopped at the fourth occurrences. Thus, 41 HSIs are selected between the ninth and fourth occurrences with both HSIs missing from the disaster theme. This goes against the conditions that all themes within the selected analysis must be represented with at least one HSI.

A generally accepted means to address this situation was to consider the next number of occurrences. To do so, the asterisk symbol identifies the HSI on the next number of occurrences (this is the 3rd occurrence). Tables 4.3 and 4.4 identifies an additional 17 HSI if the third occurrence is considered and these are marked by two and three asterisk. Two asterisks in Table 4.3 identify the number of present HSI in the third occurrence and three asterisks in Table 4.4 identify the names of actual HSI in the third occurrence. The consideration of the third occurrence accounts for the two missing HSI but also added 15 HSIs to the already established 41 HSIs (see *** in Table 4.4). It should be noted that this project is about optimization of the strategy for the selection process. Therefore, considering that a category was neglected from the list, given that all that is needed is two HSI, and the dimensional coverage has already been addressed by the fourth occurrence, the question of how optimal it is to add 17 indicators then arises. Also, it remains to be seen that within the disaster theme there are only two indicators that occur three times. Tanguay et al. (2009) considered if it was optimal to add a greater number of indicators to improve sustainability coverage or if minimizing the number of indicators could still provide similar level of sustainability efficacy. Tanguay et al. (2009) opted for minimization, arguing that the reason for minimization is due to redundancy factors and loss in public dissemination of information and results. Although, Tanguay et al. (2009) admitted it was impossible to answer the

question objectively, if maximization of indicators is better suited to improve sustainability coverage as opposed to minimization. Nonetheless, Tanguay et al. (2009) combined the most prevalent indicators that occur to represent the missing category or theme. Therefore, this study identifies one missing theme and looks for a more transparent and coherent means to select HSI under these circumstances.

Thus, in the process of selecting between the third and fourth occurrence based on the principles of SPM and using step 6 explained in the methodology section, two elements of the analysis indicate that it is preferable to use fewer HSI:

1) The fourth occurrence satisfied all sustainability dimensional coverage as previously recommended (see Table 4.3).

2) The fourth occurrence has a higher level of interrelationship on a planar level and lower percentage of point aspect (shown in Table 4.5). It is important to note that the efficacy of HSI and generally any sustainability concept is the ability to cover as many dimensions that are available while fulfilling the parameters of that HSI.

Therefore, to complete the missing theme, it was irrelevant to take all 17 HSI in the third occurrence. Rather, the base selection would remain at the 9th to 4th occurrence but HSI from third occurrence needed to be selected to complete the missing theme. All 17 HSI were reviewed and those which had higher interrelationships were selected whilst those with no relationships or point aspects were neglected. For example, Green infrastructure which possesses one environmental (E) dimension but two environmental-social (E-S) dimensions was chosen but local parking possessed two environmental dimension (E) and one socio-economic (S-EC) was neglected (see Table 4.4). The results from utilizing this selection process is presented in Table 4.4, in which an additional six HSIs (Water Body Preservation, Regional Materials, Green Infrastructure, Ecological Preservation, Disaster Resilience and Climate Adaptation Flood Avoidance) were added, this took the total to 47 and also covers

the missing disaster and prevention category (Table 4.4: six additional HSI highlighted in bold fonts). Also, when point, linear and planar based calculation were executed with the addition of 6 HSIs making 47, the results were much closer to that of 120 HSIs as well as higher relationships (see Table 4.5).

Table 4.3: Table of number of HSI and frequency of occurrence of nine NSATs

Number of Occurrence			9	8	7	6	5	4*	3**	2	1
Number of HSI			3	3	1	8	10	16	17	18	44
Dimensions of Sustainability	Points	E	11	9	6	14	29	15	20	15	8
		EC									4
		S		3		9	3	3	11	2	3
		I									
	Linear	E-EC		2	1		1	5	4	1	1
		E-S	12	6		9	8	14	12	9	7
		E-I		2		1	4	3	1	0	2
		EC-S	2	1		2	5	4	2	1	5
		EC-I									
		S-I						1	1	1	4
	Planar	E-EC-S	2	1		9		16		3	3
		E-S-I				2	0	2		3	3
		E-EC-I				1					1
		EC-S-I						1		2	3

Table 4.4: Table of common indicators and interrelationships of 3rd to 9th occurrence

	Occurrences	Dimensional Placement													
		E	EC	S	I	E-EC	E-S	E-I	EC-S	EC-I	S-I	E-EC-S	E-S-I	E-EC-I	EC-S-I
Water Management Including Waste Water															
Rainwater Management	5	2					2	1							
Outdoor Water Use Reduction	5	5													
***Water Body Preservation**	3	1					2								
***Indoor Water Use	3	2					1								
Wastewater management	5	3					2								
Sustainable Storm water Design and Management	5	5													
Sustainable Material Use and Solid Waste Management															
Solid Waste Management	6	4					2								
Construction Waste Management	8	4				2	1					1			
***Regional Materials**	3					3									
Construction Plan	4	1					3								
***Responsible Sourcing of Materials	3	2						1							
Organic Waste Management	4	3				1									
Recycled Materials	7	6				1									
Life Cycle Assessment	4	3						1							
Sustainable Transport															
Transport Assessment and Master Plan	6	1					1		1			2	1		
Eco-Friendly Transportation service	4	1					1					2			
Access to public transport	4						3					1			
Bikeability	4	1					3								
Walkability	6			3			3								
Facilities for Public Transportation	4			1			1					1			1
***Reduced Parking Footprint	3	2					1								
Sustainable Site and Urban Form															
Sustainable site	8	5					1	2							
Compact Development	4						2	1					1		
Proximity to Existing Infrastructure and District	4											4			
Pubic Space	8			3			4		1						
Mixed Use Development	9						5		2			2			

*****Green Infrastructure**	3	1							2						
Sustainable Sustenance															
Access to Fresh Food	4											4			
Crime and Public Safety															
Crime Prevention	6			5			1								
Light pollution Reduction	5	1		2			2								
Inclusive Design and Public Consideration															
***Provision for Universal Accessibility	3			3											
Design Review	5	2		1			2				1				
Heritage and Cultural Identity	6	2		1					1			1		1	
***Consultation and Engagement	3			3											
Sustainable Energy (Design. Technology, Building and Infrastructure)															
		E	EC	S	I	E-EC	E-S	E-I	EC-S	EC-I	S-I	E-EC-S	E-S-I	E-EC-I	EC-S-I
Community Energy Strategy	5	5													
***Efficient Infrastructure: Smart Grid Technology	3	3													
Green Buildings	9	9													
Renewable Energy Production	3	3													
Community Strategies for Passive Cooling and Solar	4	3										1			
***Energy Efficiency in Infrastructural Equipment	5	4				1									
***Offsite Renewable Energy	3	2				1									
Urban Heat Reduction (UHR) and Outdoor Thermal Comfort Strategy Orientation	9	2					7								
Sustainable Urban Ecology															
Ecology Strategy	6	3					2						1		
Biodiversity and Habitat Conservation/Restoration	6	4						1					1		
Ecological Enhancement	4	3						1							
***Wetlands and Water Body Preservation	3	3													
*****Ecological Preservation**	3						2	1							
Environmental Management System	5	2						3							
Institutional Governance - Governance, Maintenance and Management															
Area Management	4			1					1		1	1			
Sustainability Awareness	4			1			1					1	1		
Disaster Prevention															

*****Disaster Resilience and Climate Adaptation**	3	1					2								
*****Flood Avoidance**	3						3								
Economic Prosperity															
***Housing Diversity	3			3											
Affordable Housing	5								5						
Employment and Economic Resilience	4								3			1			
***Digital Infrastructure	3			2			1								
Innovation															
Innovating Practice	6											6			
Accredited Assessors	4					4									

Table 4.5: Point, linear and planar aspect of indicator occurrences

	Total indicators (120)	Most widely used Indicators (9,8,7)	(4 or more occurrence)	(3 or more occurrence)	Least widely used indicators (1,2)	Optimized
Point	47%	50%	46%	49%	40%	44%
Linear	38%	45%	38%	38%	39%	42%
Planar	15%	5%	16%	13%	21%	14%
No. of indicators	120	7	41	58	62	47

4.4.3 Universal Sustainability Indicators

Finally, this study investigates the occurrence of universal HSI. Table 4.6 highlights the most prevalent HSI within the nine NSATs analyzed that occur 7, 8 and 9 times. The results were obtained by following the process of optimizing HSI number selection (step 1 to 5 in methodology). Results from Fig. 4.5 showed that 62 HSI had occurred 1 or 2 times and was identified as contextual occurrence. The reason being, when an HSI shows less repetition this may be synonymous to a community-centered or local based HSI. Yet, this is not to say that other higher occurrences may not be context specific. Additionally, the highest occurrences of SI were identified to be 7, 8 and 9 occurrences. This separation was to answer the question of the viability and possibility for universal HSI that cover sustainability issues.

Results from Table 4.6 indicate that urban heat island effect and thermal comfort, mixed use development and sustainable buildings are the most prevalent and common HSI within the nine NSATs analyzed. However, the universality of these HSI can be called into question. Investigations showed that though these HSI have similar targets, the DoS which they address vary. An example is mixed-use development that had 9 occurrences. The five dimensions interpreted by the reviewer covered the E-S dimension, two covered the EC-S dimension and final two covered the E-S-EC dimension (see Table 4.4). However, the HSI of green building had all nine dimensions represented as the point aspect of environment (E). This indicates that the repetition of HSI may indeed bring about common indicators but the dimensions of the HSI still vary significantly across all NSATs, and is what determines the universality of the HSI, especially since only one of the HSI, especially since only one of the HSI from fourth to ninth occurrence had the same dimensional coverage.

Table 4.6: Statistics on most widely used SI (9, 8, 7 occurrences)

No[2] of HSI	**7**
Most Widely Used Indicators (9,8,7)	**Frequency of HSI occurrences**
Construction Waste Management	8
Recycled Materials	7
Sustainable Site Selection	8
Public Spaces	8
Mixed Use Development	9
Sustainable Buildings	9
Urban Heat Island Effect and Thermal comfort strategy	9

4.5 Discussion

4.5.1 Selection of ideology and conceptual frameworks

This study focuses on developing a methodological approach for HSI selection and obtaining a common set of HSI, whilst also considering influential factors such as the outlook behind the framework, the interrelationships between the DoS, its transparency and efficacy in HSI selection and motivation for study. A list of steps was developed and tested to form the basis of the selection of HSI for NSATs. Firstly, in terms of outlook, the methodology was based on the fact that urban sustainability should be consistent with aims and directives of the Brundtland report, and should simultaneously consider both the green and brown agendas (Reith and Orova, 2015; World Commission on Environment and Development, 1987). Secondly, in terms of the conceptual framework, the four DoS and their interrelationships was the main driver behind the optimization of

HSI selection, as posited in step 1 of the methodology section. The process actively encouraged HSI of two or three interrelationships. This methodology, termed SPM, was developed by Valentin and Spangenberg (2000) and optimized by Dawodu et al. (2017). Interrelationships in this model was a priority largely due to advantages of HSI handling more than one sustainability issue, thereby improving HSI efficacy (Valentin and Spangenberg, 2000). A good example is the HSI of regional material under GBI, GSAS and Green Mark, which aims to reduce the impact of carbon emissions from transportation of regional materials. The indicator is predominantly focused on the environmental perspective (E) but the secondary derivative of this endeavor would promote economic growth by forcing investment in local businesses that deal in materials, where new industries may then emerge. This would make the overall dimension of focus, enviro-economic (E-EC). As such, the SPM which identifies and emphasizes the efficacy of dimensional interrelationships within a HSI is an irreplaceable asset in this sustainability indicator development strategy. The potential limitation to this approach is the inherent biases of the reviewer towards the interpretation,

hence for the sake of objectivity, it is recommended that multiple reviewers assess the dimensions.

It should also be noted that the lack of institutional based HSI, leading to the neglect of institutional dimension was addressed as a limitation that most NSATs have (Reith and Orova, 2015; Sharifi and Murayama, 2013). Nevertheless, various literature such as (Reith and Orova, 2015; Sharifi and Murayama, 2013; Valentin and Spangenberg, 2000) shows the value of promoting interrelationships within SI development. Additionally, though the institutional dimension is noted to be relevant in all societies, in developed nations this is largely embedded into the existing government or legislative system and is often neglected as an active dimension. This study firstly illustrates that this dimension is weak in Africa and its proper recognition and evaluation is the key for NSATs to be successful in Africa. This study does this by drawing out the dimension as active as opposed to an embedded component. It ensures that the process of indicator selection makes visible, considers and selects institutionally based indicators. Furthermore, this methodology ensures that at the very least African societies has a balanced consideration of all DoS. Particularly because there is a tendency for indicators to be more socio-economic neglecting the environmental and not realizing the influence of the institutional dimension due to the approach of previous tools (Spangenberg et al., 2002; United Nations, 2014). Bear in mind chapter 2 and 3 have shown the limited consideration of institutionally based indicators due to the fact that the development of NSATs is largely in developed regions. This essentially means that this process alone is not enough to address sustainability fully. Investigations by the United Nations demonstrates that Africa is largely plagued by institutional challenges, such as corrupt governance, disconnection between the general populace and governing policies and lack of environmental and energy conservation policies and initiatives (Howells, Shrattenholzer, and Aldy, 2008; Shaaban and Petinrin, 2014; UN-Habitat, 2009, 2015). Essentially, institutionally based urban HSI such as public awareness, integrated decision making, renewable energy

policies, and environmental conservation need to be investigated and developed further. These institutionally based urban indicators also must be enforced and adequately utilized for sustainability to truly be achieved in Africa.

4.5.2 Selection of common set of HSI and number optimization

This study addressed the major aims related to urban HSI development for NSATs in order to achieve urban sustainability. Firstly, the proposed methodology provides a transparent stepwise process in determining a common set and scope of topics HSI should cover for NSATs. This required a (1) clear motivation of study, (2) utilization of sustainability outlook and the technical analysis of already established tools. The technical analysis involved the utilization of the four DoS and the 14 interrelationships to select HSI that were deemed most relevant. By doing so, less effective HSI were minimized based on the terms of four DoS principles and their interrelationships.

Out of 120 HSI, 47 common HSI were selected and 62 context-specific HSI were identified through the process detailed from step 1 to 6 in the methodology. This led to the second question of the existence of truly universal HSI. Results show that urban heat island effect and thermal comfort, mixed use development and sustainable buildings had been repeated in all nine NSATs (see Table 4.6). The seven indicators that are presented as the most widely used come as no surprise. In terms of waste management and recycled materials. It has been proven that by utilizing the 4R's (Reduction, reuse recycling and recovery) a significant amount of pollution activities and environmental degradation can be mitigated more by avoiding waste that would otherwise be incinerated and used for land fill. Which coincidentally is the major method of waste disposal in most developing countries including Lagos Nigeria (UNEP, 2015). Thus, creating HSI that guides and rewards sustainable waste management practices becomes quite intuitive. In terms of site selection, public spaces and mixed use development, this again is intuitive considering the fact that the tools were created for neighborhood development and to promote environmental and social aspects of

sustainability. Providing public spaces accomplishes both by providing a location for green infrastructure to improve air quality and mitigate the impacts of climate change while also providing a sense of place for the citizens and place for the locales to interact. Mixed use development is more closely linked to reducing the impact of emissions due to transport while also optimizing ease of accessibility to amenities and infrastructure. Again, according to World Bank transport contributes to about 25% of world emissions and with respect to Nigeria the percentage is 35% (World Bank, 2018). For sustainable buildings the two key reasons are: firstly, the impact of sustainable building in reducing energy use and emissions when they operate under sustainability initiatives such as the use of passive design, energy efficient lighting, sustainable technology use, optimization of building fabric etc. The second reason is that each NSAT originated from building assessment tools and it should be remembered that these tools are commercial tools thus by including the use of the each NSATs bespoke building assessment tool they further market their product, gain financially and use of their method to influence planning. Again similar to the above, Urban heat island effect is known as popular issue that affects most large cities. This because most modern cities generate high temperature in their urban centers. This leads to great discomfort for city dwellers and increased energy use (due increased air conditioning, destruction of trees, wind blocking) thus translating to emissions and numerous other health hazards (increased mortality). This phenomenon is largely prevalent in congested cities and cities with hot and humid climactic conditions (Most highly populated and dense African cities would objectively fall into this category). In essence, results from Table 4.5 illustrate the significance and relevance of widely popular HSI and how they would generally be needed by most assessment tools in various context (Nuruzzaman, 2015).

It could be said that these HSI could be referred to as universal HSI, however, results in Table 4.4 showed that the DoS and their interrelationships varied significantly within these high reoccurring HSI. The only HSI that occurred nine times with nine identical dimensions

was the HSI of green buildings. This is due to an early unilateral focus of green building tools to mitigate the impact of greenhouse gas emissions, which was majorly environmental driven. There was also the need for developers to commercialize and market the continuous use of their previously developed building assessment tools in their newly developed NSATs, essentially marketing the relevance and popularity of their product (Alyami and Rezgui, 2012; Berardi, 2015; Cole and Valdebenito, 2013; Haapio and Viitaniemi, 2008). Thus, though it is not impossible for universal HSI to exist, it is however improbable, in line with most published literature. The improbable nature of universal HSI is based on the fact that though it is possible for HSI to have the same goals and even the same HSI name, it is highly unlikely for a HSI to occur nine times and also be identified by the same DoS nine times. Bear in mind that the limitation to this study is that it only analyzes nine out of a possible 20 NSATs in existence. By analyzing all 20 third-party assessment tools, it would be immensely difficult to obtain a HSI that repeats itself 20 times with 20 identical dimensions. In summary, though HSI names may be shared, and the intended goals of these HSI the same, nevertheless the approach with relation to the DoS of each tool and each NSAT vary significantly (Sharifi and Murayama, 2015). It thus might be concluded that universal HSI may be difficult to achieve, and common HSI that have similar dimensions are more attainable. Furthermore, commonly reoccurring HSI do exist and these still provide a comparative basis to measure the sustainability success or failure of sustainability initiatives between one society and another. Thus, an argument can be made for the pursuit and utilization of a common set of HSI to handle relevant urban issues.

Additionally, it needs to be understood that these common HSI still undergo context specific applications, which may transform them into context specific indicators in the long run. Taking water management, under NSAT, water use reduction occurs 5 times making it a viable common HSI. However, in Lagos state water use in various literatures highlights an alternative focus. Literature indicates that Lagos state is plagued with lack of access to water

with leakages, vandalism ineffective regulations being the primary drivers for the lack of water (Jideonwo, 2014; Omole, 2013, Omole et al., 2016). When interviewed, citizens responded that access to water, availability and distance travelled to obtain water as well as water quality, were the immediate need of their community. Respondents were willing to pay additional costs for adequate water service even though it was perceived to be a role of the government to supply water (Omole et al., 2016). Essentially, what this suggests is that, though common indicators may be relevant to the overall concept of sustainability such as efficient use and reduction in wasteful behavior of water, more contextual HSI need to be investigated. Assuming that water access was present in the list of HSI, it is evident from this example that the dimension chosen by the citizens of Lagos would be socially inclined, based on emphasis to water access and water quality. This is likely the opposite in developed nations which may have access already embedded in their society, thereby focusing their resources on the environmental consequences of water access, such as, water use efficiency. Hence, though common indicators play their role in achieving the principles of sustainability, the method through which these HSI are obtained determines how useful the chosen indicator may be. For instance, key reasons exist for the absence of this HSI, such as the fact that the tools utilized in this study are largely from experts and professionals with minimal input from local citizens (see Table 4.1) and also, no African NSAT currently exists to specially highlight this urban HSI. Concurrently, low occurring HSI are also deemed context specific due to the low level of reoccurrence in the tools analyzed but that does not mean it cannot be used in various other locations, it simply means proper validation and investigation towards the usefulness and efficiency of the HSI will need to be conducted. A possible solution could be to vet the discarded HSI for their usefulness, while simultaneously investigating additional HSI through the participation of the people in the given location. This approach would be crucial to African oriented NSATs, as the top-down approach is generally criticized for missing local issues and imposing middle inapposite values on the populace (Fraser et al., 2006; Soma et al., 2017; Turcu, 2013). Since literature has established the need of Africa is largely

institutional and socio-economic, the citizen approach to indicator validation would reinforce the adaptability and implementation of such indicators. In principle, in this study the vetted HSI would then be the 62 context-specific HSIs and the 11 neglected HSIs.

In sum, sustainability dimensions and their interrelationships allow successful categorization of the characteristics of HSI, and this step is essential for optimal selection of HSI to a specific region. Detailed meticulousness in the examination of dimensions and classifications is required for a successful implementation of HSI within any region, particularly Africa. Likewise, it can also be concluded that to improve the objectivity of this methodology, more reviewers and more NSATs would be required. Table 4.7 therefore summarizes the methodology and how this can be improved upon in future studies

Table 4.7: Process flow of HSI selection and optimization of results

		Improving viability of results	Future studies
1	**Identify NSATs for selection and justification**	Increase NSATs to highest attainable number	Use all 3rd party Assessment tools
2	**Identify motivation and select a sustainability ideology**	Utilize four dimensions of sustainability and interrelationships (Consider institution, particularly for the African context)	Other dimensions and interpretations of dimension could be tested
3	**Allocate sustainability dimension to all HSI and Merge similar HSI together**	Increase number of reviewers for a more objective consensus	
4	**Selecting and optimizing number of HSI** **a) Select maximum number of occurrences and count backwards. Stop when all the 14 dimensions are covered by at least one dimension**		

	b) **All themes must be covered by at least one HSI. If this does not occur investigate the next level of occurrences** c) **Choose between maximization and minimization (see section 4.2)**		

4.6 Conclusions

In the wake of poverty, social injustice, corruption and environmental degradation, NSATs are modern tools used by planners and sustainability experts to mitigate the impact of the aforementioned challenges through a series of executable, point-based tasks that improve the urban realm. These tasks are classified under various HSI as criteria assessment, intentions and aims. By fulfilling these aims and assessment criteria, a community is on course to address urban issues in a sustainable manner. As has been identified in this study, no African-oriented NSAT exist and no transparent method that illustrates how such tools may be developed for African countries have also been developed. This study provides a lucid methodology that initiates this process. An important approach established in this study is the process of selecting HSI from already developed tools, which implies the rigorous use of preexisting data. This is advantageous for regions which experience financial and time constraints. Additionally, this is the first attempt to develop a transparent methodology in the formulations NSATs. This is significant because the developmental process for most HSI is shrouded in mystery, largely due to the profit-oriented nature of the available NSATs. Furthermore, in terms of selection process and theoretical advancement, the addition of the fourth institutional dimension and its ensuing interrelationships is a necessary operation in the selection of HSI for African cities. This means that NSATs developed from the template proposed in this study, would have an important advantage over most tools which are largely based on three DoS and thus falls short in rigorously appraising scenarios in which the institution has explicit functionalities with respect to the other dimensions. Summarily, this

selection process appraises what has already been developed and merges best practices of existing tools to draw out stronger, implementable and more relevant HSI. It should, however, be reiterated that the methodologies behind the selection process of the HSI is the actual result, not the selected HSI themselves. This is due to limitations of objectivity in dimensional selection of HSI and the available number of NSATs under investigation which totaled nine. In the same vein, the limitations in this study can be attributed to the fact that a major step in the method of selecting HSI was ascription of sustainability dimensions to the HSI. This is because this process is what is used to select the common set HSI (see Section 4.2). Moreover, this procedure is fraught with some challenges because the interpretation of the dimensions covered by various HSI may vary from one reviewer to the other. Correspondingly, it was suggested that objectivity can be ensured by increasing the number of reviewers investigating the specific NSAT from which a consensus can be arrived at based on various expert opinions on the DoS of the HSI. Furthermore, such consensus would also incorporate diverse viewpoints and perspectives which would promote the robustness of the selection process. The second limitation can be linked to the fact that about half of the total number of NSATs were analyzed (9/20). This introduces some level of uncertainty from the derived results because the validity of results is based on the frequency of occurrences and number of HSI analyzed which would expectedly increase and vary with additional NSATs. Therefore, an extension of this work would comprise of the analysis of all 20 NSATs, both as a means of obtaining expanded statistical data and being abreast with the sporadic updates of these NSATs.

The results of this study has been used for the development and selection of HSI for NSATs in Lagos, Nigeria by the authors. It is envisaged that these investigations can also be extended to other African countries. In line with this specific contextualization of the research with respect to Africa, a significant finding was that the theoretical application of the proposed approach resulted in the selection of 47 HSI, whilst 73 were neglected due to their lower

levels of occurrence and interrelationship; which could translate to a reduction in the effectiveness of the HSI in the African context. Nevertheless, in the development African oriented NSATs, it would be wasteful and unscientific to simply discard these neglected HSI and it would also be naïve to think that the selected HSI will not undergo transformation based on the new location of implementation. A procedure for further study would thus be to further scrutinize and investigate the relevance of these neglected HSI from the standpoint of the inputs obtained from local citizens. This would further validate the selection of implementable indicators and ultimately ignore indicators that would prove difficult to implement. This is thoroughly investigated in Chapter 5. Also, the current methodology proposed in this work already assembles NSATs that have hitherto undergone rigorous analysis by planners and researchers; hence, a balance would imply validation through the local communities of the given African nation via various survey techniques. Thusly, addressing these limitations and furthering this study is required for the proper development of a truly implementable NSAT for the various regions of Africa, in order to propagate transparency, local-content, integrated decision making and increase objectivity in tackling urban sustainability issues. In general, the methodology in this study, provides the very first step for the rigorous selection of HSI pertinent to the development of NSATs that can aptly address the prevailing urban issues within the African context. The second step would therefore require more contextual validation of the early selected HSI.

References

Abila N. 2014. Managing municipal wastes for energy generation in nigeria. Renewable and Sustainable Energy Reviews. 37:182-190.

Abu Dhabi Urban Planning Council. 2010. The pearl rating system for estidama 1.0.

Adewole T. 2009. Waste management towards sustainable development in nigeria: A case study of lagos state. International NGO journal. 4(4):173-179.

Afon AO. 2007. Informal sector initiative in the primary sub-system of urban solid waste management in lagos, nigeria. Habitat International. 31(2):193-204.

Ajibade I, McBean G. 2014. Climate extremes and housing rights: A political ecology of impacts, early warning and adaptation constraints in lagos slum communities. Geoforum. 55:76-86.

Ajibade I, McBean G, Bezner-Kerr R. 2013. Urban flooding in lagos, nigeria: Patterns of vulnerability and resilience among women. Global Environmental Change. 23(6):1714-1725.

Alyami SH, Rezgui Y. 2012. Sustainable building assessment tool development approach. Sustainable Cities and Society. 5(0):52-62.

Ameen RFM, Mourshed M, Li H. 2015. A critical review of environmental assessment tools for sustainable urban design. Environmental Impact Assessment Review. 55:110-125.

AtKisson A. 1996. Developing indicators of sustainable community: Lessons from sustainable seattle. Environmental Impact Assessment Review. 16(4):337-350.

Bandura, R., 2008. A Survey of Composite Indices Measuring Country Performance:2008 Update. United Nations Development Programme, New York, Office ofDevelopment Studies (UNDP/ODS Working Paper).

Barton, H., Grant, M., and Guise, R., 2003. Shaping neighbourhoods. A guide for health, sustainability and vitality. London: Spon Press.

Bell, S. and Morse, S., 2003. Measuring sustainability. Learning from doing. London: Earthscan.

Berardi U. 2013. Clarifying the new interpretations of the concept of sustainable building. Sustainable Cities and Society. 8(0):72-78.

Berardi U. 2015. Chapter 15 - sustainability assessments of buildings, communities, and cities a2 - klemeš, jiří jaromír. Assessing and measuring environmental impact and sustainability. Oxford: Butterworth-Heinemann. p. 497-545.

Bond, Alan, Angus Morrison-Saunders, and Jenny Pope. 2012. "Sustainability Assessment: The State of the Art." Impact Assessment and Project Appraisal 30 (1): 53–62. doi: 10.1080/14615517.2012.661974.

Bourdic L, Salat S, Nowacki C. 2012. Assessing cities: A new system of cross-scale spatial indicators. Building Research and Information. 40(5):592-605.

Braulio-Gonzalo M, Bovea MD, Ruá MJ. 2015. Sustainability on the urban scale: Proposal of a structure of indicators for the spanish context. Environmental Impact Assessment Review. 53:16-30.

BRE Global. 2012. Breeam community: Technical manual sd202 version:2012.

Cappuyns V. 2016. Inclusion of social indicators in decision support tools for the selection of sustainable site remediation options. Journal of Environmental Management. 184, Part 1:45-56.

Charoenkit S, Kumar S. 2014. Environmental sustainability assessment tools for low carbon and climate resilient low income housing settlements. Renewable and Sustainable Energy Reviews. 38:509-525.

Clarke G, Wilson A. 1994. Performance indicators in urban planning: The historical context. Modelling the city: Performance, policy and planning. . London Routledge; 19944–19.

Cole RJ, Valdebenito MJ. 2013. The importation of building environmental certification systems: International usages of breeam and leed Routledge.

Dahl AL. 2012. Achievements and gaps in indicators for sustainability. Ecological Indicators. 17:14-19.

Dawodu A, Akinwolemiwa B, Cheshmehzangi A. 2017. A conceptual re-visualization of the adoption and utilization of the pillars of sustainability in the development of neighbourhood sustainability assessment tools. Sustainable Cities and Society. 28:398-410.

Dhingra, M., M. K. Singh, and S. Chattopadhyay, 2016, Rapid Assessment Tool for traditional Indian Neighborhoods: a Case Study of Alwar Walled City in Rajasthan: Sustainable Cities and Society, v. 26, p. 364-382.

de Jong M, Joss S, Schraven D, Zhan C, Weijnen M. 2015. Sustainable–smart–resilient–low carbon–eco–knowledge cities; making sense of a multitude of concepts promoting sustainable urbanization. Journal of Cleaner Production. 109:25-38.

Elias P, Omojola A. 2015. Case study: The challenges of climate change for lagos, nigeria. Current Opinion in Environmental Sustainability. 13:74-78.

Green Building Index. 2011. Gbi assessment criteria for township. Malaysia: Green Building Index.

Haapio A. 2012. Towards sustainable urban communities. Environmental Impact Assessment Review. 32(1):165-169.

Haapio A, Viitaniemi P. 2008. A critical review of building environmental assessment tools. Environmental Impact Assessment Review. 28(7):469-482.

Haider, H., K. Hewage, A. Umer, R. Ruparathna, G. Chhipi-Shrestha, K. Culver, M. Holland, J. Kay, and R. Sadiq, 2018, Sustainability assessment framework for small-sized urban neighborhoods: An application of fuzzy synthetic evaluation: Sustainable Cities and Society, v. 36, p. 21-32.

Hak T, Kovanda J, Weinzettel J. 2012. A method to assess the relevance of sustainability indicators: Application to the indicator set of the czech republic's sustainable development strategy. Ecological Indicators. 17:46-57.

Hiremath RB, Balachandra P, Kumar B, Bansode SS, Murali J. 2013. Indicator-based urban sustainability—a review. Energy for Sustainable Development. 17(6):555-563.

Hove M, 2013 The Urban Crisis in Sub-Saharan Africa. Stability, 2(1): 7, pp. 1-14, DOI:

http://dx.doi.org/10.5334/sta.ap

Howells M, Shrattenholzer L, Aldy JE. 2008. Energy and development in africa. Elsevier.

Hák T, Janoušková S, Moldan B. 2016. Sustainable development goals: A need for relevant indicators. Ecological Indicators. 60:565-573.

Jideonwo, J. 2014. Ensuring Sustainable Water Supply in Lagos, Nigeria Master of Environmental. Studies Capstone Projects 58. http://repository.upenn.edu/mes_capstones/58

Joss S. 2015. Eco-cities and sustainable urbanism a2 - wright, james d. International encyclopedia of the social and behavioral sciences (second edition). Oxford: Elsevier. p. 829-837.

Komeily A, Srinivasan RS. 2015. A need for balanced approach to neighborhood sustainability assessments: A critical review and analysis. Sustainable Cities and Society. 18:32-43.

Komeily A, Srinivasan RS. 2016. What is neighborhood context and why does it matter in sustainability assessment? Procedia Engineering. 145:876-883.

Lehmann S. 2015. Low carbon cities: Transforming urban systems. London and New York: Routledge.

Luederitz C, Lang DJ, Von Wehrden H. 2013. A systematic review of guiding principles for sustainable urban neighborhood development. Landscape and Urban Planning. 118:40-52.

Maclaren, V., 1996. Urban sustainability reporting. Journal of the American Planning Association, 62, 184–202.

Moldan, B., 1997. Introduction. In: Moldan, B., Billharz, S. (Eds.), Sustainability Indi-cators. Report of the Project on Indicators of Sustainable Development. SCOPE58. Willey, pp. 1–5.

Niemeijer, D. and de Groot, R.S. (2008) A Conceptual Framework for Selecting Environmental Indicator Sets. Ecological Indicators, 8, 14-25. http://dx.doi.org/10.1016/j.ecolind.2006.11.012.

NURUZZAMAN, M. 2015. Urban Heat Island: Causes, Effects and Mitigation Measures - A Review. A Review. International Journal of Environmental Monitoring and Analysis.

Oguntoyinbo OO. 2012. Informal waste management system in nigeria and barriers to an inclusive modern waste management system: A review. Public Health. 126(5):441-447.

Omole DO, 2013, Sustainable Groundwater Exploitation in Nigeria, J Water Resour Ocean Sci, 2(2) (2013) 9-14

Omole, D. O., Ndambuki, J. M., Badejo, A. A., Oyewo, D. O., and Soyemi, T. O. (2016). Public feedback on state of domestic water supply in Lagos: Implications for public health. Indian Journal of Traditional Knowledge, 15, 245–253.

Pedro, J., C. Silva, and M. D. Pinheiro, 2017, Scaling up LEED-ND sustainability assessment from the neighborhood towards the city scale with the support of GIS modeling: Lisbon case study: Sustainable Cities and Society.

Pope J, Annandale D, Morrison-Saunders A. 2004. Conceptualising sustainability assessment. Environmental Impact Assessment Review. 24(6):595-616.

Reith A, Orova M. 2015. Do green neighborhood ratings cover sustainability? Ecological Indicators. 48(0):660-672.

Sanusi YA, Owoyele GS. 2016. Energy poverty and its spatial differences in nigeria: Reversing the trend. Energy Procedia. 93:53-60.

Shaaban M, Petinrin JO. 2014. Renewable energy potentials in nigeria: Meeting rural energy needs. Renewable and Sustainable Energy Reviews. 29:72-84.

Sharifi A, Murayama A. 2013. A critical review of seven selected neighborhood sustainability assessment tools. Environmental Impact Assessment Review. 38(0):73-87.

Sharifi A, Murayama A. 2014. Neighborhood sustainability assessment in action: Cross-evaluation of three assessment systems and their cases from the us, the uk, and japan. Building and Environment. 72(0):243-258.

Sharifi A, Murayama A. 2015. Viability of using global standards for neighborhood sustainability assessment: Insights from a comparative case study. Journal of Environmental Planning and Management. 58(1):1-23.

Sharifi, A., 2016, From Garden City to Eco-urbanism: The quest for sustainable neighborhood development: Sustainable Cities and Society, v. 20, p. 1-16.

Shen, L.-Y., Jorge Ochoa, J., Shah, M.N., Zhang, X., 2011. The application of urban sustainability indicators — a comparison between various practices. Habitat International 35 (1), 17–29.

Singh RK, Murty HR, Gupta SK, Dikshit AK. 2012. An overview of sustainability assessment methodologies. Ecological Indicators. 15(1):281-299.

Soma, K., M. W. C. Dijkshoorn-Dekker, and N. B. P. Polman, 2017, Stakeholder contributions through transitions towards urban sustainability: Sustainable Cities and Society.

Spangenberg JH, Pfahl S, Deller K. 2002. Towards indicators for institutional sustainability: Lessons from an analysis of agenda 21. Ecological Indicators. 2(1–2):61-77.

Tanguay, G. A., Rajaonson, J., Lefebvre, J., Lanoie, P., Canada, B., Chabot, R., et al.(2009). Measuring the sustainability of cities: A survey-Based analysis of the use oflocal indicators.

Tasser E, Sternbach E, Tappeiner U. 2008. Biodiversity indicators for sustainability monitoring at municipality level: An example of implementation in an alpine region. Ecological Indicators. 8(3):204-223.

Turcu C. 2013. Re-thinking sustainability indicators: Local perspectives of urban sustainability. Journal of Environmental Planning and Management. 56(5):695-719.

UN-Habitat. 2009. Planning sustainable cities: Policy direction - global report on human settlement. UK and USA: Earthscan.

UN-Habitat. 2014. A practical guide to designing, planning and executing citywide slum upgrading programmes.

UN-Habitat. 2015. Sustainable urban development in africa.

UNEP. 2012. Sustainable, resource efficient cities - making it happen.

UNEP, Global Waste Management Outlook, 2015, United Nations Environment Programme

UNSD, 2015. Discussion paper on Principles of Using Quantification to Operational-ize the SDGs and Criteria for Indicator Selection. ESA/STAT/441/2/58A/14. UNStatistical Division, New York

United Nations. 2014. Sustainable development indicator framework for africa and initial compendium. Addis Ababa, Ethiopia: Economic Commissions for Africa.

Valentin A, Spangenberg JH. 2000. A guide to community sustainability indicators. Environmental Impact Assessment Review. 20(3):381-392.

Whorton J, Morgan D. 1975. Measuring community performance: A handbook of indicators. In: University of Oklahoma, Bureau of Government Research, editors. Norman, Oklahoma: .

World Commission on Environment and Development. 1987. Our common future. Oxford Press.

WORLD BANK. 2018. *CO2 emissions from transport (% of total fuel combustion)* [Online]. Available: https://data.worldbank.org/indicator/EN.CO2.TRAN.ZS [Accessed November 10th 2018].

Xia B, Chen Q, Skitmore M, Zuo J, Li M. 2015. Comparison of sustainable community rating tools in australia. Journal of Cleaner Production. 109:84-91.

Zeijl-Rozema, A. and Martens, P., 2010. An adaptive indicator framework for monitoring regional sustainable development: a case study of the INSURE project in Limburg, The Netherlands. Sustainability: science, practice and policy, 6, 6–17.

Chapter 5

Expert-initiated integrated approach to development of Sustainability Indicators for Neighborhood Sustainability Assessment Tools: An African perspective

"If you want to go quickly, go alone. If you want to go far, go together."

~ African proverb

Under review by Journal of Cleaner air production (Elsevier)

5. 1 Introduction

5.1.1 The need for participatory approach for early selection of sustainable indicators

NSATs were created to consider the three dimensions of sustainability (DoS), and to reflect the complex interaction between city and various components such as neighbourhoods, population, transportation, open spaces, water management, waste management and energy etc. NSATs essentially measure and assign sustainability points to a list of urban issues, via the development of HSI, SI and a point based system (Gil and Duarte, 2013; Sharifi and Murayama, 2015). The general idea is to have a series of HSI that possess equal traits of all DoS. Yet, as chapters 2 and 3 have shown assessment tools developed prioritize HSI based on regional origin in the form of weighting specific HSI according to what developers of the tool deem as most important. Moreover, NSATs possess mandatory or prerequisite HSI, which imposes the selection and use of non-negotiable HSI in the development of an urban realm. Similar to weighting, this is executed by professionals who determine 'what is' and 'what is not' mandatory (Ameen et al., 2015; Braulio-Gonzalo et al., 2015; Haapio, 2012; Komeily and Srinivasan, 2015, 2016; Sharifi and Murayama, 2013, 2014; Xia et al., 2015).

The aforementioned approach is also largely used in achieving Sustainable Development Goal 11 (SDG11), also known as "sustainable communities and cities". Unfortunately, in the context of Africa these tools are non-existent (Dawodu et al., 2017; Tam et al., 2018). This non-existent reality is detrimental towards global efforts of climate change, as a consortium of urban issues plague sub-Saharan African cities and a strategy that could transform these cities into sustainable cities is the utilization of NSATs. Moreover, existing NSATs cannot be simply lifted and utilized in another region due to the contextual differences surrounding their development (Dawodu et al., 2017; Sharifi and Murayama, 2015). For instance, the Japanese tool, Comprehensive Assessment System for Built Environment Efficiency for Urban Development (CASBEE-UD), has disaster and ICT focused tool for

sustainability, while the UK tool, Building Research Establishment Environmental Assessment Method for communities (BREEAM communities) champions social inclusion in city design for sustainability. Therefore, a key aspect of this chapter becomes how to develop such a tool that best considers the contextual development of already created tools and applies this knowledge in an African based setting.

However, a major setback in prior studies but motivation in this study, is the subjective HSI selection system, which is top-down oriented and is generally shrouded in secrecy (see table 4.1 – Chapter 4) (Dawodu et al., 2017; Komeily and Srinivasan, 2015). Top-down approaches are either government-led or expert-led (Vaidya and Mayer, 2014). Fraser et al. (2006) states that indicators that originate from this approach are generally, collected rigorously, scrutinized by experts, and assessed for relevance using statistical tools. However, they fail to measure what is important to the community, which is the social aspect of sustainability. Furthermore, the irony as it applies to NSATs is that though the HSI is developed from the top-down approach, within some tools such as BREEAM Communities, HSI exist that attempt to encourage participation e.g. BREEAM HSI of 'consultation plan', 'consultation and engagement', 'Design review' and 'community management' these HSI are awarded 1 to 3 points, if the criterion or procedural SI involved are achieved. For instance, sustainability points are given under the HSI of 'consultation plan' when an independently facilitated community consultation method to engage the community on specific aspects of the design is used.' In essence, the developers of these NSATs recognize the need for public participation; yet the methodology to develop such indictors have little or no public participants (Komeily and Srinivasan, 2015). Furthermore, This lack of integration of people in the decision making process goes against the spirit of the Local Agenda 21 that places local involvement at the forefront of any planning process, essentially emphasizing that policy makers should allow local communities to establish the concept of their own sustainability (Morse and Fraser, 2005; Valentin and Spangenberg, 2000; World Commission on

Environment and Development, 1987). A people-centred approach is even more critical, when trying to develop or utilize such tools in sub-Saharan African cities, which already have an innate distrust for government-led approaches due to widespread corruption, inability of the government to fulfil tasks competently, self-serving political leaders and lack of data and expertise in project implementation (Ajibade and McBean, 2014; Ajibade et al., 2013; Elias and Omojola, 2015). This has led to several authors recommending more integrated approach to the development of indicators for NSATs, particularly in the development of the weighting system (Braulio-Gonzalo et al., 2015; Dawodu et al., 2017; Haapio, 2012; Sharifi and Murayama, 2013). Yet, the integrated approach for developing or selecting indicators tends to be recommended but rarely implemented (Reed and Dougill, 2002; Reed et al., 2007)

Considering the above-mentioned, this study aims to:

1) Use an integrated participatory approach as a core method in the development of a process for the early selection of HSI;

2) Show that the bottom-up approach via survey-based questionnaires can be a competent method in determining the relevance of top-down developed HSI; and

3) Identify key motivations and constraints that inhibit the successful implementation and transfer of already developed HSI in an African society.

The next section provides a detailed literature review on participatory processes and the reasoning behind the selection of three themes (Sustainable land use and Transportation) to be used as case studies in relation to Lagos. Thereafter, the methodology, and results are briefly explained followed by the discussion section.

5.2 Literature Review

5.2.1 Integrated approaches to early selection of sustainable indicators

Participatory approaches were partly developed as a response to the failings of the top-down approach; especially when scientists, policy makers and various other authorities have exhibited a lack in ability to unilaterally solve controversies bound up with politics, struggles on knowledge claims, problems of definitions, trust and power (Soma et al., 2017). The argument is that the scientific approach without the involvement of the local community operates on partial or incomplete information that would limit a more robust and inclusive decision. Nonetheless, Reed et al. (2006) contends that indicators development through participatory approaches requires objective validation. One of the reasons why, is that a people led approach could lead to a high number of potential indicators. An example of such was a project on sustainable forestry in Canada where stakeholders chose 141 social indicators and a similar number of environmental indicators. The second key reason is that indicator validation requires technical and scientific skill and more time than may not be afforded to the project. But HSI need to cover social, economic and institutional aspects of sustainability and not just the environmental dimension. Hence, there is a need to select indicators objectively and systematically that are grounded in local issues, guided by local expertise and empowering local people to choose and be involved in selecting useful indicators. Thus, there is a need for an integrated selection of HSI.

This thesis is more concerned with the early selection of the HSI for NSATs, as this represents the foundation of not only the development of indicators but also participatory practices. The initial selection of HSI in an integrated manner is imperative to the process of NSAT development. Otherwise the same issues that have plagued prior to NSATs and various indicator programs will plague the future development of NSATs, particularly in the African regions. The integrated participatory approach is divided into two methods of execution, which are the expert-assisted approach (people-led approach) or expert-initiated approach. Expert-

assisted approach uses stakeholders or organization that are directly affected by the system or whose behavior or actions affect the system to select SI. The participants play a major role in the defining the problem, identifying the SI and generating the final set of indicators. This is done either through providing essential pieces of information or by participation in the selection process itself. This means that the sustainability indicators are entirely based of the information and judgement of the participants. Within this approach there are two approaches which are community based and system based approaches (Vaidya and Mayer, 2014). The community-based approach is a process where community members are the stakeholders and the authorities only facilitate discussion. This allows participants to define their problem and provide their solutions. This process is noted to look at the context specific issues from a socio-economic and institutional perspective. However, if participants champion unsustainable practices and lifestyles, this may render this approach futile (Reed et al., 2006; Simon and Etienne, 2010). The system based approach mixes the stakeholders with representatives from public, private and government sectors. This focuses more on negotiations and collaborative learning. It usually requires more time and resources but the positive is that indicators are picked based of demonstrations. Also, it is well established empirically that engaging local communities in sustainability monitoring has several benefits. SI chosen via observations by stakeholders can be just as meaningful and holistic as the top-down process. Yet, the fact still remains that the qualitative approach needs to be vetted and certified by top-down approach or vice versa. This is because it is not always possible to determine the accuracy and reliability of indicators without scientific testing.

This leads to the use of the expert-initiated integrated approach, which is a more extensively practiced strategy for sustainability indicator selection due to its accessibility, measurability, efficiency, ease of use, and reduced time requirements (Reed and Dougill, 2002). As such, an expert-initiated integrated approach is a 'participatory technique where pre-existing framework or sets of indicators developed by non-local experts are used as a

starting point, followed by a participatory assessment to narrow the list' (Vaidya and Mayer, 2014, p. 374). Similar to the expert-assisted method, the participatory groups can be either community-based or system-based, depending on the time, resources, aims and objectives of the project. In the case where expert-initiated selection of SI is used as the starting point, less time tends to be spent on problem definition. Rather, in this approach, more resources are spent on consensus building on the selection of SI via the participants. Therefore, there is an inevitability that tradeoffs would exist between the integration of effective and meaningful participation and scientific rigor. However, Reed's study of indicator development in Botswana (2008) showed that there was quite a significant overlap between scientific literatures, local knowledge and minimizing tradeoffs. Hence, this fear or hypothesis is by no means set in stone but is dependent on the survey techniques used, experience and knowledge of experts and people in question, power given to stakeholders and type of projects that such an integrated process will be used for and implemented.

This section illustrates that integration is not one dimensional and can be implemented via various angles and perspectives (expert-assisted approach or expert-initiated approach). However, participatory practices are more intricate than simply bringing people together to make a decision. Effective participation is reliant on key best practice methods that optimize the decision making process. Without these best practices the likelihood of inefficient, time consuming, expensive and unsatisfactory results are high (Arnstein, 1969; Beierle, 2002; Gene and Lynn, 2000; Soma et al., 2017; Ward, 2001; Warner, 1997). The next section investigates these best practices and provides recommendation on situations that should be avoided.

5.2.2 Best practices of the bottom-up participatory approach

Arnstein (1969) warns that in a bid to involve the public in planning certain situations should be avoided or at least noted. Arnstein (1969) postulated the eight ladders on participation. The bottom of the ladder represents manipulation and therapy categorized as non-participation. Where there is an attempt to cure citizens of their ignorance, this kind of participation does not enable people to participate in the program. The next level is classified as tokenism and allows citizens the opportunity of having a voice: the lower classification under tokenism are informing and consultation. Under this category citizens may indeed have a voice and be heard but there is no guarantee that their opinions would be catered to in any capacity by those in power. Better put, there is no follow through or muscle to drive home and see to fruition the perspective of the citizens or stakeholders. A higher level of tokenism is placation the slight difference here is that the citizens can advise but again power holders hold autonomy on decisions made. The top level of participation involves partnership, delegated power and the highest being citizen control. These rungs help identify what level of participation is considered and how to avoid situation of citizen manipulation and therapy, which is a common trait of practitioners in their bid to fulfil requirements of participation in order for their projects to be approved and/or funded (Arnstein, 1969; Garde, 2009; Kotus and Sowada, 2017) (see Fig. 5.1).

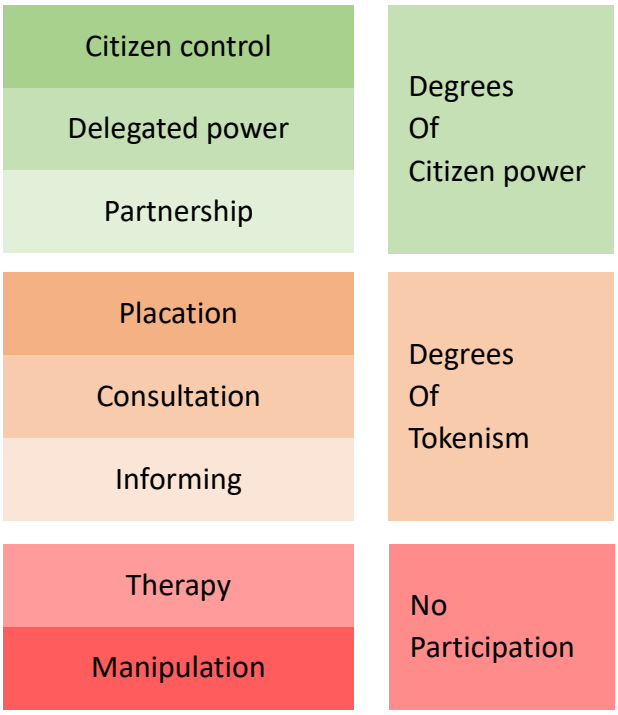


Fig. 5.1 : Arnstein's participatory ladder obtained from

(Source: Arnstein, 1969)

Reed (2008) further categorizes participation into normative and pragmatic approaches where the former is about acceptability and where the decision making is a democratic process that focuses on equity, while pragmatism is based on the quality of decisions and is more goal oriented (Reed, 2008). Speaking strictly on the normative, the process allows for the marginalised or the 'have-nots' to have a voice in the decision making process. By doing so, more relevant stakeholders who are severely affected are actively part of process, thereby increasing their public trust in decisions (Drazkiewicz et al., 2015; Reed, 2008). This ideology is further strengthened if the process is viewed to be transparent and considers all conflicting views (Martin and Sherington, 1997). What tends to follow are a series of negotiations and deliberations, which have additional advantages such as social learning, knowledge transfer etc. (Stroud, 1996). It follows that participation under the normative claim generates a consensus or agreement over solutions thereby increasing support for implementation. The benefits of this approach is that it empowers citizens through co-

generation of knowledge and increases participant's capacity to use this knowledge; in a sense it educates and raises awareness (Stroud, 1996). During the golden era of planning approaches (i.e. World War 2 era) when climate change was not a priority and neither was it institutionalize, participation was a matter of choice or a matter of, if and when the public could effectively participate. John Clayton (1993) created a map for such activities which was centered on the appropriateness of the participants in making decisions (see Fig. 5.2) (John Clayton, 1993). This is now in stark contrast to modern day planning, where Agenda 21 and the creation of the four pillars of sustainability as a guide to planning emerged, which mandated people oriented planning without necessarily checking for its appropriateness.

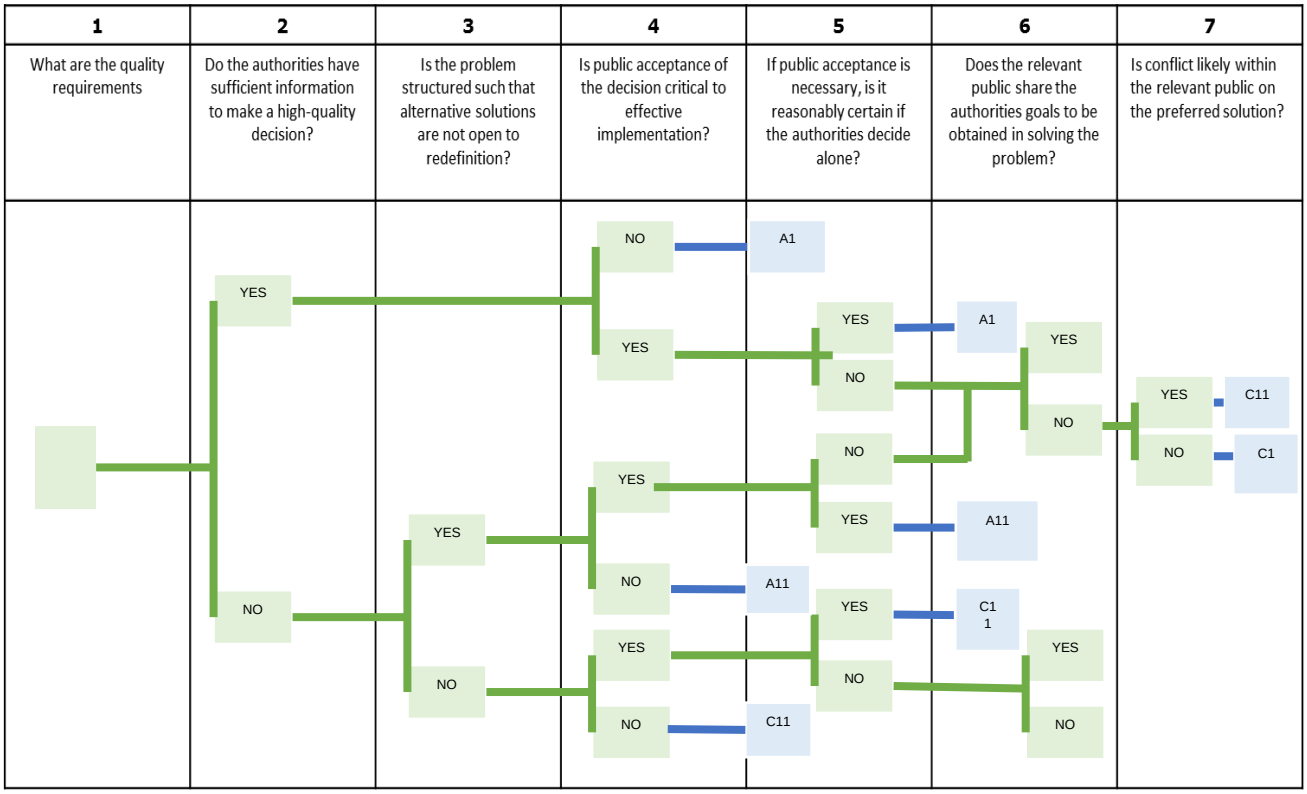


Fig. 5.2 : The Effective Decision Model of Public Involvement (Source: John Clayton, 1993)

Note: A1 = sole decision by the authorities; A11 = modified decision by authority; C1 = segmented public consultation; C11 = unitary public consultation; G11 = public decision

From a quality (pragmatic) perspective, key stakeholders with relevant knowledge of the project are utilized in order to improve the efficacy of the decision. This approach is also very useful when acceptability of the decisions is not necessarily a criteria for the successful implementation. However, it is a common notion that the bottom-up approach is perceived to be led by lay participants who are selfish and do not necessarily understand the intricacies of higher level issues. They are also more susceptible to psychological influences that lead to over estimating and underestimating risk (Beierle, 2002; Drazkiewicz et al., 2015). However, Beierle (2002) study investigates the quality behind the decisions made via the bottom-up approach and five key questions were asked: are the decision more cost effective than the possible alternative? Do decisions increase joint gains? Do participants contribute to innovative ideas? Do participant have access to information? The summary of the analysis showed that over the span of 239 environmental projects via public hearing, meetings, workshops and advisory committees, that indeed decisions could be cost effective. It also showed that involving the citizens allows for deliberations and negotiations where participants generally have opposing views, which lead to improved dialogue, higher quality result and increased acceptability, when an agreement is finally made. When answering the question of innovation, the bottom-up approach should fulfil some certain parameters 1) Did the participants contribute to information that would not have been generally available 2) Did participants undertake technical analysis to improve the basis of the decision making process 3) Did the participants create innovative ideas to tackle issue and challenges 4) Did the participants develop a holistic and integrated method of viewing and solving a specific problem. Once answered you begin to have general idea of the impact and importance of the stakeholders under question. In these older studies participation had to be validated in order to be used as opposed to now where it is mandated (Arnstein, 1969; John et al., 1985; Rexhepi et al., 2018; Soma et al., 2017; Thomas and Seth, 2000; Warner, 1997). This is not to say that mandating without validation lacks merit but doing so without understanding the

context of use could be ineffective (Davidson 1998). Finally, the question of access to information in the 21st century is all but answered with the internet and several tools available to citizens, it now becomes a matter of rigor and thoroughness and some case training on the part of citizens to utilize these tools (Beierle, 2002). In fact, Gene and Lynn (2000) mandates for effective participation certain resources should be available to participants which include (1) information resources (summaries of the pertinent facts), (2) human resources (e.g., access to scientists, witnesses, decision analysts), (3) material resources (e.g., overhead projectors/whiteboards), and (4) time resources (participants should have sufficient time to make decisions). Gene and Lynn (2000) also assesses the participatory process and provides a prescriptive list of features and suggestion to ensure that participation projects are executed effectively. The evaluation is based of experiences of practitioners and researchers and is as follows: The criterion are divided into two categories of 'acceptance criteria' and 'process criteria'. The latter is concerned about the effective implementation of the procedure and the former is concerned with the potential public acceptance of the procedure. The argument put forward is that a democratic process with poor implementation is likely to fail. Similarly, an effective procedure executed in an undemocratic manner would equally fail. The first criteria is the acceptance criteria and simply states that that participants should represent a broad and relevant sample size of population of the affected public (Reed, 2008). For true representation of all affected communities, all members need to be considered. However, there are political and economic difficulties in achieving this (Reed et al., 2009). Next is the independence criteria which simply implies that participation should be conducted in an independent and unbiased setting, absent influences such as sponsoring bodies (Fraser et al., 2006). A remedy to this would be the use of neutral organization to execute the project such as university academics (Gene and Lynn, 2000). The criterion of early involvement is a reoccurring opinion in literature as a number participatory frameworks recommends that participation should occur as early as reasonably practical, an example is the placement of a hazardous site facility. The first key action should be discussion with citizens to determine if

the site is even needed. Therefore early participation allows for agenda setting from the onset, which may also be the most significant element a citizens may have the skills to participate in (Cohen et al., 2015; Kotus and Sowada, 2017; Rexhepi et al., 2018).

Still, caution is recommended in participatory process as this may lead to too many participants which may cause confusion over aims, and produce defensive arguments. Hence, it is quite possible that each stage of participation requires a certain level of participation and each level may not involve all participants equally (Reed, 2007; Reed, 2008; Reed et al., 2007). The next is the criterion of influence which simply implies that the decisions should have a genuine impact, which goes back to Arnstein (1969) ladder of participation, asking the question what power of decision making is afforded to the citizens. The next two criterions are particularly of significant importance to developing nation. I.e. criterion of transparency, where the public can see what is going on and how decisions are being made. The other criterion is resource accessibility, which was also mentioned under the Beierle (2002) five quality questions. This leads to the process criteria's which considers not only resources accessibility but also criterion of task definition, structured decision making and cost effectiveness (Gene and Lynn, 2000). These are more focused on the effective implementation by giving due diligence to the process e.g. ensuring the process is affordable and as earlier mentioned ensuring the right resources are available for participants to make an effective decision. These processes of effective participation are key elements to consider when your investigation involving the citizen in decision making. This leads to the important question and as Reed (2009) would frame it "Who is in?" meaning, how do we determine the participants in participatory process and what method do we use to extract relevant information.

5.2.3 Stakeholder analysis and methods

The question of 'who is in?' is answered via stakeholder analysis. This is a process that defines the social and environmental phenomenon affected by the decision or action ii) it identifies individuals, groups and/or organizations affected by or that can be affected by the aforementioned phenomenon (This also includes non-human, non-living entities and future generations. This is then finalised by prioritizing the selected individual or groups in the decision making process. The importance of stakeholder analysis to indicator development is that before the actual survey on whichever urban issue such as transport, energy, water etc., questions of whose in and why needs to be answered. In short, who has a stake in the phenomena under question? Meaning, how can diverse stakeholders be represented and how are their interest and influences taken into account. Finally, if the stakeholders or participant are defined by the issues that are being investigated, then who defines these issues? Fundamentally, the stakeholder analysis investigates power dynamics, transparency and equity in decision making (Reed et al., 2009). The absence of stakeholder analysis heightens the tendency of the powerful and well connected to have greater influence on the decision making outcome. However, this method can also be abused depending on the underlying agenda, by dictating who to empower via selection. This could lead to hidden agendas skewing the result of the process (Friedman and Miles, 2002; Friedman and Miles, S., 2004.) When executed properly, it can be used to understand a diverse range of conflicting stakeholder interests. Gass (1998) also highlights the issues of skill and knowledge required to execute stakeholder analysis efficiently. These counterarguments are partly why this process tends to be overlooked in the participatory approach. Nonetheless, the determination of who has a stake in the initiative is still an important aspect of participation. To determine this, three categorizations are used, which include (i) identifying the stakeholders (ii) differentiate and categorize the stakeholders and iii) investigate the relationship between stakeholders. Different methods can be used to achieve each step. Firstly, If the boundaries (social, environmental economic, institutional) of the phenomena are clearly defined then the

participants can be easily identified. The participants could then be obtained, through interviews, focus groups or a combination of relevant survey methods, as this provides an understanding of the boundaries of the phenomena under investigation. It is generally not possible to consider all participants and a line has to be drawn at some point based on objective criteria's (Reed, 2008; Reed et al., 2009). Yet, the chicken or the egg question emerges, i.e. should the phenomenon dictate the participants involved or vice versa.

Regardless, both stakeholder analysis and the execution of the actual survey requires the selection of an ideal survey techniques to ensure efficient participation based on the system boundaries i.e. limitations context, available resources etc. Gene and Lynn (2000) attempts to address this by assessing the quality of participation procedures and techniques. These techniques enable citizens to actively participate in the decision process. There is generally no one size fit all method to the selection of survey techniques, in some cases, due to context and constraints an ideal survey method may be deemed unsuitable (Lin and Simmons, 2017; Soma et al., 2017). In other cases it may be a combination of techniques that would be best utilized for effective decision making (in this case, indicator selection). Due to various unpredictable environmental, social, institutional and economic factors, the precision of defining the measuring criteria to categorize effective participation is qualitative and liable to modifications. Thus, it is not entirely possible to definitively state whether a specific method will succeed or fail (Beierle, 2002; Lawrence, 2006; Warner, 1997). Gene and Lynn (2000), however, postulates based on gathered experiences that the most appropriate method of citizen participation will be on the specifics of the particular situation and more value based or acceptance based decision would require higher participation as opposed to more knowledge based decision, which would require lower level of participation. Table 5.1 illustrates eight key approaches and their level of importance used to gain the input off various citizens as regards policy, and other technical aspects of decisions making. In terms of developing a method for indicator selection, the table 4.1 illustrates within a spectrum, the

parameters and the likely consequences of a selected method when involving citizens in decision making.

Table 5.1: Participation survey methods against a variety of evaluation criteria

(Source: Gene and Lynn, 2000)

	Referenda	Public Hearings	Public Opinion Survey	Negotiated Rule Making	Consensus Conference	Citizen Jury/Panel	Citizen Advisory Committee	Focus Groups
Acceptance Criteria								
Representativeness of participants	High	Low	Generally high	Low	Moderate (limited by small samples)	Moderate (limited by small samples)	Moderate low	Moderate (limited by small sample)
Independence of true participants	High	Generally Low	High	Moderate	High	High	Moderate (often in relation to sponsors	High
Early Involvement	Variable	Variable	Potentially high	Variable	Potential high	Potential High	Variable but may be high	Potentially high
Influence on final policy	High	Moderate	Indirect and difficult to ascertain	High	Variable but not guaranteed	Variable but not guaranteed	Variable but not guaranteed	Liable to be indirect
Transparency of process to the public	High	Moderate	Moderate	Low	High	Moderate	Variable but often low	Low
Process Criteria								
Resources accessibility	Low	Low-moderate	Low	High	High	High	Variable	Low
Task definition	High	Generally high	Low	High	Generally high	Generally high	Variable but may be high	Variable but may ne high
Structured decision making	Low	Low	Low	Moderate	Moderate (influence of facilitator)	Potentially high	Variable (influence of facilitator)	Low

Cost-effectiveness	Variable / low	Low	Potentially high	Potential high	Moderate to high	Moderate to high	Variable	Potentially high

5.2.4 Selection of Case Study

In order to develop an integrated participatory approach that can be used to effectively select HSI for NSATs, a case study was required. The study uses an African city (Lagos, Nigeria) to not only illustrate how participatory integration can be implemented but to do so in a city where NSATs do not exist (Dawodu et al., 2017). This can then serve as an optimized template for future development of NSATs not only in Western cities but African nations as well. The motivation of NSATs originates from SDG 11, which the United Nations proposed as a goal to attain sustainability in communities and cities. Various themes and targets under SDG 11 exist such as waste management, disaster prevention, land use and transportation etc. For the sake of brevity and also due to the regional focus of SDGs in the sub-Saharan region, three key themes were selected and these are transport, land use and dg 11 (United Nations Economic Commission of Africa, 2015). The section below briefly describes the city of Lagos, which is followed by methodology of how people of Lagos were factored into the participatory process. Also, the Map of Lagos is illustrated in Fig 5.3 and show Lagos mainland and Lagos Island as the location where the survey in this research was conducted.

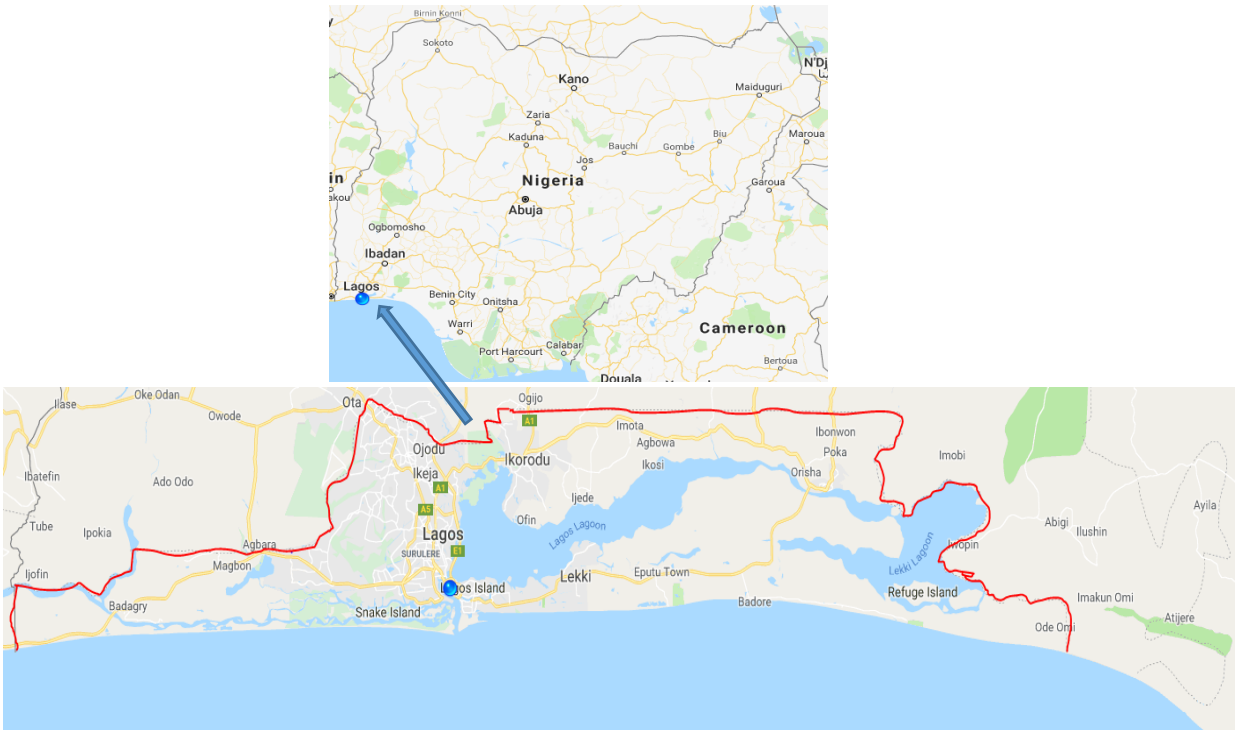


Fig. 5.3: Simplified map of Lagos and Nigeria (Source: google map)

5.2.4.1 Brief overview of Lagos State

Lagos is a coastal city, which borders the Atlantic Ocean and is one of the 36 states of Nigeria. the land mass is calculated to be 3, 577km^2 and 787 km^2 of inland water, Lagos is the smallest state in Nigeria in terms of landmass, but also the most populated (Omole et al, 2015). The land percentage takes 0.4% of the country and accommodates 10 percent of an estimated Nigerian population of 200 million (Oduwaye, 2009; Abila, 2014). Lagos is predominantly a metropolitan area and is also the most urbanised out of all the states, with about 5% of the state population being rural. These statistics have serious consequences for one of the top ten megacities in the world. A strain on infrastructure can be seen, and includes problems with housing, water access, land use, waste management, storm drainage, traffic congestion, insecure power supply, roads, security, over population, slum development and other socio economic activities (Oduwaye, 2009). This is additionally exacerbated by corruption of government officials, poverty, unequal share of wealth, lack of jobs and cultural and administrative issues (Afon, 2007; Elias and Omojola, 2015; Soyinka et al., 2016). Even with these issues Lagos stands to be the best served with infrastructural facilities in the

country, with the exception of Abuja (Oduwaye, 2009). While Nigeria is an oil rich country, it is still inefficient in electricity generation, resulting in frequent electricity interruptions due to load shedding. Specifically, there is a demand of 16000MW of energy from Lagos, which has a generating capacity of 4000MW (Oyedepo, 2012).

5.2.4.2 Transportation and connectivity

Urban transportation in Lagos and Nigeria as whole remains riddled with problems, off which are derived from similar factors. These include rapid urbanization and an increase in population heightening the amount of vehicular activity (Onatere, 2014). Subsequently, an increased rate of car ownership, congestion, highly inept public transportation system, inadequate road networks, poorly timed traffic signals, and poorly built roads (uncompleted roads and potholes debris present on roads) serve as big deterrents towards efficient transport. From a non-infrastructural perspective, there is also a wide-spread violations of traffic laws. Wrong-way driving, and abrupt stoppages by drivers (even on highways) are prevalent road practices. (Ukpata and Etika, 2012; (Ibitayo, 2012) . For example, in a study by Ibitayo (2012) on transportation adequacy in Lagos via questionnaire survey and observation, results revealed that the causes of congestion were 1) drivers that load and offload passengers at the middle of roadway 2) one way drivers 3) flooded roadways 4) area boys/local touts 5) road way construction 6) roadway accident 7) vehicular breakdown 8) traffic police check points areas. Also, riding bicycles is not a common form of transportation in Lagos due to lack of bicycle lanes, resulting in frequent accidents. Walking, while popular, was identified to be popular not so much by choice but necessity borne out of the traffic congestion. Notably, 70% of respondents surveyed opt to stay after work-hours, in a bid to avoid the traffic. Furthermore, roadside vendors, hawkers and street traders proliferate the roads, aggravating the bottlenecks of traffic. Cars tend to be bought second-hand, suffering from the problems of over-usage and 'age'. Poor vehicle maintenance, combined with the common practice for drivers to drive without licences, add to the number of accidents and

breakdowns on road, and more congestion. (Asiyanbola et al., 2012; Ibitayo, 2012; Solagberu et al., 2015). Solagberu et al. (2015) studied 702 pedestrians over the course of a year in Lagos, revealing that the highest injuries were caused by crossing the highway (63%), walking along pavements (17%), and standing by bus stops (12%). In addition, the vehicles responsible for these accidents were largely motorcycles, followed by cars. The study also found that a lack of observation and enforcement of safety measures by drivers and authorities formed the basis for these findings. Additionally, annual growth rates of car ownership are particularly high in Lagos, despite its status as a developing city. Private cars account for most of the vehicular traffic in Lagos, and numbers are projected to rise, due to the convenience, safety, reliability and prestige it affords (Chijoke (2005).

Another major issue on Lagos state roads is traffic congestion. The consequences that arise from traffic congestion includes longer trip times which means increased fuel consumption, more particles emitted to the environment, reduced worker efficiency due to fatigue and stress, health deterioration, frustration in terms of road rage, and wear and tear of the vehicles (Balogun et al., 2012; Ibitayo, 2012). In addition rail transport is obsolete in the metropolitan area of Lagos, though current rail project is underway (LASTMA 2005).

5.2.4.3 Sustainable site: land use and open spaces

Studies have shown that by 2025 about 71% of the African population would be concentrated on 30% of the continents' habitable land area. In these areas, green spaces in these areas have been identified to take up less than 3% (Brockerhoff, 2000; UN-Habitat, 2003). However, some cities do exist in Africa that consider green spaces such as Cairo, Cape Town and Abuja (Mensah, 2014). A lack of green spaces have been associated with adverse consequences, ranging from urban pollution, urban heat island effect, heat waves, erosion and flooding (Omar 2000; Abegunde et al., 2009). Therefore, the development and creation of green spaces is an agenda that needs to be championed nationally and regionally. In Lagos, approximately 3% of open space (green space included) is the representation of land use

distribution (i.e. 9669 ha (52.1% of residential land use), 1021 ha (5.5% of commercial use), 1448 ha (7.8% of industrial use), 2784 ha (14% of institutional and special uses), 3340ha (18%, transportation), 520ha (open spaces 2.8%)). The 2.8% also represents recreational space, which include parks, gardens, urban agricultural land, incidental open spaces, commercial agricultural land, commercial and individual horticultural gardens (Oduwaye 2006; Abegunde et al., 2009; Oduwaye 2013). Nonetheless, despite the importance of green spaces, there has been no significant plan to guide city development, let alone propagate a green city initiative. While Lagos has begun the practice of planting trees, and ranked top five amongst other African cities with respect to the number of trees planted (Mensah, 2014), the city is characterized by limited land, choked housing development, prevalence of slums, heavy industry and high number of vehicles (Abegunde et al., 2009; Oduwaye, 2013; Olaleye et al., 2013), making such a plan all the more necessary, despite these positive developments.

Other significant forms of open spaces in Lagos are that of beaches. This also serves as a form of tourist attraction that generates revenue and offers a place for social activities. It is also the most popular outdoor recreational location in Lagos, attributable to it being a coastal settlement (Ajala and Aliu, 2012). Lagosians, especially on weekends and festive periods like Christmas and "Ileya" (a localized term for the Muslim festival, often held about 2 months after Ramadan Fasting every year), head to the beaches in droves. Some of these beaches include Eleko, Kuramo, Ilado, Ojo, Bar (Victoria), and Coconut in Badagry (Ajala and Aliu, 2011). However, Adejumo (2005) argues that most of the beaches in Lagos are not currently in conditions that can optimally attract tourists. Ajani (2016) corroborate this point, highlighting the environmental and security-related shortcomings of several prominent beaches in Lagos. To reach an acceptable standard, waste management would need to improve, as well as the facilities offered. Heightening security, providing health services and potable water are amongst other suggestions.

5.3 Methodology

5.3.1 Phase 1: Literature review and Top-down selection

In order to develop a methodology for an integrated approach to HSI selection, three processes were involved:

1) An extensive literature review of participatory practices was conducted, during this discovery it was argued by Reed (2006) that in order to successfully develop a tool kit approach to integrated participation, 'the process must be underpinned by appropriate philosophies'. Thus, aside, a general literature review, five pioneering studies and best practice methods formed the basis for the rules that would guide the early selection of SI. Firstly, this study opted for the Expert-initiated approach and its associated benefits (see section 5.2.1 reasons and advantages). This approach is guided and inspired by the philosophies and methods of Arnstein (1969) Ladder of participations approach; John Clayton (1993) Effective decision model for public involvement; Reed (2009) Stakeholder analysis and identification methods; Beierle (2002) Five questions to ascertain quality of stakeholder decisions and ; Gene and Lynn (2000) Ten requirements for effective public participation methods.

2) The next review required the selection of the case study HSI. A systematic literature review of nine NSATs was conducted in chapter 4 in order to come up with a list of HSI (see table 5.2). These HSIs are noted to be created from the top-down (see table 4.1 – Chapter 4); the procedure of the systematic review is explained below and illustrated in Fig. 5.4. Under phase 1 in Fig. 5.4, the second step, required using a case study (Lagos state) and specific themes to illustrate the impact of an integrated approach, this led to the selection of sustainable site (i.e. land and open spaces) and transportation, which are key priorities for SDG11 and sub-Saharan Africa. Step 3 was to collect as many HSI that fit the SDG 11 theme (sustainable land use and transport) from the

nine assessment tools. Similar HSI were merged together under one overarching HSI based on their aims, intents and assessment criteria together (see table 5.2 for seven HSI under sustainable site and five under transportation). similar to chapter 4, nine NSATs were used for this study due to the manuals not being readily available or kept confidential owing to the commercial nature of NSATs (Berardi, 2015; Charoenkit and Kumar, 2014; Komeily and Srinivasan, 2015; Sharifi and Murayama, 2014). Table 5.2 shows the HSI obtained and the frequency of occurrence under various NSATs (BREEAM Communities, LEED Neighborhood, Green Mark for Districts, Green Building Index, Global Sustainability Assessment System : District, The Pearl Community, Green Star, Green Township and CASBEE Urban Development). Each HSI has various levels of occurrences. It should be remembered that HSI occurring once or twice are tagged as context specific due to their lack of uptake by several tools thereby suggesting that the HSI may have been created for context specific purposes. Also, HSI with higher level of occurrences such as seven, eight and nine occurrences are deemed to be more common in nature due to their high uptake under several tools. (See chapter 4 for full method). For the purpose of efficiency and brevity, it was not necessary to test the relevance of all HSI. Hence common HSI and context specific HSI were of primary focus. Mid-range HSI was also included to provide a more holistic view of results. The HSI Biodiversity and Habitat Conservation/Restoration though classified under the ecological theme was observed to have strong links to sustainability site in terms of prioritizing what land should be used for. Hence, as a special case, it was added to the sustainable site theme for investigation in the chapter.

The bottom-up approach is subsequently used to ascertain the relevancy or redundancy of these HSI when applied to Lagos (see Fig. 5.4, Phase 2). This is via the questionnaire approach. Section 5.3.2 explains this process.

Note - All ethical consideration and permissions were made and acquired before the commencement of the survey

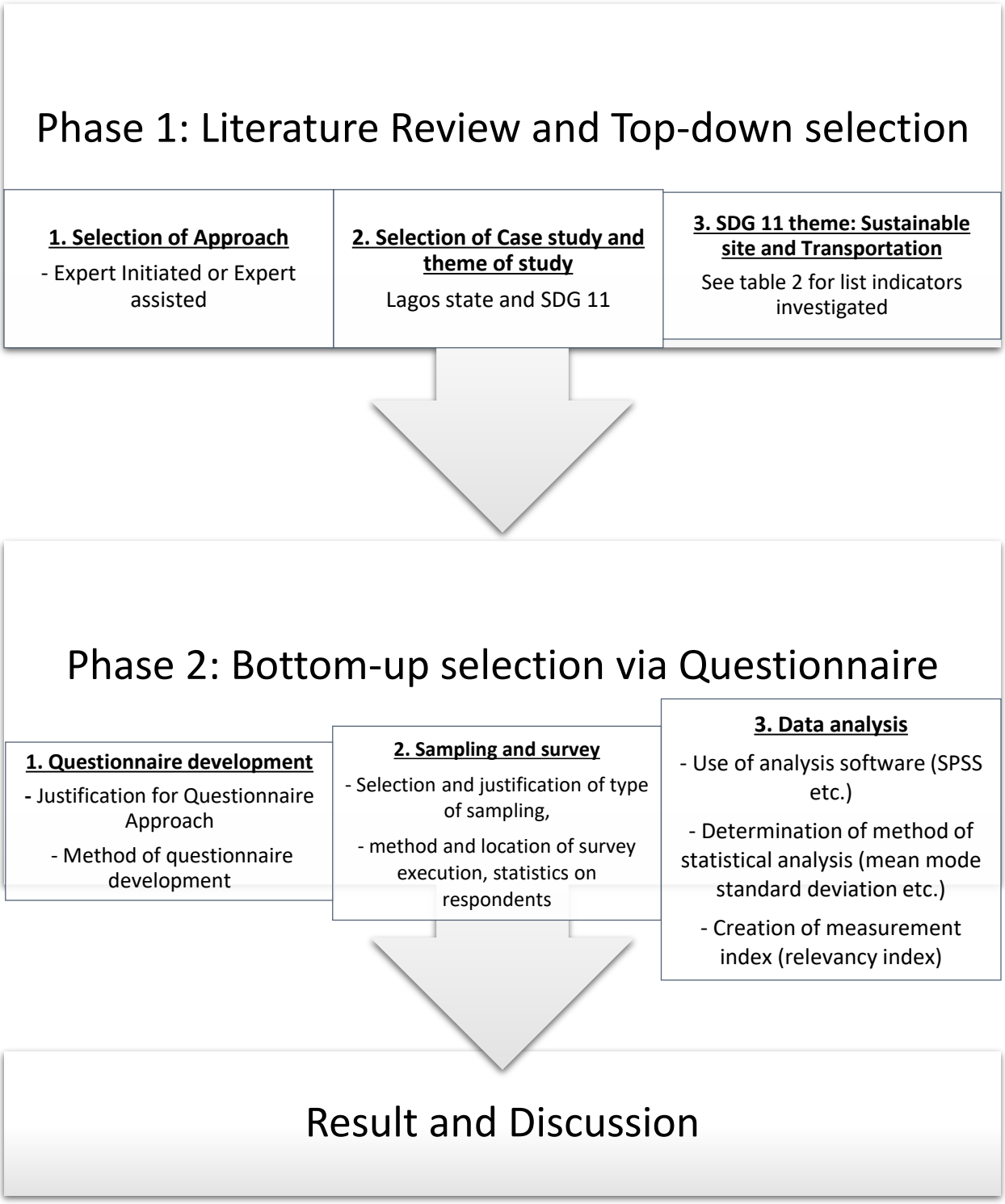


Fig. 5.4: Methodological steps of testing relevancy of HSI via bottom-up approach

Table 5.2: Chosen HSI for investigation

	Occurrences	Neighborhood Sustainability Assessment Tools								
		BREEAM	CASBEE	LEED	IGBC	GSAS	GREEN STAR	GREEN MARK	GBI	PCRS
Sustainable Site										
Mixed use development	9	1	1	1	1	1	1	1	1	1
Timber utilization	2			1						1
Agricultural Land Preserve	1								1	
Heritage and Cultural Identity	6	1	1	1		1	1	1		
Biodiversity and Habitat Conservation/ Restoration	6		1	1	1		1		1	1
Public Spaces/Active urban community	8	1		1	1	1	1		1	1
Sustainable Transport										
Neighborhood Connectivity	2			1						1
Eco-Friendly Transportation	4	1		1	1				1	

Logistics Management and Policy	1		1							
'Bike'-ability	4	1			1	1			1	
Walkability	6	1		1	1	1				1

5.3.2 Phase 2: Bottom up approach via Questionnaire

1) **Questionnaire development:** The method used for data in the expert-initiated approach were questionnaires. Which is categorized under public opinion survey in table 5.1. The key reason for the selection of the questionnaire approach was its high ranking in early participation, cost effectiveness and representativeness.

To begin developing the questionnaire, a strategy from Maclaren (1996) was chosen. The framework used from Maclaren's (1996) study for this questionnaire are both 'domain based' and 'issue-based'. Domain based framework involved basing questions on the key dimensions of sustainability. Issue-based framework involved, basing questions on a list of key sustainability issues in the community for example waste management, water access, employment etc. The frameworks were chosen based on its ease of construction, readily understandable and the ease of incorporating pillars of sustainability into the questions (Maclaren, 1996). Based on this, the four pillars of sustainability serves the theoretical framework behind questionnaire development. Also, in addition to directly asking respondents the importance of an HSI as was done by Turcu (2016), several indirect questions were asked to uncover the underlying rationale behind selection each HSI by respondents. The questionnaire is a combination of open, closed and Likert scale questions (Ornstein 2013).

2) **Sampling and survey:** The sampling technique used is critical case sampling. Critical case sampling is a type of purposive sampling technique that is particularly useful in exploratory qualitative research. This refers to research with limited resources, and research where a single case, or small number of cases, can be decisive in explaining the phenomenon of interest. The idea is to know if the case is decisive. The logic posed in simple terms is: 'If it happens in the given location, it can happen anywhere. And if a group in a given location is having problems, then we can be sure all the groups are having problems' (Patton, 2002, p.237). Furthermore, this study develops an expert-initiated template for early selection of HSI and is not concerned with making statistical generalisations of the urban populace of Lagos, but to a make logical generalisations on the impact of an expert-initiated participatory approach to HSI selection.

A total of 200 questionnaires were filled via a direct approach to citizens of Lagos that were accessible in both areas of Lekki, Victoria Island, Yaba and Ikeja (May-Sep 2016) (see Appendix 5D-1 for breakdown of respondents). 100 questionnaires each were distributed on both the mainland (low cost of living) and Victoria Island (high cost of living) to account for the economic differences (see Table 5.3 for demographic breakdown). Regarding the number of respondents, a few hundred was deemed sufficient. Various factors were factored in -- the goal was to explore a new area of research and the survey contained an investigative purpose, thus allowing a small number of respondents to be sufficient.

Moreover, there were constraints on funding and manpower (Patton, 2002; Ornstein 2013). In short, the sample size of 200 respondents was based on respondent accessibility, the budget (only the researcher was available to give out questionnaires) and the investigative purpose of the integrated approach.

Reverting to stakeholder analysis and identifying the stakeholders, it should be noted that in some cases when there is considerable documentable evidence, and analysts have the intimate knowledge of the individuals or groups of people with a stake in the system (e.g. organization, companies, general public, rights groups, and disadvantaged) stakeholder analysis can be conducted without the participation of potential stakeholders. This method was used in the RELu bird project on predicting how farmers make management decisions on arable land and how this affects farmland bird population. In their study stakeholder identification was non-participatory and was used with the justification of limited resources and also because the farmland birds in UK are well researched and evidence exist in scientific papers, electronic media and key informants. Similarly, due to the exploratory purpose of this study, intimate knowledge possessed by analyst, limited budget, and the issue based method of the questionnaires, any citizen within Lagos could be selected.

Table 5.3: Breakdown of respondent's information

How long have you been living in Lagos?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than a year	16	8.0	8.0	8.0
	1-10 years	36	18.0	18.0	26.0
	11-20 years	36	18.0	18.0	44.0
	21 + years	112	56.0	56.0	100.0
	Total	200	100.0	100.0	

Age

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	18-24 years	35	17.5	17.5	17.5
	25-29 years	73	36.5	36.5	54.0
	30-39 years	58	29.0	29.0	83.0
	40 and above	34	17.0	17.0	100.0
	Total	200	100.0	100.0	

Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	122	61.0	61.0	61.0
	Female	78	39.0	39.0	100.0
	Total	200	100.0	100.0	

Highest Level of Education

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Secondary School and below	11	5.5	5.6	5.6
	First degree or bachelors	101	50.5	51.0	56.6
	Master's Degree or postgraduate	79	39.5	39.9	96.5
	PhD	7	3.5	3.5	100.0
	Total	198	99.0	100.0	
Missing	9.00	2	1.0		
Total		200	100.0		

What is your own salary?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Do not work	27	13.5	14.1	14.1
	< N80,000	39	19.5	20.3	34.4
	N80,00 – N120,000	26	13.0	13.5	47.9
	N120,001 – N180,000	28	14.0	14.6	62.5
	N180,001 – N250,000	27	13.5	14.1	76.6
	N250,001 – N350,000	10	5.0	5.2	81.8
	N350,000 >	35	17.5	18.2	100.0
	Total	192	96.0	100.0	
Missing	.00	2	1.0		
	9.00	6	3.0		
	Total	8	4.0		
Total		200	100.0		

3) **Data Analysis:** Data was analysed through frequency analysis with the use of Statistical Package for Social Scientist (SPSS) (full results can be seen in Appendix 5D-2). This was followed by the description of results that informed the development of the nine rule to expert-initiated selection of indictors. To better understand the impact and implementation strategy of the bottom-up approach, a relevancy index was utilized based on questionnaire oriented results. Similar strategies were used by Al-Hammed and Assaff (1996) and Longe et al. (2009) in their studies, where they termed this the 'severity index'. 'Relevancy' refers to when respondents agree with the 'need' for a resource. It also means respondents citing methods to mitigate the issue under question. Alternatively, it refers to respondents ascertaining the lack of a specific resource, thereby indicating its need. For instance, a lack of park visits by said respondent and said respondent advocating for more accessible parks, (see table 5.3) thus signifying a positive selection of this particular HSI. For clarity, questions that are asterisked are used as supportive questions to understand the constraints behind a HSI. Questions not asterisked are the main questions and in a case where the main questions are more than one under a specific HSI, the average positive responses are gathered to see where they fall under the relevancy index shown below.

1) Less than 46% of negative response = Improbable HSI
2) 56% - 80% = relevant HSI
3) 81% - 100% = Mandatory
4) 46% - 55% = Debatable

5.4 Results

The results shown in this section illustrate the contribution of respondents towards the issue-based questionnaire. Each table represents a specific theme and within each theme sit the HSI. For ease of analysis, sustainable sites were split into 'land use' and 'open space'. The contributions of respondents were used to confirm the relevancy of the HSI and simultaneously provide possible reasons (if any) for their 'relevancy'. These results shall be deliberated in the following discussion section and juxtaposed against existing literature.

5.4.1 Bottom-up approach to sustainable site based HSI

Table 5.4 and 5.5 focuses on sustainable land use and open spaces respectively. The questions in table 5.4 revolves round how land can be sustainably used and topics range from timber use to mixed and use. Via questionnaires the relevancy of the expert recommended HSI were put forward. Also, open ended questions which allowed participants to give recommendations were available. Table 5.5 shows questions related to open spaces and is more focused on respondents opinions on the social aspects of land use. This HSI is called 'active urban spaces', which considers open spaces such as parks, playgrounds, beaches, and sports centre.

Table 5.4: Key results on sustainable land use

Headline Indicators	**Questions developed in association with the Indicators**	**Statistics**	**Verdict**
Timber utilization	Do you consider it bad to cut down trees and forest to develop more land for more people to live and work i.e. for houses, offices and shops?	Yes (57%)	**Relevant (67%)**: However, the mode to achieve the HSI is debatable. Uptake may be swayed more by local benefits
	Would you support a program, policy or law that ensures that for	Yes (77%)	**Constraints:** Due to several uncertainties import or export are viable

	every tree cut town more trees are planted within the city?		options. Local wood production is driven by economic needs of improvement. Importation is driven by a distrust in quality and lack of sustainable timber practices.
	*Wood is an important product in Lagos, used for building construction (farming structures and houses, furniture such as table, chairs, beds shelves etc.). How would you recommend this would to be obtained?	Import from other country (49.5%); Chop locally (50.5%)	
	*For the above, give reason for selection of locally produced wood?	Use locally produced wood because of reduction in rate of importation (high cost) (49.3%); Use locally produced wood because of reduction of environmental impact (20.9%); Use locally produced wood because of development of local industry (19.4%)	
	* For the above, give reason for selection of Imported wood	Import from countries with replanting programs: preservation of local trees (33.3%; 12 respondents out of 96 gave reasons)	
Mixed use development	Would you encourage Lagos state planners to mix residential houses close to jobs and offices?	Yes (65.3%)	**Relevant (65.3%)** **Constraints:** Providing a healthy combination of facilities. I.e. avoiding a

	*Would you support investment of government funds in non-residential community infrastructure, such as business hubs, public libraries etc.?	Yes (91.7%)	biased focus one or two types of infrastructure.
	*In order of preference arrange your priorities to be developed in community. A) Sport centre and gyms in your community B) Public parks and playgrounds C) More shopping malls D) Others (please state)	Sport centre and gyms (first Priority); Public parks and playgrounds (second priority); more shopping malls (third priority) However; via point based system (where 4 point was given to 1st priority and 1 was given to the 4th priority); sport centre (36%); public parks (36%); shopping malls (24%)	
Biodiversity and habitat conservation/restoration	Do you think Undeveloped land Should be left undisturbed and not used for construction to preserve the environment i.e. save the land that is home to animals and birds?	No (54.7%); Yes (46.3 %)	**Relevant (58.5%). Avg. (46.3%+54.4%+75%)** **Constraints:** The need for sustainable land use and preservation are not ecologically and environmentally driven; emphasis is laid on local and international tourism and historical preservation. There is relatively more support for
	Do you think Undeveloped land should be used for city expansion and creation of roads, walkable	Yes (54.4%)	

	streets and more affordable homes?		land preservation for expansion of roads, affordable home etc. as compared to environmental preservation of animals. However, policy for "endangered" animals and green and blue infrastructure is high.
	Would you support Program policy or law that protects trees and endangered animals in Lagos? I.e. nothing can built in these areas.	Yes (75%)	
	*Would you support the conservation of lakes, swamps, native plants and trees in Lagos?	No, it should be removed for other important things like land for food (10.6%) No, it should be removed for important things like affordable homes (4.2%) No, it would be too expensive to maintain (4.2%) Yes, it should be conserved to save the environment (30.2%) Yes, it should be conserved and maintained because it is part of our identity (9.5%) Yes, it should be conserved and maintained to boost tourism an increase Lagos revenue (25.4%) Yes, it should be conserved and	

		renovated for the Lagosians to visit, rest and relax (15.9%)	
	*How concerned are you about the wildlife (animals not pets) animal life that exist is Lagos?	I have little concern (52.3%); I am concerned (26.7%)	
Agricultural Land Preserve	Do you think Undeveloped land should be used for construction that promotes agriculture and other food production activities?	Yes (80.1%)	**Relevant (80.1%)**
Heritage and Cultural Identity	Do you think Undeveloped land that has historical meaning and value like trees and unique to Lagos environment should be preserved?	Yes (91.6%)	**Mandatory (91.6%)**

Table 5.5: Key results on sustainable open spaces

Headline Indicators	**Questions developed in association with the Indicators**	**Key Statistics**	**Verdict**
Active Urban Environments	Do you feel that Lagos needs more outdoor parks where the public can relax, exercise and have fun?	Yes, it does (80.2%), It's not safe (10.2%), No, I don't see the need (9.6%)	**Mandatory (85.7%) Avg. (80.2%+94.3% + 82.4%)**
	Would you encourage the development of more open sports fields?	Yes, I would (94.3%)	**Constraints:** The validity and success is hinged on the safety

	Would you encourage the development of public playing grounds for children in your community in Lagos?	Yes (82.4%), No, it's not safe (11.2%)	and security of these areas. It is also hinged on the location of these open spaces, cleanliness and the level of maintenance of these places**.**
	*How many different parks have you visited in Lagos to have picnics, play sports and have outdoor activities? Note: A park is an area of grass, vegetation and trees surrounded and sometimes populated by birds and other peaceful animals	0parks (48%), 1 park (18%), 2 parks (19.5%), 3 parks (7%)	
	*Would safety affect your support for more outdoor spaces like parks and beaches for people and children?	Yes (84.5%), Yes but other concerns (9.8%)	
	*Please state 1 or 2 of those concerns	Improving security at beaches and park (hooliganism, kidnappings, general safety) (60%); Lack of a Clean Environment (20%); More activities are required (20%)	
	*How clean and maintained are the beaches you have been to?	Could be maintained better (49.5%); Not well maintained (30.9%); No maintenance at all (11.9%)	
	*Do you consider the beaches enough in terms of open outdoor space for Lagos?	Yes (52.5%), No (47.7%)	

	*How safe do you feel when at the beach?	Safe – totally safe (64%); Unsafe - very unsafe (36%)	
	*How many times in a month do you go to the beach?	Less than 5 times a year (29%); one weekend in a month (22.3%)	
	*If the park or beach were closer to your home or community would you attend more times	Yes (81.2%), No (18.8%)	

5.4.2 Bottom-up approach to sustainable transport

Table 5.6 examines the environmental, social, economic and institutional aspect of sustainable transport and connectivity. Similar to the above, participants give a verdict on the relevancy of HSI such as eco-friendly transportation, which is seen as debatable, connectivity and walkability which is seen as mandatory, bikeability, which is observed to be improbable and logistics management and policy, which is deemed as relevant. Also, some of the HSI come with constraints that affect their success or failure, this is also identified in Table 5.6 and summarized in Table 5.7. The implications of this is deliberated in the discussion section

Table 5.6: Key results on sustainable transport and connectivity

Headline Indicators	Questions developed in association with the Indicators	Statistics	Verdict
Eco-Friendly Transportation	If available, would you consider alternative option of fuel such as electric car or cars that run of cassava oil, and other vegetable oil?	Yes (90%)	**Improbable (32%):** **Avg. (90% +9% + 6.5%)** **Constraints:** Inconsistent power supply and high cost of clean transport. Though clear

	Electric car cost 11 million Naira, would you buy this vehicle considering the fact that it runs on electricity and has zero pollution/smoke?	No irregular power (49%), too expensive (35.4%), yes no fuel scarcity and queuing (9%), yes reduce air pollution (6.5%)	motivation for possible support is reduction in traffic hours and reduction in pollution for health benefits. Incentive can improve selection.
	*If you answered No in the above, would you change your mind, if the government provided, 30% off (7.7 million Naira) any purchased	Too expensive (26.7%), irregular power (50%) Yes I would (23.3%)	
	*Cars are known to pollute the air with their smoke and cause traffic. If available, what would motivate you to consider other transports such as efficient BRTs, cycling, electric trains, electric cars	Reducing the hours you spent in traffic (1st Priority Selected = 229 points), Improve health and respiratory diseases such as asthma, (2nd Priority Selected = 202 points),	
Bikeability	How regularly do you use bicycles	85.6% (Never), 14.4% (once week - everyday)	**Improbable (35.3%) Avg. (14.4%+42.7%+53.2%)** **Constraints:** no available bicycle infrastructure such as cycle lanes and storage facilities, dependency on more comfortable means of transport e.g. car.
	Would you consider using a bicycle for short distance travel?	No (57.3%), 42.7% slightly- I may consider it	
	How regularly do you use motorcycles	46.8% (Never), 53.2% (Once a week - Everyday)	

	*Would the development of bicycle lane improve the likelihood of you using a bicycle	No (18.8%); Slightly I may consider (26.9%); Most likely (24.9%); Highly likely (7.6%); Yes, Definitely (21.8%)	
	*Why don't you use Bicycles	*I don't have one (36%), Not safe (15.3%), No cycle lane) (11.7%); I don't know how to ride a bicycle (11.7%)	
	*Why don't you use Motorcycles	Unsafe (43.4%), I have a car (34%)	
	*Would providing a safe bicycle storage at shops, offices, homes improve the likelihood of using bicycle	No (36.2%), Slightly (36.2%), most likely (18.9%), highly likely (3.1%), yes, definitely (5.5%),	
Neighborhood connectivity	Do you agree that a new community or area should be developed where there is already developed route for transporting people?	Yes (75.4%)	**Mandatory (81.4%): Avg. (75.4% + 87.4%)** There is strong need to reduce traffic due to automobile dependency. Positive reception towards train use as mitigation strategy, motivated by its ability to avoid traffic. **Constraints:** though connectivity exist a good percentage face public transport connectivity issues; the concept of a car leaves respondent uninterested in
	On scale of 1 to 5 how bad would you rate the level of traffic in Lagos?	Very high level (49.2%); High level (38.2%). This equates to (87.4%)	
	*How accessible is public transport in your community i.e. how close are bus stops to your	The bus stop is not too far (I have to walk a maximum of 10mins) (28%), Very close I have to walk	

	homes, offices and shops	(24.9%), I have a car it doesn't matter (19.2%), The bus stop is very far (I have to bike or take keke there) (17.1%)	other transport options; this is linked to safety and lack of comfort afforded to them by buses and bikes. Also Infrastructure plays a role in connectivity such as lack of bus stops. It should be noted that the improved use of trains is based on avoidance of traffic, reduced environmental impact such as air pollution and it should be cheaper than cars.
	*How regularly do you use public buses	Never (39.4%); Everyday (17.6%); Once a week (15.5%); Twice - six times a week (24.6%)	
	*How regularly do you use private cars	Every day (43.6%); Never (17.9%); Once a week (13.8%); Twice-six times a week (43%)	
	*Why don't you use private car	I don't have one (95.7%)	
	*Why don't you use Buses	I have a car (50%), Unsafe (17.8%); Stressful (10.9%); No bus route (8.7%)	
	*If trains were made available and connect mainland region of Lagos to the island region or mainland to another part of mainland would this be your daily transport to work?	Yes, if I can avoid the traffic (43.4%); Health concerns; Yes, trains are better for the environment than cars and buses (25.5%) Yes, if it is cheaper than the using in car (17.9%)	
Walkability	Do you think there are enough sidewalks in Lagos that secure pedestrian safety?	No (81.5%)	**Mandatory (84.75%)** **Avg (81.5%+ 88.8%)** **Constraints:** There is a clear lack of sidewalks and safety infrastructure for walking
	Should the government (local,	Yes (88.8%)	

	state and federal) do more about pedestrian safety on Lagos roads?		
Logistics Management and transport Policy	How do you think the government can solve the problem of trailers and freights that transport goods and other products like petrol and diesel in Lagos A) Goods and products should be moved by trains if possible **(infrastructure)** B) Policy and law that bans freights and trailers from moving during the day **(Policy)** C) Roads should be widened to make separate lane for trailers and freights **(Infrastructure)** D) A different route should be developed for freights and trailers **(Infrastructure)** E) Trailers and freight should have minimum speed of movement **(Policy)** F) All trailers and freight developed from 2005	Policy related solutions (57%) Policy: B (29%); E (18%); F (9%). Infrastructure: A (16%); C (13%); D (13%)	**Relevan**t: There is more support for policy driven action against vehicles that cause pollution, accidents and delays

	downward should be replaced with more efficient model **(Policy)** G) Other (please state the other)		
	*Air pollution is quite high in Lagos, which law would you support	Support laws that removed old vehicles on the road and support laws that places heavy fine vehicles depending on how old they are (85.1%)	

5.4.3 Relevancy and constraints

Table 5.7 summarizes the validity and constraints that support or would inhibit the selection and optimum utilization of an HSI. Results show one debatable HSI, two improbable HSI, five relevant HSI and four mandatory HSI. The results also showed that constraints ranged from financial to infrastructural challenges. The implications to this is assessed in the discussion section.

Table 5.7: Relevancy and constraints of HSI

Expert initiated HSI	Relevance	Constraints	Occurrences
Sustainable Land Use			
Timber Utilization	Relevant	Financial Incentive; Lack of sustainable Environmental laws	2
Mixed Use Development	Mandatory	Providing a healthy mix of community infrastructure	9
Agricultural Land Preserve	Relevant		1
Heritage and Cultural Identity	Mandatory		6

Biodiversity and Habitat Conservation/Restoration	Relevant	Raising of awareness	6
Sustainable Open Space			
Active Urban Environments	Mandatory	Connectivity; Safety; Maintenance	8
Sustainable Transport			
Bikeability	Improbable	Bicycle and road infrastructure	4
Walkability	Mandatory	Lack of pedestrian or safety infrastructure	6
Logistics Management and Policy	Relevant		1
Neighborhood Connectivity	Mandatory	Automobile dependency; Safety; Awareness; comfort; Traffic incentive; Environmental incentive; Financial incentives	2
Eco-Friendly Transportation	Improbable	Power infrastructure; Technological affordability	4

5.5 Discussion

5.5.1 Expert initiated integrated participatory approach for early selection of indictors

As mentioned earlier, this study aims to illustrate how an integrated approach to early indicator selection can optimise the selection of indicators for NSATs. Theoretical inspiration is obtained from Arnstein (1969) Ladder of participations approach; John Clayton (1993) Effective decision model for public involvement; Reed (2009) Stakeholder analysis and identification methods; Beierle (2002) Five questions to ascertain quality of stakeholder decisions and ; Gene and Lynn (2000) Ten requirements for effective public participation methods. The method was developed via aforementioned ideologies and tested via questionnaire application to the citizens of Lagos. The method is exploratory and based on an expert-initiated approach. A limitation that should be highlighted is that the selected method of decision making via the bottom-up approach was sampled through qualitative means, so generalisations are limited except for with support of secondary data i.e. observations, published studies etc. Nonetheless this study still provides meaningful information on how an integrated participatory approach could be utilized in various forms by developing a template, tested via local participants in Lagos. Fig. 5.5 illustrates the developed method for early indicator selection of NSATs and the following sections discusses the processes in detail. The Letters (A_T - F_T) flow in alphabetical order and the subscript T represents the Top down phase. Similarly, (A_B – D_B) also flow in alphabetical order and the subscript B represents the Bottom-down phase.

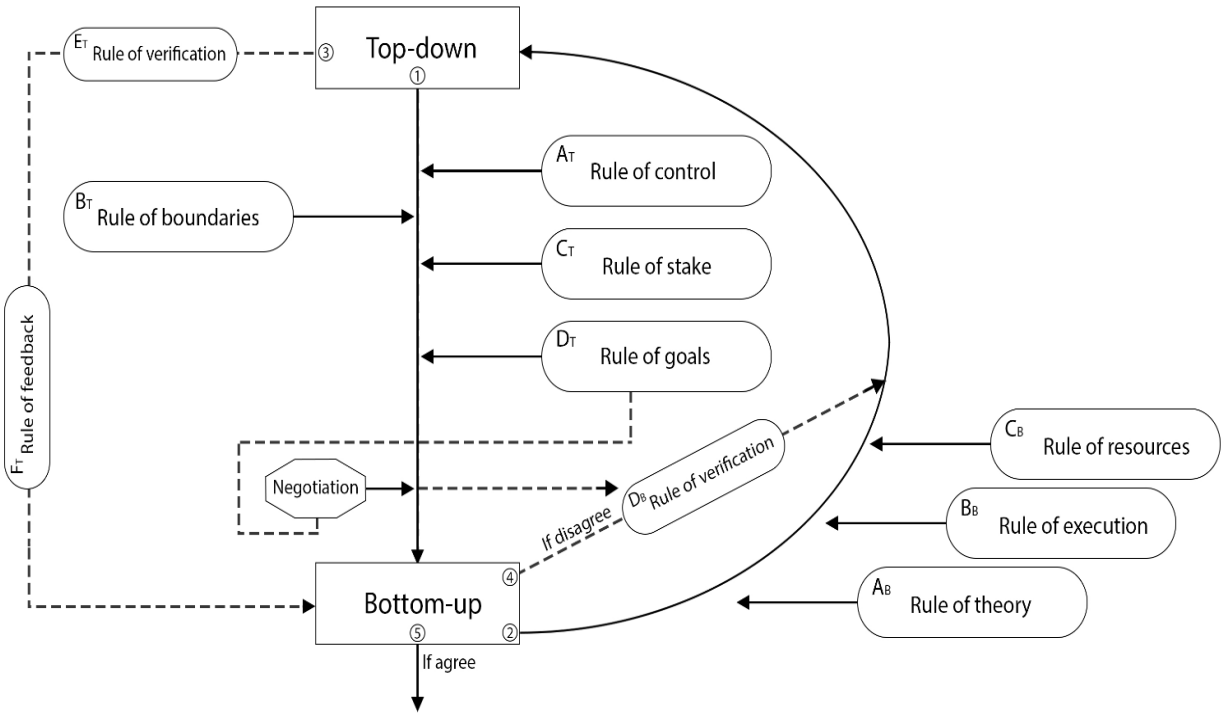


Fig. 5.5: Expert-initiated integrated participatory approach and guiding rules

5.5.1.1 Expert-initiated approach: Top-down

The first major step involves the expert-initiated approach, this was chosen because of the ease of use, accessibility to pre-existing data, time and resource constraint. Remember that under this approach two additional types of processes exist (see section 5.2.1). The community based approach (bottom-up approach) was chosen to highlight the context-specific socio-economic and institutional perspective. This balance is based on the argument that the top-down approach leads to heavily environmental indicators, neglecting or not addressing sufficiently other dimension of sustainability.This led to a sort of reductionist or validation process.

Working with this premise, certain constraints particular to Lagos, were key motivations to the selection of the expert-initiated questionnaire approach (1) Resources are limited (both time and money) – authors primary concern was to develop a methodology that would be both affordable and effective if used, and would also be relevant at that specific

time. Take the case of the participatory indicator project on sustainable forestry in British Columbia, due to the back and forth and development of over 140 social and environmental indicators in the early stages of the project, it took years for completion of the project. The long time spent made it too late to have any significant impact to policy at the required moment (2) To a certain extent this process provides a certain level of objectivity and validity with the indicators under contention. These HSI were selected out of nine already developed and heavily scrutinised tools that have been used to develop and brand settlements sustainable prior to this study. Hence, it stands to reason that the compiled HSI, though preselected through top-down influence, provides a high level of quality assurance.

To begin, the first process provides a predefined set of HSI selected via any scientific approach that is deemed sufficient (see section 3.1 for approach used in this study). Fig. 5.5 illustrates the process of validating and adding to the expert-initiated set of selected SI. To achieve this, certain rules of best practice were developed for HSI selection for NSATs, motivated by theorems, stratagems, and templates from key studies (see section 5.2.2 and 5.2.3):

1) **Rule of Control/Influence (A_T)** – This step implies that during the selection process, as a prerequisite, the people must have actionable influence in the determination of the indicators. Utilizing Arsteins (1969) ladder, the recommended minimum level of participation should be from the high level of participation which is 'Partnership' because this would enable citizens to negotiate and engage in trade-offs with traditional power holders. Anything less than this would not allow effective integration. Rungs of 'Consultation' and 'Placation', indeed allow the voice of the citizens to be heard, however, no assurances exist in changing the status quo. For this process to be effective the lower rungs of Tokenisms are simply not enough (see Fig. 5.1). Take an example, under sustainable land utilization, respondents opted for more 'agricultural land use' and 'building heritage preservation' with 'city expansion' being

the last. Based on the impacts of climate change and the principles of sustainability one can see how all these HSI are valid methods. However, with the context of Lagos it would then be counterproductive for authorities to select city expansions due to economic or population justifications, without investigating the reasons for the choices made by citizens. The dismissive approach of expert towards public opinion is well documented under various urban scenarios in Africa (UN-HABITAT, 2009). This dismissiveness is one of the reason why the trust in the African government is very low. By not giving reasonable power to the bottom-up decision makers, the process becomes a mirage focused on sustainability box ticking and ultimately renders the procedure ineffective. This can then lead to issues of frustration, protests, litigation etc. The result also raises the question 'is public acceptance necessary?' because with respect to the question, all choices seem relevant. However, if the decision is based on 'acceptability' as opposed to 'quality' then ideally agricultural and preservation of heritage would be selected as most important.

2) **The rule of boundaries (B_T)** - The next step involves the rule of boundaries, which emphasizes two main aspects. The first aspect is based of Reed et al. (2009) initial process to stakeholder analysis, which asks the question; what are the parameters within the boundary of an investigated phenomenon and how would they potentially affect the project i.e. what are the social, economic, environmental and institutional boundaries at which a decision can be made? Take for an example economic boundary, this could mean firstly, the amount of resources available in order to execute the participatory process. Based on table 5.1 some survey processes require more rigor, commitment and skills than others. Also within the decisions being made, knowing early on the economic constraints behind a specific decision or even support could prove to be useful. Take institutional dimension for example, questions that needs to be asked for the selection of HSI are 'is there support from local or national

government in making participatory decisions.' Secondly, 'are these support systems binding commitments in national law or international agreements (e.g. SDGs)? With respect to the Lagos case study, the current state of policy, regulations or incentives that govern land use and transport need to be understood. Looking at the boundaries from social perspective, a question worth noting could be 'what is the current state of awareness or education of people within parameters being investigated.'

The aforementioned argument leads to a sub-rule i.e. the rule of non-negotiables. This implies that within the boundary investigated, what are the expert initiated topics or issues or in this case HSI that cannot be negotiated on. The source of the non-negotiability could be embedded in policy, it could be embedded in scientific justification etc. Take for example, Active Urban Environment and Walkability, which occur eight and six times respectively (see table 5.7). Experts could argue that due to this high level of occurrence, such tools cannot be excluded. Similarly, an identical argument can be made for the 47 common HSI chosen in Chapter 4, due to its high coverage of DoS and interlinkages. This could limit the community suggestions that would contextualize and improve the implementation of the HSI. Notwithstanding, if the system or phenomenon cannot be changed (e.g. due to binding agreements, methods of development used or in the case of privately developed NSATs due to company policies) then at least they should be identified and known. This raises awareness of the situation and allows participant to work within these limitations from the onset. This would divert the attention from validation of the indicator to its improvement and implementation success. For instance, in the Logistics management HSI, the question was not about the relevance of logistics but rather the best method to improve management. 57% of respondents in this case opted for a policy approach in dealing with solve the problem of trailers and freights that transport goods and other products like petrol and diesel.

3) **Rule of Stake (C_T)** – Essentially, who holds a stake in the process or the phenomenon under investigation, the developers of the NSAT are either private organizations such as BREEAM communities (UK) or government parastatals such as Pearl (UAE). Such organizations and their expert representatives already have a stake in the decision making. To infuse the bottom-up approach to the top-down process requires the identification of those who have a stake, before the execution of the actual survey to select the HSI. Therefore a pre-survey is recommended to objectively and systematically identify relevant participants, which is essential to improving the quality of the results. Also, figuring out who has a stake aids in understanding the conflicts and also power hierarchies with the given society. This also helps determine who the voiceless are, bearing in mind that the powerless tend to be in position to provide unique perspectives to local issues. Inequalities such as age, gender and educational background needs to be vetted to see how they would affect the decision of the final results.

In environmental resource management stakeholder analysis is very key to overcome the obstacles of local residents adopting new technologies (Johnston. 2004). In this study stakeholder analysis was executed via the experience of the researcher (see 5.3.2 for reasons). Nonetheless, the execution of the survey and development of the relevancy index illustrates potential impact community based stockholders have in decisions. Open questions and the relevancy index was used to validate the relevancy of expert selected HSI and the constraints behind them. For instance, clean transport was deemed an improbable HSI (see Table 5.6) due to the socio-economic perspective of participants.

To determine applicability, the survey questions were developed to uncover the underlying factors behind the response of participants to each HSI under investigation. The questionnaire-based survey was constructed in such a way that the importance of the HSI was not directly obvious to the respondents, rather, it was indirectly induced through a series realistic and intricate questions that queried the challenges faced by respondents in their community. By doing so, classifications such as 'improbable HSI' and 'mandatory HSI' were used. Improbable means the unlikeness of a specific indicator being implemented successfully, which is usual due to one or number of reasons. For instance, under the HSI of eco-friendly mobility, the concept of clean energy via transport was explained, 90% of respondent indicated their support for biofuel vehicles. This is most likely motivated by the fact that Lagos has been identified in several studies to suffer from severe traffic congestion and associated environmental issues (Ibitayo, 2012; Ukpata and Etika, 2012; Onatere, 2014). The gravity of the situation is heightened when citizens of Lagos have been noted to wait till late hours of the evening to avoid traffic (Ibitayo, 2012). Hence, additional questions were asked to discern the motivation behind selecting alternative and cleaner means of transport. The result showed that it was to avoid traffic delays and reduce negative impact on health. Both choices are essentially socially motivated. However, this question was not enough to conclude that clean approach to transport would be welcomed or successful in Lagos. Thus, additional questions on eco-friendly transport HSI and the economic dimension of sustainability was asked. This introduced the question of buying or investing in electric vehicles. Two major constraints emerged from the respondent response and these were financial constraints (would be too expensive) and the power infrastructure constraints (inconsistent power). Validating this with peer reviewed literature Oduwaye (2009) finds that Nigeria suffers from inconsistent power supply and frequent power outages due to load shedding. The

economic situation in Nigeria is also deplorable with the minimum wage being 19,800N ($56) and the average salary of the 200 respondents being $220.

The question that must then be asked is, would this HSI be effective under these constraints? Especially an HSI which requires prerequisite infrastructural changes and affordable prices? The answer is no. For this HSI to be successful the constraints need to be addressed. How they are addressed is up to the developer of the NSATs but until then, the facts as relates to the Nigerian society and participants response show eco-transport would not succeed. A recommendation would be to focus on biofuel based cars and hybrid vehicles for the short terms due to the positive feedback from respondents. To illustrate, the Toyota Prius can be bought brand new or imported as a used vehicle, thereby providing more competitive prices and relying on a battery system charged by the fuel engine of the car (Palmer et al., 2018). Another approach, may be to offer incentives on price reduction or some sort of rebate or motivation for investing in clean vehicles. Results of incentives showed a positive change of 30% in respondent's opinion (institutional dimension) (see Table 5.6). In term of mandatory HSI, while reviewing NSATs some HSI were deemed mandatory by the tool developer such as land use and transportation assessment, which would mean that when utilizing the specific NSAT that HSI must be addressed. In this investigation none of the HSI were mandatory by developer standards, though several HSI are popular (Mixed use, Walkability, Heritage and cultural identity) and occurred in a number tools, speaking to its high level of commonality. Regardless, the common HSI would ideally still undergo verification for context specific relevance. This applies even if these HSI were mandatory.

In sum, effectively executing initial stakeholder analysis (identifying relevant people or groups) would provide respondents who can give relevant information on

sustainability initiatives and in this case, the success rate of adopting clean technologies. If for instance stakeholders were rich and affluent participants, it likely that response would vary dramatically. The next process is the rule of goals.

4) **Rule of goals (D_T) –** this aspect is governed by two principles. Firstly, it must be determined if the goals of the participants and that of the developers align. Secondly, there should be clear articulation of the goals from the beginning of the project. The implication of the former relates to the question asked by John Clayton (1993), which is 'can the decision be achieved without public outcry'. Hence, in the context of HSI would the selection of these predetermined HSI be accepted with minimal resistance? For instance, the result from the sampled respondents showed overwhelming support for additional infrastructure such as libraries. Also, when ranked according to preferences, gyms and sport centres were highlighted as a first-priority preferences followed by public parks and playgrounds. The lowest ranking was 'more shops', indicating clear decision by respondents to prioritize their health and social activities. However, if the developers create or select an HSI that focuses of more economic dimensions in terms of infrastructure development this may lead to a breakdown of the whole process. This is important because as it stands the respondent believe that shops and malls over shadow other infrastructure but the developers may have their own profit oriented agenda. This is quite significant because in the top-down process, the creation of NSATs is either via private organizations or government based organizations. Private organizations who embark on sustainability programs are indeed trying to save the environment but there are still commercial enterprises that require revenue and profit to function. The nine NSATs above charge considerably for branding development as sustainable, for example for BREEAM communities it is £8,000 GBP not including assessor fee.

Perhaps a better approach to align citizen and NSATs goals may be government driven approach, since the governments are generally tasked with safety and security of citizens. However, the issue with governments in Africa is there susceptibility to corrupt devices and influences. Whichever, the case may be, the likelihood of conflict to occur at this point is quite high. Hence, there is a 'conflict resolution loop' at this point where no further progress can be made until decisions on the overall aim of the indicators project is agreed upon. This means that negotiations and deliberation at this stage would take place. As mentioned in study by Gene (2000) this has the ability to bring out ideas that were not initially obvious. For instance, the additional infrastructures mentioned by respondent included not so obvious options such as public pools, museums and skill development centres. Reed (2008) also showed in the participatory project in British Columbia that the process of negotiation provides data on societal gaps. The general consensus on negotiation and deliberation is that it can be an intensive exercise (Beierle, 2002; Reed, 2008). Regardless, when decision is made via this process, it would be much better at increasing joint gains. In essence, a win-win situation is the prerogative of both parties. For instance, for the HSI of "mixed use development", it is quite possible that all infrastructure could be considered under the HSI and sustainability points could be vary across the importance of each infrastructure. This would allow for the consideration of both commercial and social infrastructure.

5.5.1.2 Expert-initiated approach: Bottom-up

The rules that govern how the expert-initiated process can effectively fuse the bottom-up process have been highlighted from a top-down perspective (see Fig. 5.6 for general picture). Likewise key rules that govern how the bottom-up process should effectively function are explained in this section. Fig. 5.6 shows the execution of this process via questionnaire

survey. The methodology involved in gauging the relevance, usability and applicability of these HSI classifies them into improbable, debatable, relevant, and mandatory HSI. Aside from validating the indicator selected, the process is an opportunity for co-learning and co-generation of knowledge. By engaging respondents with predetermined HSI they familiarise themselves early on with the intricacies of the project. This would then inspire more unique and innovative recommendations of indicators by participants relevant to the process (Reed et al., 2007; Reed et al., 2006). This would also allow for the introduction of more context-specific HSI that may not have been suggested early on in the process (Fig. 5.6: step 2). To accommodate this, the questionnaire provided significant amount of open questions and allowed for additional recommendation at the end. The rule that guide this process are as follows:

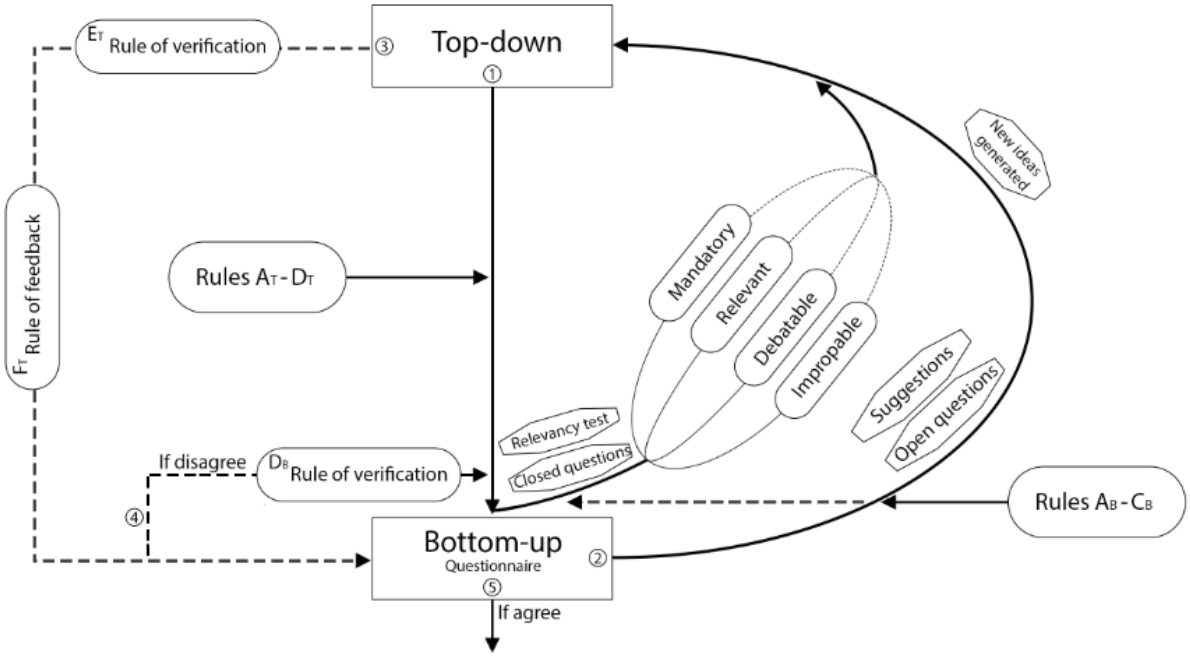


Fig 5.5: A questionnaire expert-initiated integrated participatory approach

1) **Rule of theory (A_B)** - this brings forward the question of should indicators be selected based on quality of participants, which Beierle, (2002) mention would lead to fewer

participants, or is it about the acceptability of the selection of the HSI. Also, do the developers have information to make a high quality decision? (John Clayton, 1993). In modern day practices of executing sustainability principles and the context-specific information that participants possess, the answer would be no. As mentioned in previous example respondents were able to identify museums and a need for more green spaces, insight which a government-led or expert-led stakeholders might ignore. This leads to the next questions 'what are the quality requirements needed to make these decisions'. Too often there are doubts about the quality of the decisions by public participants, Beierle, (2002) investigated 239 environmental sustainability projects and came to the conclusion that that participation practices improves decisions over the status quo. Similarly, respondents in this study made it abundantly clear that active environment HSI is a mandatory requirement through observation that green and open space facilities are lacking within the city of Lagos. About half the respondents had not visited any green parks. When respondents' opinions are compared to similar studies by Oduwaye (2006), Abegunde et al. (2009), Adejumo (2005) and Ajani, et al. (2016), the responses correlate with their studies. This is further justified because there only 3% green spaces in Lagos urban environment (Oduwaye, 2006). Through secondary confirmation, the observation of the community response correlates with existing literature on why green spaces are limited. Strengthening argument of Gene (2000) that participation can be well informed and accurate, particularly in urban settings where the consequences of the decisions are experienced directly by the residents.

This leads to the normative aspect which ask the question, 'is public acceptance critical to effective implementation' and even if acceptance is necessary if opinions of the people is not sought after would the decision still be accepted'. To answer this question, it is important to note that normative claims focuses on equity in the pursuit of

democratic society. In essence, the marginalised have a voice and are included in the decision making process. By doing so more relevant stakeholders who are severely affected are made actively part of process, thereby increasing their public trust in decisions and civil society. This ideology is further strengthened if the process is viewed to be transparent and considers all conflicting views (Martin and Sherington, 1997; Richards et al., 2004). Hence, with regards to the question and relating to this to African countries such as Nigeria. Public acceptance for the HSI would be needed. However, this answer may also be dependent of the developers and there aims (see rule of stake and impact of acceptability). Thus, can the decision in this study be accepted without participation? The answer would be no, Not in this context, because of the distrust that already exist within the government, the belief that decision makers are self-serving and the general opinion that the experts don't fully understand the inner workings of an average Nigerian citizens (Ajibade and McBean, 2014; Ajibade et al., 2013; Aliyu and Amadu, 2017). In sum, whichever theory is used would be dependent on the context. The context here would be guided by location, characteristics and the quality of participants. The context would also be guided by acceptability of decisions, which is hinged on the trust, political climate, political commitments etc.

2) **Rule of execution (B_B)** – this stage involves how the participatory process will be implemented (e.g. focus group, referenda and interviews). Various methods boast several performance characteristics and it is generally not possible to state definitively the failure or success of a specific approach. Thus, more relative term are used to gauge the efficacy of a number of survey methods (see table 5.1). This study utilized community participation in the form of questionnaire survey (see section 5.3.2 for reason). Table 5.1 shows the evaluation performance of various method of participation. In terms of the acceptance criteria; referenda, opinion survey and focus

group do quite well. This was one of the motivation for the selection the questionnaire based approach. Because questionnaire allows for reasonable level of transparency and greater level of acceptability compared to focus group approach. However, the score on process criterion is quite low (see table 5.1). This implies that the quality of decisions based on implementation of the project may not be very effective. Another reason for the selection of the questionnaire approach is based on the early involvement participants which is critical aspect to participation (Gene and Lynn, 2000; Reed, 2008; Reed et al., 2006). Gene and Lynn (2000) argued that early involvement in opinion surveys and focus groups is critical base to successful policy formation, thus such types of survey were categorized as being highly effective.

In terms of influence, it is quite difficult to determine under public survey opinion, because effectiveness is based on how the process is executed and the questions developed to understand the issues. In this indicator study, utilizing a questionnaire method would reach a far wider audience and decisions of selecting HSI would be based on acceptability. Though, issues such as sampling method and how they are utilized would inevitably determine the accuracy of results. Quantitative methods such as random sampling, stratified random sampling may be used. However, for this study, a qualitative sampling method (critical case) is used. Critical case sampling is an exploratory method of sampling used. This is because the aim of the study is not necessarily to select the indicators for Lagos state but to illustrate the process of how the HSI can be selected within a sample group. Take for example, 'Walkability' which is a mandatory classification (see table 5.7). The reason for this classification is based on overwhelming support or lack of support of an important amenity or service, thereby making it 'mandatory'. Under 'Walkability', 81.5% and 88% of respondents clearly stated a lack of sidewalks and need to improve pedestrian safety. Respondent here are 200 but if 2000 respondent had similar opinions, this

would improve acceptability and likely efficacy of project implementation. Speaking again to accuracy in decision making. According to Solagberu et al. (2015), 702 accident cases involving vehicles occurred from crossing the highway, walking along pavements, and pedestrians standing at bus stops. Hence, the reason for wanting walkable streets is in line with literature. While it would be ideal to get all citizens in a given location to participate in the survey for HSI selection, it is clearly impractical. It would also be expensive, bearing in mind that effective participation needs to be accomplished through affordable means.

Unfortunately this process has the disadvantage of lack of dialogue. I.e. during the admission of the questionnaire, respondents could not make queries to questions raised. Again, this was mitigated via the use of open questionnaire and space for additional views at the end of the questionnaire. As discussed earlier, the questionnaire should be developed to accommodate open and closed questions as well provide a space for open suggestions. Also, the process of opinion surveys, focus groups and referenda all generally suffer from the fact that there is no structured access to resources to improve the efficacy of decision. Hence, participants may have biased and ill-informed opinions of HSI under question. However, in the context of this study, this is mitigated by providing such resources during this stage of participation.

3) **Rule of resources (C_B)** – as mentioned earlier by Beierle (2002), Gene and Lynn (2000) and Soma et al. (2017), it is essential to provide citizens with the relevant resources so that they can have access to the appropriate and relevant information needed for them to make quality decisions (see section 5.3 for types of resources). The exact problem of the phenomena under investigation will dictate the type of resources required. In some cases the decision to be made involves the provision of fundamental scientific facts and in others, it could requires practical demonstration of

scientific features to help participants understand. In the case of this questionnaire, additional resources were not given, firstly because it was an issue based questionnaire which deal with direct experiences of respondents. Secondly, the questionnaire was intentionally left over to be picked up by the interviewers a week later, this gave the respondents time to use various resources such as the internet, advice from experienced associates etc. Nevertheless, it is recognised that under such an uncontrolled system, the tendency for respondent to give an uninformed or biased opinion as opposed to seeking additional facts still remains. To illustrate this, Results from table 5.4 showed respondents were more inclined to support the agricultural expansion and cultural heritage preservation as compared to a lukewarm response to environmental preservation.

One of the limitations to survey questions is the tendency for respondents to say what they feel is ideal or correct as opposed to their opinion about the situation (Ornstein 2013). Hence, some HSI such as 'Biodiversity and habitat conservation/restoration', required questions to be inverted and rephrased in order to determine consistency of response. For 'Biodiversity and habitat conservation/restoration' which was developed to see respondent's attitude towards land use versus other uses, it was shown that when preservation of land was juxtaposed against construction activities for homes, respondents provided a 'debatable' response. When the question was then phrased with respect to policy and 'endangered animals' and 'trees', respondents' opinions shifted towards land preservation. To further understand the motivation and constraints to their response, the question was phrased with a direct focus on green and blue infrastructure. 50% of the respondent's reasons for preservation was based on socio-economic reasons i.e. for preservation of heritage, rest and relaxation and to boost tourism and the economy. Nonetheless, 30% still agreed on environmental reason for preservation. The next

question focused on animals and respondents showed little concern for wildlife. The results essentially implied that respondents place greater value to green and blue infrastructure and are only concerned about animals when they are endangered. This suggests a need to raise awareness and educate the respondents on the importance of the whole ecosystem and human-environmental interactions. Essentially, additional resources may have been required to explain the fact that animals don't have to be endangered to be considered important.

3) **Rule of verification (E_T, D_B) and feedback (F_T) -** This rule occurs in two folds. The first fold (E_T) is after the expert-initiated approach has gone through Bottom-up validation and recommendation, then the approved and suggested HSI are then crosschecked by the experts or authorities (see Fig. 5.6). This then leads to rule of feedback (**F_T**), which is a key aspect of the process, as it provides a transparent presentation of the decision made by the experts. Two scenarios occur at this point. The first scenario is that the experts agree with the verified and recommended HSI, signalling the end of the process (Fig. 5.6: step 5). For instance under the HSI of 'Bike-ability' and with regards to cycling facilities, two fundamental questions were asked, concerning the use of bicycles. 'How often did respondents use bicycles? (85.6% said never)' and 'Would it be considered for short distance travel? (57% said no)'. However, a more positive view on bicycle usage was observed when infrastructure such as bicycle and safety facilities were mentioned. In principle, it can be inferred that there is a general fear of safety while riding bicycles. It is worth noting that respondents in this study and study by Ibitayo, (2012) highlighted the non-existence of bicycle lanes in Lagos. Likewise, in a study by Solagberu et al. (2015), 702 cases of accidents were attributed to motorcycles as the vehicle of the highest fatalities, further indicating the extreme dangers of two wheeled vehicles in the absence of suitable infrastructure.

Therefore the low uptake of bicycles and infrastructural challenges surrounding makes this a difficult HSI to select.

Moreover, respondents also mentioned not knowing how to ride bicycles. If the opinions given by respondents was agreed by experts then this HSI would be removed signalling an end to the process. However if the second scenario occurs, which is that expert feedback disputes the verified and recommended HSI (Fig. 5.6: step 4), this then leads to the creation of loop system until an agreed number of HSI are finalised (Fig. 5.6: step 4 back to step 2). Let's assume that experts insist on HSI of 'Bike-ability' and recommend and that the validity of the Bikeability HSI can be linked to the availability of infrastructure and the introduction of bicycle riding into the school curriculum or as an additional program in driving schools, in order to teach riders how to ride and follow cycling rules. This would then be fed back to participants until a final agreement can be made. The second or third round of negotiations (if any) can either pursue the same questionnaire loop or an alternative survey approach. As it is not unusual to use several survey methods at different stages of participatory processes (Crosby et al. 1986).

The above expert-initiated integrated participatory process illustrates how the use of questionnaires is a valid method in the early stages of HSI selection. Also, the aforementioned rules emphasize how effective participation should be systematic and deliberate and is key to obtaining quality and raising acceptance in results that optimise the early selection HSI for NSATs.

5.5.2 Replacement of the point based system

All NSATs and associated HSI were created with a particular society in mind. Although, general or common HSI can be applied in more than one location, the question of how one

indicator can be prioritized over another arises. NSATs achieve this through point based system which again is based on expert analysis of already agreed set of Indicators (Côté et al., 2007; Sardain et al., 2016; Sharifi and Murayama, 2014). However, what this bottom-up approach does is validate and sets a precedence for relevant indicators, thus reducing redundant indicators that would not otherwise function. This could otherwise render the point based system of NSATs obsolete by streamlining HSI to the most implementable and applicable indictors in a society. As discussed in section 5.5.1.2 (rule of verification) 'Bike-ability' is an improbable HSI. Hence, the integrated method could then be used to eliminate HSIs that would most likely not succeed currently (in this case Bike-ability). Essentially, the argument for future NSATs could be a list of HSI which are strictly relevant to a given society, with the uptake of various HSI on a given project made based on the resources available to the developers and clients and guided by the sustainability laws in place. Also, due to the transient state of sustainability, the tool can be reviewed annually or Bi-annually to observe if there are changes in policy, infrastructure and peoples mentality towards the uptake of improbable HSI which may then be added. This may very well be the case with Bikeability in Lagos after a few years

5.6 Conclusions

The early selection of HSIs is a pivotal process in any indicator based framework. This study has addressed a critical gap in the current method of HSI selection for NSATs by replacing the top-down secretive process with an integrated participatory process that is expert-initiated and community validated. This led to the introduction of the concept of 'improbable', 'relevant', 'debatable' and 'mandatory' HSI. This also led to the development of the nine rules of expert-initiated participation (see Fig.5.5 and Fig.5.6), which provide a systematic approach to integrated participatory planning guided by theorems and stratagems from well-established best practices and validated via questionnaire survey. By doing so, the constraints that allow HSI to be successfully implemented were visualised. The implication of

this would be the reduction or augmentation of HSI to fit the narrative of the local community. Accordingly, the study shows that the bottom-up approach can be successfully combined with an already top-down developed process, thereby creating an integrated system. Indeed, the strength of this process is that it also elucidates other important factors such as the identifications of constraints and motivators that make HSI more usable, as well as the classification of HSI to better understand their potential role as an urban planning tool and the reduction in redundant and otherwise useless HSI that would not thrive if implemented in the society of study (Lagos). Further investigation showed this reduction in redundant and useless HSI could potentially eliminate the point based system, as a consequence of an already rigorous process that determines the usefulness and applicability of HSI.

As Turcu (2013) argues, understanding the underlying cause of SI is important and by establishing the constraints, this study provides information, which if used in the right political arena may permit the modification of policies and ill-conceived sustainability focuses to more specific and relevant issues. More specifically, the significance of this expert-initiated integrated participatory approach in Lagos and any other African city is the financial viability and ease of executing this approach and the fact that it gives people a voice in a society that distrust the words of policy makers. In conclusion, the development of HSI for NSATs is plagued with vague and hidden methodologies, which is driven by the professional opinions of experts, which although effective in most cases, falls short in its ability to carry along the citizens. This implies that the HSI of assessment tools are based mainly on scientific and technical perspectives with little concern to the socio-cultural import of its directives – a situation that might make it untenable to the broader African context. To the best of my knowledge, this thesis takes the first and furthest step in NSAT development through the derivation of a transparent integrated method that considers both technical and social constructs, thus making them implementable to rapidly urbanising African cities such as Lagos.

References

Abegunde AA, Omisore EO, Oluodo OF, Olaleye D (2009). Commercial horticultural practice in Nigeria: its sociospatial effect in Lagos city. Afr. J. Agric Res., 4 (10): 1064-1072.

Adejumo, O. T. (2005). Sustainable beach tourism: Formalization of local agenda from Eleko community coastal resources. In Globalization, culture and the Nigerian built environment. Lagos.

Afon, A. O., 2007, Informal sector initiative in the primary sub-system of urban solid waste management in Lagos, Nigeria: Habitat International, v. 31, p. 193-204.

Ajibade, I., and G. McBean, 2014, Climate extremes and housing rights: A political ecology of impacts, early warning and adaptation constraints in Lagos slum communities: Geoforum, v. 55, p. 76-86.

Ajibade, I., G. McBean, and R. Bezner-Kerr, 2013, Urban flooding in Lagos, Nigeria: Patterns of vulnerability and resilience among women: Global Environmental Change, v. 23, p. 1714-1725.

Aliyu, A., and L. Amadu, 2017, Urbanization, cities, and health: The challenges to Nigeria - A review: Annals of African Medicine, v. 16, p. 149-158.

Ameen, R. F. M., M. Mourshed, and H. Li, 2015, A critical review of environmental assessment tools for sustainable urban design: Environmental Impact Assessment Review, v. 55, p. 110-125.

Arnstein, S. R., 1969, A Ladder Of Citizen Participation: Journal of the American Institute of Planners, v. 35, p. 216-224.

Beierle, T. C., 2002, The Quality of Stakeholder-Based Decisions: Risk Analysis, v. 22, p. 739-749.

Berardi, U., 2015, Chapter 15 - Sustainability assessments of buildings, communities, and cities A2 - Klemeš, Jiří Jaromír, Assessing and Measuring Environmental Impact and Sustainability: Oxford, Butterworth-Heinemann, p. 497-545.

Braulio-Gonzalo, M., M. D. Bovea, and M. J. Ruá, 2015, Sustainability on the urban scale: Proposal of a structure of indicators for the Spanish context: Environmental Impact Assessment Review, v. 53, p. 16-30.

Cappuyns, V., 2016, Inclusion of social indicators in decision support tools for the selection of sustainable site remediation options: Journal of Environmental Management, v. 184, Part 1, p. 45-56.

Charoenkit, S., and S. Kumar, 2014, Environmental sustainability assessment tools for low carbon and climate resilient low income housing settlements: Renewable and Sustainable Energy Reviews, v. 38, p. 509-525.

Checkland, P., 1981. Systems Thinking, Systems Practice. John Wiley, Chichester.

Cohen, M., A. Wiek, B. Kay, and J. Harlow, 2015, Aligning Public Participation to Stakeholders' Sustainability Literacy—A Case Study on Sustainable Urban Development in Phoenix, Arizona: Sustainability, 8709-8728 p.

Crosby, N., J. M.Kelly, and P. Schaefer. 1986. Citizens panels:Anewapproach to citizen participation. Public Administration Review 46: 170-78.

Dale, A.P., Lane, M.B., 1994. Strategic perspectives analysis: a procedure for participatory and political social impact assessment. Society and Natural Resources 7, 253–267.

Davidson, S., 1998. Spinning the wheel of empowerment. Planning (3), 14–15.

Dawodu, A., B. Akinwolemiwa, and A. Cheshmehzangi, 2017, A conceptual re-visualization of the adoption and utilization of the Pillars of Sustainability in the development of Neighborhood Sustainability Assessment Tools: Sustainable Cities and Society, v. 28, p. 398-410.

Drazkiewicz, A., E. Challies, and J. Newig, 2015, Public participation and local environmental planning: Testing factors influencing decision quality and implementation in four case studies from Germany: Land Use Policy, v. 46, p. 211-222.

Dryzek, J.S., Berejikian, J., 1993. Reconstructive democratic theory. The American Political Science Review 87, 48–60.

Elias, P., and A. Omojola, 2015, Case study: The challenges of climate change for Lagos, Nigeria: Current Opinion in Environmental Sustainability, v. 13, p. 74-78.

Fraser, E. D. G., A. J. Dougill, W. E. Mabee, M. Reed, and P. McAlpine, 2006, Bottom up and top down: Analysis of participatory processes for sustainability indicator identification as a pathway to community empowerment and sustainable environmental management: Journal of Environmental Management, v. 78, p. 114-127.

Friedman, A.L., Miles, S., 2002. Developing stakeholder theory. Journal of Management Studies 39, 1 - 21.

Friedman, A.L., Miles, S., 2004. Stakeholder theory and communication practice. Journal of Communication Management 9, 89–97.

Garde, A., 2009, Sustainable by Design?: Insights From U.S. LEED-ND Pilot Projects: Journal of the American Planning Association, v. 75, p. 424-440.

Gass, G., Biggs, S., Kelly, A., 1997. Stakeholders, science and decision making for poverty-focused rural mechanization research and development. World Development 25, 115–126

Gene, R., and J. F. Lynn, 2000, Public Participation Methods: A Framework for Evaluation: Science, Technology, and Human Values, v. 25, p. 3-29.

Haapio, A., 2012, Towards sustainable urban communities: Environmental Impact Assessment Review, v. 32, p. 165-169.

Hare, M., Pahl-Wostl, C., 2002. Stakeholder categorization in participatory integrated assessment. Integrated Assessment 3, 50–62.

Hiremath, R. B., P. Balachandra, B. Kumar, S. S. Bansode, and J. Murali, 2013, Indicator-based urban sustainability—A review: Energy for Sustainable Development, v. 17, p. 555-563.

John Clayton, T., 1993, Public Involvement and Governmental Effectiveness: A Decision-Making Model for Public Managers: Administration and Society, v. 24, p. 444-469.

John, P. P., D. S. Jay, and W. K. Kenneth, 1985, Citizen Participation in Water Quality Planning: A Case Study of Perceived Failure: Administration and Society, v. 16, p. 455-473.

Komeily, A., and R. S. Srinivasan, 2015, A need for balanced approach to neighborhood sustainability assessments: A critical review and analysis: Sustainable Cities and Society, v. 18, p. 32-43.

Komeily, A., and R. S. Srinivasan, 2016, What is Neighborhood Context and Why does it Matter in Sustainability Assessment?: Procedia Engineering, v. 145, p. 876-883.

Kotus, J., and T. Sowada, 2017, Behavioural model of collaborative urban management: extending the concept of Arnstein's ladder: Cities, v. 65, p. 78-86.

Lawrence, A., 2006, 'No Personal Motive?' Volunteers, Biodiversity, and the False Dichotomies of Participation: Ethics, Place and Environment, v. 9, p. 279-298.

Lin, D., and D. Simmons, 2017, Structured inter-network collaboration: Public participation in tourism planning in Southern China: Tourism Management, v. 63, p. 315-328.

Martin, A., and J. Sherington, 1997, Participatory research methods—Implementation, effectiveness and institutional context: Agricultural Systems, v. 55, p. 195-216.

Morse, S., and E. D. G. Fraser, 2005, Making 'dirty' nations look clean? The nation state and the problem of selecting and weighting indices as tools for measuring progress towards sustainability: Geoforum, v. 36, p. 625-640.

Oyedepo, S. O., 2012, On energy for sustainable development in Nigeria: Renewable and Sustainable Energy Reviews, v. 16, p. 2583-2598.

Palmer, K., J. E. Tate, Z. Wadud, and J. Nellthorp, 2018, Total cost of ownership and market share for hybrid and electric vehicles in the UK, US and Japan: Applied Energy, v. 209, p. 108-119.

Reed, M., 2007, Participatory technology development for agroforestry extension: an innovation-decision approach: African Journal of Agricultural Research, 334-341 p.

Reed, M. S., 2008, Stakeholder participation for environmental management: A literature review: Biological Conservation, v. 141, p. 2417-2431.

Reed, M. S., and A. J. Dougill, 2002, Participatory selection process for indicators of rangeland condition in the Kalahari: Geographical Journal, v. 168, p. 224-234.

Reed, M. S., A. J. Dougill, and M. J. Taylor, 2007, Integrating local and scientific knowledge for adaptation to land degradation: Kalahari rangeland management options: Land Degradation and Development, v. 18, p. 249-268.

Reed, M. S., E. D. G. Fraser, and A. J. Dougill, 2006, An adaptive learning process for developing and applying sustainability indicators with local communities: Ecological Economics, v. 59, p. 406-418.

Reed, M. S., A. Graves, N. Dandy, H. Posthumus, K. Hubacek, J. Morris, C. Prell, C. H. Quinn, and L. C. Stringer, 2009, Who's in and why? A typology of stakeholder analysis methods for natural resource management: Journal of Environmental Management, v. 90, p. 1933-1949.

Rexhepi, A., S. Filiposka, and V. Trajkovik, 2018, Youth e-participation as a pillar of sustainable societies: Journal of Cleaner Production, v. 174, p. 114-122.

Sharifi, A., and A. Murayama, 2013, A critical review of seven selected neighborhood sustainability assessment tools: Environmental Impact Assessment Review, v. 38, p. 73-87.

Sharifi, A., and A. Murayama, 2014, Neighborhood sustainability assessment in action: Cross-evaluation of three assessment systems and their cases from the US, the UK, and Japan: Building and Environment, v. 72, p. 243-258.

Sharifi, A., and A. Murayama, 2015, Viability of using global standards for neighborhood sustainability assessment: insights from a comparative case study: Journal of Environmental Planning and Management, v. 58, p. 1-23.

Simon, C., and M. Etienne, 2010, A companion modelling approach applied to forest management planning: Environmental Modelling and Software, v. 25, p. 1371-1384.

Soma, K., M. W. C. Dijkshoorn-Dekker, and N. B. P. Polman, 2017, Stakeholder contributions through transitions towards urban sustainability: Sustainable Cities and Society.

Soyinka, O., K. W. M. Siu, T. Lawanson, and O. Adeniji, 2016, Assessing smart infrastructure for sustainable urban development in the Lagos metropolis: Journal of Urban Management, v. 5, p. 52-64.

Stroud, A., 1996, Farmer participatory research — Rhetoric and reality: C. Okali, J. Sumberg and J. Farrington. Overseas Development Institute, 1994, available through Intermediate Technology Publications, London. 159 pp. Price: £8.95 or US$17.50 (paperback). ISBN 1 85339 252 9: Agricultural Systems, v. 51, p. 364-367.

Tam, V. W. Y., H. Karimipour, K. N. Le, and J. Wang, 2018, Green neighborhood: Review on the international assessment systems: Renewable and Sustainable Energy Reviews, v. 82, p. 689-699.

Thomas, W., and T. Seth, 2000, Fairness and Competence in Citizen Participation: Theoretical Reflections from a Case Study: Administration and Society, v. 32, p. 566-595.

UN-HABITAT, 2009, Planning Sustainable Cities: Policy Direction - Global Report on Human Settlement, UK and USA, Earthscan.

United Nations Economic Commission of Africa, 2015, Africa Regional Report on the Sustainable Development Goals: Summary, Addis Ababa, Ethiopia, Economic Commission for Africa.

Vaidya, A., and A. L. Mayer, 2014, Use of the participatory approach to develop sustainability assessments for natural resource management: International Journal of Sustainable Development and World Ecology, v. 21, p. 369-379.

Valentin, A., and J. H. Spangenberg, 2000, A guide to community sustainability indicators: Environmental Impact Assessment Review, v. 20, p. 381-392.

Ward, D., 2001, Stakeholder involvement in transport planning: participation and power: Impact Assessment and Project Appraisal, v. 19, p. 119-130.

Warner, M., 1997, 'Consensus' participation: an example for protected areas planning: Public Administration and Development, v. 17, p. 413-432.

World Commission on Environment and Development, 1987, Our Common Future, Oxford Press.

Xia, B., Q. Chen, M. Skitmore, J. Zuo, and M. Li, 2015, Comparison of sustainable community rating tools in Australia: Journal of Cleaner Production, v. 109, p. 84-91.

Chapter 6

Conclusion – Perspectives on the Development of Practicable NSATs:

Observations and Method for the Early Selection of Headline Sustainability Indicator

"For Africa to me… is more than a glamorous fact. It is a historical truth. No man can know where he is going unless he knows exactly where he has been and exactly how he arrived at his present place."

~ Maya Angelou

6.1 Debrief and Overall achievement of research aims and objectives

This thesis argues in support of an effective and extensive use of participatory approaches to sustainable urban planning. The aspect of sustainable urban planning here refers to the selection of indicators as a step to not only optimize NSATs generally, but to make them more usable within the African context. Several aims were outlined at the beginning of this thesis. To conclude this thesis, the research aims are repeated below, in light of the findings of this study and specify with the "perspective" analogy how the aims and objectives have been addressed. These issues to an extent have been discussed at the end of each chapter section but to avoid total repetition of what has been said, this chapter provides systematic approach that gives a snapshot integration of results from different parts of the research, which tie the research together.

After a snapshot of the how the aims are achieved and the lessons learned, the main implications of the research are discussed and the limitations that should be addressed in future works are highlighted. The list below is reminder of research aims and objectives.

The main aim of this study was to:

- Develop an integrated framework for the early selection of indicators for NSATs.
- Develop a framework for evaluating the effectiveness of NSATs.
- Elucidate the successes and shortcoming in current tools and how this would affect tools created in Africa as well as other world regions.
- Elucidate the importance of top-down and bottom-up approach to early indicator selection.

In order to achieve these aims certain research questions need to be asked and answered.

The main research questions to be answered were:

- Why can't the existing NSATs be utilized directly in African nations such as Nigeria?
- Why are current tools Top-down focused?
- Why current NSATs are environmentally focused and what significance does that bear to Africa?
- What is the significance of the bottom-up approach in early indicator selection?
- How can indicators be selected from pre-existing tools to aid the development of future tools?
- How can indicators be selected to integrate the needs of both the experts and the local community?
- Can indicators be global i.e. relevant in all regions of the world?

6.1.1 Perspectives on the development of practicable NSATs: road from template to actual tool

This section brings together the major observations of chapters 2, 3, 4 and 5, and summarizes the lessons learned, offers recommendations and provides illustrative templates or road map of the process involved in early selection of HSI for NSAT development. In a sense this chapter represent a best practice review and also preliminary template development. These will be addressed according to "perspectives" on each chapter. The arguments are deliberately concise to give a snapshot picture of what this research has achieved over the years of study. As mentioned from the beginning of this study, the research has been developed to optimize NSATs performance, while also creating the framework for

cities in Africa such Lagos to develop their own assessment tool. The following perspectives illustrate this.

6.1.1.1 Perspective 1: Sustainable pathway model (multi-dimensional approach)

The first perspective summarizes the lessons learned from the development and application of the SPM approach.

(1) In order to develop an NSAT, it is imperative to understand the pros and cons of previously developed tools.

(2) For this research, a method to understand the shortcomings of previously developed tools was to develop and use the SPM. This is a novel approach that could easily be used to identify the presence of the DoS in indicators of NSATs, and as such can be used to rigorously assess the properties and features of various NSATs. The use of SPM in combination with content analysis of the given manuals drew out more specific trends and characteristics of the tools (see Figs. 2.3, 2.4 and 2.5). The use of the SPM and content analysis also led to the identification of the gaps shown in table 6.1.

(3) The development of the SPM illustrates that HSI as well as any other sustainability initiative should be appraised based on the four DoS and the interrelationship between the four DoS. It should be noted that the SPM broke away from the conventional three DoS and added a fourth dimension (institution), as it was deemed necessary to properly visualize how indicators perform. It was also critical when considering a location like Lagos, Nigeria, which has poor institutional frameworks.

(4) Fundamentally, SPM showed that DoS have relationships and links with one another. This led to the categorization of these interrelationships into Point Aspect (one DoS), Linear Aspect (two DoS), Planar Aspect (three DoS) and Aggregate Aspect (four DoS). The idea was that the higher the interrelationship, the stronger the impact of HSI in

achieving urban sustainability. Considering the HSI of regional material, it is far more impactful for such an indicator to have environmental, social and economic advantages than simply environmental advantages (see section 2.4 for further explanation).

(5) The interrelationship between the DoS came with specific traits and consequences, as such the TRAC (Tractability, Relationality, Adaptability and Contextuality) system was created to point out these consequences. Basically consequences as related to HSI was ease of identifying the DoS, the intensity of the interrelationship, adaptability of the theoretical HSI to reality and clarity in the context of a tool. Table 2.3 illustrates the characteristics of each Aspect. The implication of this result is that interrelationships of DoS comes at a cost, regardless the maximum DoS that HSI can achieve should be sought after in the development or selection of HSI. Thereafter, it becomes the practitioner's job to address as many dimensions as the HSI has been shown to have based on the resources available.

(6) Each tool developed focuses and prioritizes the context specific issues plaguing their region at that point in time; meaning that the development of these indicators should be time specific and should be reviewed after a given time period.

(7) Two key points in this section is that assessment tools are heavily environmentally focused and rarely consider the institutional dimension. This institutional dimension was noted to be paramount for the success of NSATs in Africa.

(8) Figs 3.1, 4.1, 4.2 and 4.3 all show how HSI are represented in their respective manuals. The illustrations show in terms of presentation that the DoS is not visibly represented. However, Table 6.2 gives an example of how future HSI can be represented. This is to improve practitioner's selection of indicators with higher interlinkages. Future HSI should illustrate the DoS either qualitatively or graphically

thereby demonstrating the aspect of sustainability affected by their decisions and encouraging developers to target higher DoS.

(9) Linear Aspect should be the minimum target of all HSI under NSATs due to its high tractability and adaptability relative to the Planar Aspects. This implies that the Linear Aspect could be easily extracted from a given indicator, whilst being more practically deployable.

(10) The SPM method was developed as a prescriptive tool to help not only NSATs but also as a method to appraise any other policy document or sustainability initiative or project in order to help improve their chances of attain sustainability. A good example of the SPM in use, is the recently published article titled "A Diversity of Eco-Developments: An Overview and Comparison of Sustainability in Six Eco-Developments" which utilized the SPM method to map out the sustainability pathway of the two eco-development scales. The first is the neighborhood scale that consisted of Hammarby Sjöstad, Kronsberg and Vauban and the second is the village which consists of BedZED, Findhorn and Crystal Waters (Villanueva and Horan, 2018). Essentially, their study used the SPM approach to identify gaps in the eco-development case studies Fig 6.1 illustrates their SPM results.

Table 6.1: Gaps and limitations in Current Tools with respect to Africa

Definition of Sustainability		**Adaption to locality (Copy and paste)**		**Mode of NSAT development**
Three pillar Vs four pillar	None/Limited Institutional Dimension	Green Vs Brown agenda (Lack of Appropriate Socio-Economic HSI)	Environmental bias	Predominantly top-down or expert-led
Limited interrelationships of dimensions	Limited understanding of Institutional dimension			Lack of transparency

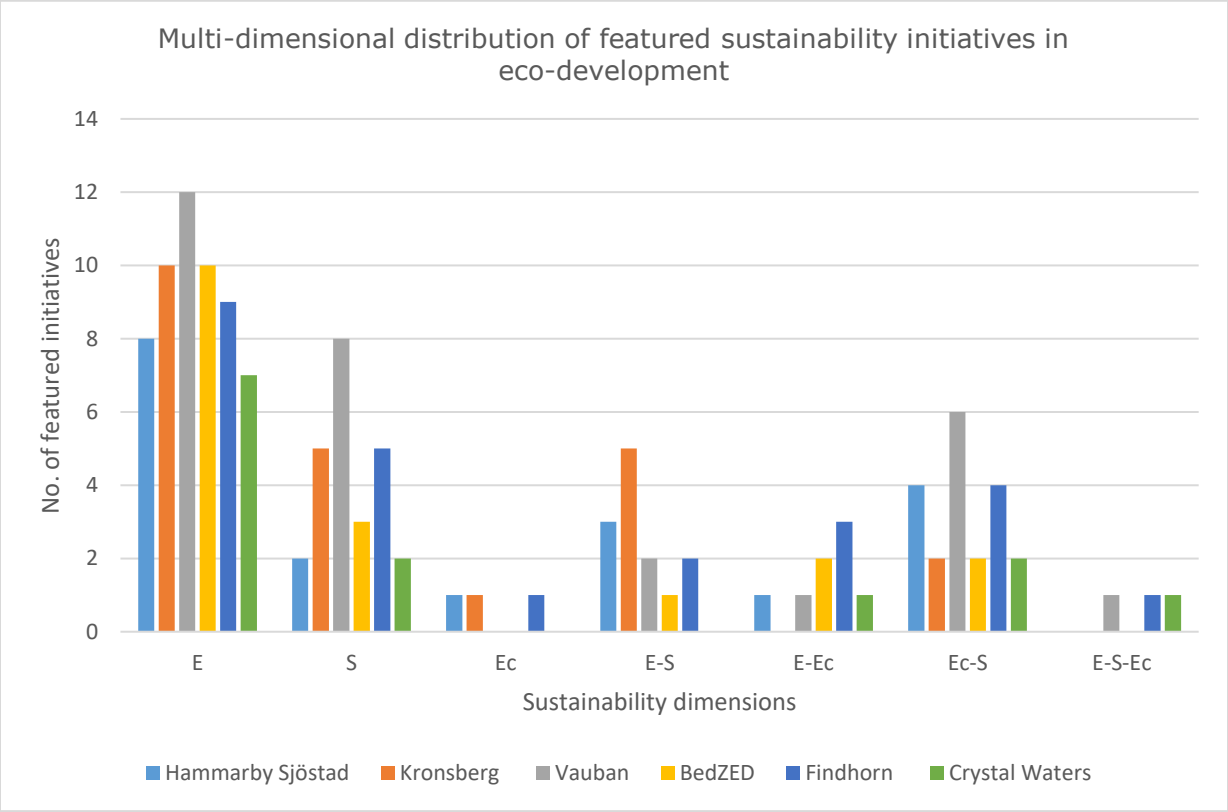


Fig. 6.1: Multi-dimensional distribution of featured sustainability initiatives in eco-development

Table 6.2: Gaps and limitations in Current Tools with respect to Africa

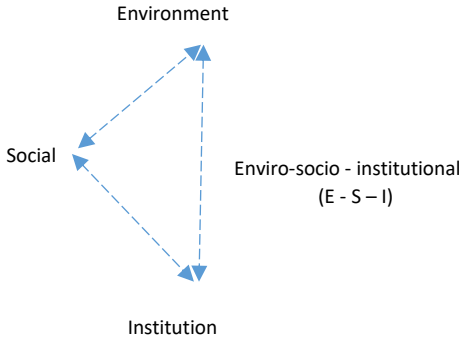
<table>
<tr><th colspan="2">HISTORIC RESOURCE PRESERVATION AND ADAPTIVE REUSE</th></tr>
<tr><td>ND

2 points

This credit applies to

• Neighborhood Development Plan

• Neighborhood Development</td><td rowspan="2">Dimensions of sustainability

 
</td></tr>
<tr><td>Intent

To respect local and national landmarks and conserve material and cultural resources by encouraging the preservation and adaptive reuse of historic buildings and cultural landscapes.</td></tr>
<tr><td colspan="2">Requirements

<u>ND PLAN, ND (GIB)</u>

This credit is available to projects with at least one historic building, contributing building in a historic district, or cultural landscape on the project site.

Do not demolish any historic buildings or contributing buildings in a historic district, or portions thereof, or alter any cultural landscapes as part of the project.

An exception is granted only with approval from an appropriate review body. For buildings or landscapes listed locally, approval must be granted by the local historic preservation review board, or equivalent. For buildings or landscapes listed in a state register or in the National Register of Historic Places (or equivalent for projects outside the U.S.), approval must appear in a programmatic agreement with the state historic preservation office or National Park Service (or local equivalent for projects outside the U.S.).</td></tr>
</table>

If any historic building or a contributing building in a historic district in the project site is to be altered (rehabilitated, preserved, or restored), use one of the following approaches for each building, as applicable.

- *Building subject to local review.* Obtain approval, in the form of a certificate of appropriateness, from a local historic preservation commission or architectural review board for any exterior alterations or additions.

- *Building subject to state or federal review.* If the building is subject to review by a state historic preservation office or the National Park Service (or equivalent body for projects outside the U.S.), the alteration must meet the Secretary of the Interior's Standards for the Treatment of Historic Properties (or equivalent for projects outside the U.S.).

- *Listed or eligible building not subject to review.* If a building is listed or determined eligible but alteration is not subject to local, state, or federal review, include on the project team a preservation professional who meets the U.S. federal qualifications for historic architects or architectural historians (or a local equivalent for projects outside the U.S.). The preservation professional must confirm adherence to the Secretary of the Interior's Standards for the Treatment of Historic Properties, or a local equivalent for projects outside the U.S.

If a cultural landscape is to be rehabilitated, restored, or preserved, do so in accordance with the Guidelines for the Treatment of Cultural Landscapes or local equivalent for projects outside the U.S. whichever is more stringent. 69 Updated to reflect the October 1, 2014 LEED v4 Neighborhood Development Addenda

6.1.1.2 Perspective 2: The silent but most impactful dimension - Institution

This section takes a closer look into a major limitations often identified in NSATs but rarely understood. This limitation was the absence and underestimated function of the institutional dimension. Hence, 'Energy' was investigated as a case study theme due to its very impactful HSI present in all assessment tools and its strong cause and effect relationship with climate change. From this, a better understanding of the role institutional dimension had to play in NSATs and specific HSIs was made clearer. This led to a clearer and more implementable pathway to the adoption of the tools in African countries.

Though the results were energy specific, the implication of the result had a wide impact on the functions of all other themes in NSATs. The following are the lessons learned and suggestions

(1) There is a far wider spectrum of what can be called institutional dimensions.

(2) Policies, recognized organizations (local or global), Codes and standards (local or global) and Informal institutions (peer reviewed journals and 3rd part assessment tools) all need to be considered under the constructs of the institutional dimension.

(3) With the use of SPM, content analysis and new DNA construct of institutional dimensions, there are more institutionally-based indicators than previously reported in prior studies.

(4) Without the institutional dimension certain indicators lose their functionality and effectiveness.

(5) It was observed that institutional dimension may sometimes be implicitly intended but for successful adoption in nations like Nigeria, the dimension needs to be visibly and explicitly mentioned as a parameter of the indicator. This observation corroborates similar observations in chapter 2 (see Table 6.2 for an illustration).

(6) The results though focused on energy based HSI also show a strong environmental focus (similar to chapter 2). However, particularly for energy based issues, socio-economic or any Linear Aspect or Phase Aspect of indicator development would be better for African societies.

(7) Nigeria has drafted proposals for codes and standards but is lagging behind their African counterparts, making Nigeria not quite ready to adopt NSATs until certain measures are put in place (see Table 3.6 for solutions to Nigeria's shortcomings).

(8) With respect to energy based HSI, feature based indicators were predominant. A review also showed that Nigeria is a high importers of second hand equipment, meaning that Nigeria's implementation of feature based indicators rely on second hand products. This was advised against, with solutions including the use of more performance based indicators or creation of specialized certification schemes (see Table 3.6 for more suggestions).

(9) Policies, incentives, subsidies must be carefully thought through and applied in order to motivate the adoption of sustainability initiatives., particularly in countries with low standard of living (e.g. Nigeria). This can increase the success of developed or selected HSI.

(10) Nigeria's weak institutions, poor infrastructure, poor regulatory framework, endemic corruption and under developed market, would not only make energy based indicator struggle to be implemented but also themes such as waste management, disaster prevention, ecological impact, which all rely on policies and regulations and operate under the same principles (See Table 3.6 on how to improve successful implementation of NSATs).

(11) A clear definition of the institutional indicator was developed to avoid confusion and optimize the selection process. This was:

"An institutional indicator is one that explicitly bears the institutional dimension (i.e. policy, regulations, incentives, organizations, codes and standards) within the instructions of how to implement the given HSI. The dimensions cannot be a single entity or identity and must operate under the linkage of the other dimensions."

6.1.1.3 Perspective 3: Early HSI selection

The Perspectives 1 and 2 (chapters 2 and 3) suggests that previous NSATs need to be investigated so as to learn from their performance and subsequently optimize it. This led to the development of the SPM. This has also created to first step to early indicator selection. A consequence of this approach was the discovery of the pitfalls, traits and challenges the current NSATs face. As a result, perspective 3 addresses these shortcomings while simultaneously creating a selection method that plug the gap to current NSATs. It should be reiterated that this method addresses the early selection of HSI, which form the foundation of any sustainability initiatives framework or plan that utilize sustainability indicators.

Perspective 3 plugs the gaps of transparency, limited interrelationships of dimensions in NSATs and provides the first step to addressing the predominantly top-down approach. The following are the lessons learned and suggestions

(1) To optimize selection of HSI a transparent method hinged on a type of sustainability ideology is required. In this study it was the four DoS and interrelationships (SPM approach) that guided the selection of HSI. The reasons for this approach is as follows:

   a. Indicator selection lacks transparency and hence limits the applicability and full utility of indicators in different context. In this case an African context.

   b. All NSATs developed utilize the three pillars of sustainability principle and neglects the fourth dimension mainly:

- Due to the fact that this dimension is embedded in society or internalized. I.e. it is identified more as a silent partner. This gives a false representation of its true impact.

- The motivation for most tools originates from the Brundtland report, therefore only three dimensions are emphasized. This ideology trickled down to currently developed tools in a sort of "copy and paste mentality"

c. For Nigeria and indeed Africa, the fourth institutional dimension cannot be silent and is needed due to the weak institution, and the ability for institutions to operationalize in practice the other three dimension. Also, the fact that it is a silent partner in other countries also speaks to the stronger institutions present in those regions in terms of sustainable development.

d. Indicators in the past have been developed or viewed as single entities, which limits the efficiency and potential of the indicator to attain a higher level of sustainability. Increasing the efficacy and optimum performance of indicators is a new parameter introduced. Efficacy here means; how many dimensions an indicator can cover, which speaks to the quality of that indicator e.g. regional material indicator, addressing the environmental issue of obtaining materials locally and also the economic dimension of providing jobs for the local people. Thus such indicators are made priorities in the method.

(2) The selection approach shows and ensures that absolutely all DoS are covered in selection of HSI, thereby enhancing the selection process.

(3) The process chosen for selection is based on already established tools that were developed via the top-down approach. By doing so, time and financial resources are saved in the initially selection. Also, the fact that the HSIs were obtained from previously developed tools implies that they have gone through a certain level of

scientific rigor, ensuring that the HSI are competent enough to handle general or as chapter 4 argues common sustainability issues. However, it should mentioned that some recent tools are inspired from the pioneering tools such as BREEAM communities, CASBEE and LEED-ND. Hence, along with their benefit have also absorbed their shortcomings (see Chapter 2)

(4) The method developed is transparent and replicable, currently it is not completely known how indicators are shortlisted or selected for NSATs. The mindset and methodology of developers is not known and due to commercialization each tools process is kept secret. This method advocates for transparency and replicability so best practices may be transferred to other regions.

(5) There are no one size fit all HSI, implying that universal indicators are not impossible but improbable to achieve:

a. Though a HSI of several tools may bear the same name, when applied in a different context the HSI may behave differently i.e. cover completely different dimensions. For example the HSI of water efficiency for BREEAM, LEED and CASBEE may be approached from an environmental perspective but when seen from GSAS, Pearl community of GBI standpoint it, may be seen as a socio-environmental concern.

b. Common indicators that have similar dimensions though are also difficult to achieve they are more attainable (e.g. HSI of recyclable material, green buildings and urban heat reduction) are attainable.

c. Identifying common HSI illustrates the global popularity of issues and these still provide a comparative basis to measure the sustainability success or failure between cities and societies.

(6) The approach of selecting HSI from predetermined tools at best provides a list of common and context specific HSI (low occurring). It cannot cover all relevant HSI needed in region of implementations.

   a. The SPM selection method sets the stage for the introduction for stakeholder involvement. In the case of this study, this refers to the bottom-up approach (community-led)

   b. The utilization of the bottom-up approach implies the verification of the relevance or irrelevance of HSIs that are deemed common or context-specific tools and the introduction of new HSI.

(7) The methodology ensures that at the very least African society has a balanced consideration of all DoS. Because there is tendency for indicators to be more socio-economic neglecting the environmental and not realizing the influence of the institutional dimension due to the approach of previous tools.

(8) To improve objectivity of the dimensional analysis and selection, several reviewers may be enlisted to identify the dimensions present in each HSI.

6.1.1.4 Perspective 4: Expert-initiated integrated participatory approach

Perspective 3 provides a systematic method of selecting NSATs from previously developed tools: essentially saving time and money by selecting from already tested and provede NSATs. However, the issues with the selection of the HSI is that the method used to develop them are top-down i.e. from planners, policy makers, architect, engineers, Government etc.

Perspective 4 plugs this gap and invariably concludes the development of the methodological process by illustrating how the top-down and bottom-up can come together to create an integrated participatory approach to early selection of HSI. This was done through an extensive literature review combined with a questionnaire survey to test and investigate

the how best to integrate the decision making process to HSI selection. The following is the summary of lessons learned and suggestions. General lessons learned and observation:

(1) Integrated participatory approach can be implemented via various angles and perspectives (expert-assisted approach or expert-initiated approach).

(2) Effective participation is systematic and cannot be achieved efficiently in an ad hoc manner. Participatory methods or typologies need to be planned from outset in order to realise the full benefits of this approach. This was achieved through the development of the Expert-initiated integrated participatory approach and guiding rules (see chapter 5- section 5.5.1).

(3) Context is very important to participation, Context or perspective refers to the region where the project is being executed, it refers to the resources available to make effective decisions and it asks the question "under what capacity or hierarchy for a given circumstance would participation be most effective?"

(4) Whoever has a stake in the process needs to be identified along with their power relationships. This is in order to obtain the best results from relevant participants, while limiting negative influences or "bullying" of the minorities.

(5) Various typologies exist as to how to effectively execute participatory processes. From observation there is no one size fit all process but rather the context of the situation needs to be understood before an approach is used. For instance, the discussion of pragmatic versus normative approach. Alternatively, a hybrid-system involving both may be executed.

(6) Trade-offs and negotiations are inescapable in order to achieve effective participation

(7) A participatory practice cannot be deemed as effective if the relevant stakeholders are not part of the decision making process. In the context of sustainable urban development, decisions cannot be made solely by citizens but rather the process has to be expert-initiated, expert-assisted or a variation of the two. This ensures that local knowledge is supported by scientific rigour and vice versa.

Contextual lessons learned and suggestions:

(1) Expert-initiated approach is highly compatible with African region such as Lagos Nigeria due to the financial viability, ease of use and time benefits.

(2) Expert-initiated approach foster trust by giving a voice to the voiceless especially African nations that have come to be sceptical about the urban developmental promises of the Government.

(3) Use of questionnaire is a viable method to integrate the options of a community due to its cost effectiveness, representativeness of participants and ability to implement this method early on in HSI selection.

(4) The use of questionnaire is an implementable verification or validation approach.

(5) Key rules that determines the efficacy of the integrated participatory process was developed (see chapter 5 for full detailed explanation). These rules were developed based on studies and theoretical inspiration from Arnstein (1969) Ladder of participations approach; John Clayton (1993) Effective decision model for public involvement; Reed (2009) Stakeholder analysis and identification methods; Beierle (2002) five questions to ascertain quality of stakeholder decisions and ; Gene and Lynn (2000) Ten requirements for effective public participation methods. These

were then supported by responses from 200 respondents leading to the process developed below:

a. Rule of Control – participants must have actionable power to influence decisions.

b. Rule of boundaries – the limitations and non-negotiables of the project should be mentioned from the onset.

c. Rule of stake – the relevant stakeholders should be identified in a fair and equal representation, from the onset.

d. Rule of goals – from the onset of the projects, a consensus agreement on the aims, objectives and goals for the project need to be achieved. if not, early negotiation and trade-offs is paramount to moving forward.

e. Rule of theory - From the outset, it should be determined if a participatory method is about quality or acceptability of the decision, or combination of both.

f. Rule of execution - Identifying what method(s) best suits participation practice, such as focus groups, interviews, questionnaires, advisory panels, and etc.

g. Rule of resources – external resources (training, use of specialised equipment etc.) should be permitted or made available to aid in decision making of participants

h. Rule of verification and feedback – scientific selection of HSI needs to be validated by local knowledge and vice-versa. The resulting information can then be transparent for all members of community to see.

(6) The very execution of the Expert-initiated approach to early selection of HSI is a testament to the need to get the community involved early on in the decision

making process. In the long run this can save time and money on issues that could potentially be missed by a singular approach.

(7) The use of the bottom-up approach in the validation process:

a. Allows for the reduction of redundant and otherwise useless HSI that would not thrive if implemented in Lagos.

b. Identifies constraints and motivators that make HSI more usable.

c. Allows for the potential elimination of the point based system that current NSATs use.

d. Confirms the relevance of HSI that are deemed as popular or common, when developed via the top-down approach;

e. It illustrates that adopting this approach brings about a local perspective on sustainability which enhances the conventional environmentally focused tools by considering the social, economic and institutional drivers.

6.1.1.5 Perspectives 5: Three stage pathway to the early selection of HSI through integrated participation

This section summarizes all the methods developed and applies this in a seamless flow process. This provides a snapshot of the methodology developed, with the aim of it being replicated on a larger scale for the eventual development of a fully participatory integrated NSATs for Lagos, various regions in Nigeria and finally Africa (see Fig. 6.2).

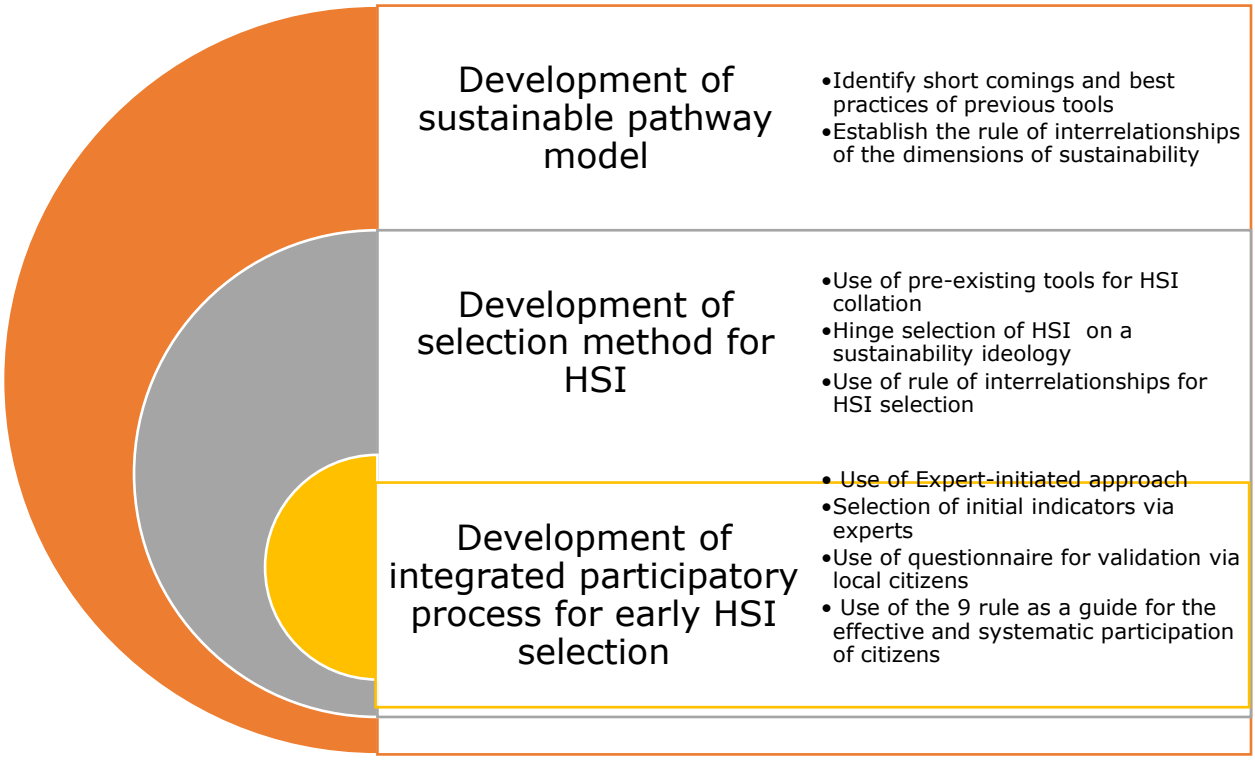


Fig. 6.2: Three stage pathway to the early selection of HSI through integrated participation

Each of the three processes developed in Fig 6.2 was validated in series of methods

1) Development of sustainable pathway model (first stage-Chapter 2 and 3) – This was tested and validated through a qualitative approach via an extensive literature review, the utilization of content analysis and analytical comparison of the manuals of a range of global NSATs.
2) Development of selection method for HSI (second stage-Chapter 4) – This was tested and validated mainly through the utilization of content analysis and analytical comparison of the manuals of a wide range of global NSATs.
3) Development of integrated participatory process for early HSI selection (third stage – chapter 5) – this was validated through survey based techniques in the form of a questionnaire approach where critical case sampling was utilized. it was also supported

by key theoretical ideologies obtained from a broad review of literature which was then combined with survey results to develop the selection process.

All three stages utilized previously developed manuals as case studies to either test, analyze, compare or validate the process being developed. By implementing three stages, in particular stage 2 and 3 a set of preliminary HSI can be selected. Stage 2 allows for the selection of Non-negotiable HSI (i.e. verification of from local community is not necessary) which has been selected via the top-down methodology to consider all the four DoS. This led to the selection 47 HSI but also relegated 62 indicators due to their low level of occurrence. These indicators would be non-negotiable as combined they cover the four DoS and their interrelationships (See 5.5.1.1: The rule of boundaries). However, The remaining 62 indicators then go through the phase 3 process of Fig. 6.2, which involves people scrutinizing the worth of the these HSI to their society. This study used the questionnaire approach detailed in Chapter 5 to select or eliminate the useful HSI. The result of this scrutiny leads to Table 6.3, where a total of 30 HSI are noted to be relevant, 16 are noted to be mandatory, 3 were noted to be debatable and 13 HSI were observed to be non-applicable (Appendix 6E-1 and 6E-2 breakdown of associated questions). In total, combining Table 4.4 and Table 6.3, the methodology in Fig 6.2 provides a list of 93 HSI (47 top-down and 46 bottom-up). It should be noted that this list is based on the 200 respondents and the nine manuals investigated. A larger number of manuals and respondent could give totally different set HSI. However, the method developed in Fig 6.2 illustrates how to use the integrated selection and represents the first step to selection of indicators for NSATs.

By following the process in Fig. 6.2, a list of HSI can be selected in an integrated manner, which is the starting point to the development of NSATs. This is crucial because the early selection of HSI forms the back bone to the selection of sustainability indicators or criterion and point systems that give performance measurements to the HSI. If the early selection of indicators is flawed from the onset this would invariably reduce the efficacy of the

tool in any given society. By considering the above mentioned perspective, it gives regions such as Lagos the means to develop such tools in an effective manner that takes local context into account. The key lesson learned in this research is the interrelationship of dimensions and need for planners, tool developers and policy makers to involve various stakeholders (particularly the community) in the assessment tool development process.

Table 6.3: Selected HSI from the list of low occurring HSIs

HSI	**Respondents verification**
Water Management Including Waste Water	
Water Monitoring and Leak Detection	Debatable
Community Water Use Reduction: Water Features	Relevant
Indoor Water Use	Relevant
Sustainable Material use and Solid Waste Management	
Timber utilisation	Relevant
Minimized Site Disturbance in Design and construction	Relevant
Hazardous Waste Management	Mandatory
Waste Conveyance	Relevant
Sustainable Transport	
Cycling facilities	Relevant
Traffic Safety	Mandatory
Logistics management - (policy Approach)	Relevant
Neighborhood Connectivity	Mandatory
Sustainable Site and Urban Form	
Connected and Open community	Debatable
Active Urban Environments	Mandatory
Sustainable Sustenance	
Agricultural Land Preserve	Mandatory
Inclusive Design and Public Consideration	
Consultation plan and Engagement	Mandatory
Urban Systems Assessment	Relevant
Acoustic Conditions and Acoustic Quality	Relevant
Sustainable Building Guidelines	Relevant
*Guest Worker Accommodation	not applicable
Sustainable Energy (Design. Technology, Building and Infrastructure)	
Measurement and Verification	Mandatory

Efficient Infrastructure: Lighting	Relevant
Regionally Responsive Planning	Debatable
Energy Management System	Mandatory
Community Water Use Reduction: Heat Rejection	Relevant
District heating or cooling	Relevant
Energy Efficient buildings	Relevant
Building Energy Guidelines	Relevant
Sustainable Urban Ecology	
Wetland and Water Body Conservation	Mandatory
Restoration of Habitat or Wetlands and Water Bodies	Mandatory
Hill Slope Development	Mandatory
Institutional Governance - Governance, Maintenance and Management	
Community Thrust	Relevant
Health in Design	Relevant
Governance	Mandatory
Incentive Programs	Relevant
Neighborhood schools and education development	Relevant
Services Infrastructure Provision	Relevant
Consideration for Formation of townscape and Landscape in district	Relevant
Harmonisation with Periphery	Relevant
Disaster Prevention	
Understanding Hazard maps	Relevant
Disaster Prevention vacant space and evacuation route	Mandatory
Flood risk assessment	Relevant
Economic Prosperity	
Population: Inhabitant Population and Staying Population	Relevant
Continuity of business and life in the block	Relevant
Housing and Job proximity	Mandatory
Return on Investment	Mandatory
Support of National Economy	Mandatory
Community Investment	Relevant
Utilization level of standard floor area ratio	Relevant
Revitalisation activity (efforts on economic revitalization for housing and non-housing)	Relevant
Green Lease	Relevant

6.2 Limitation of the research

The practice of sustainable development in itself is ridden with various aspects of context specificity, due to the fact that sustainability cannot be one size fit all process. This is because of its transient and region specific nature surrounding its implementations in numerous regions. What makes it particularly difficult also is the various definitions that surround its application, as there is no general consensus to one definition, this increases the dissimilarities in interpretation and application of sustainability. To ensure the process can be applied to broader locales, adequate care was taken to use definitions and principles which had a relatively strong consensus in the literature and practice. This research further caters to the context-specific interpretation of sustainability by providing open ended applications and suggestions to the implementations of the strategies developed at the three stages of the framework.

Regarding the development of the SPM and also its use on top-down HSI selection in chapters 2, 3 and 4 respectively, The four DoS was used as a point of analysis based on the fact that NSATs have been developed according to the Brudtland report and agenda 21, which led to the three dimensions of sustainability. However, with much supported evidence this research optimized this with four dimensions, making institutional dimension a visible dimension not just a hidden dimension. The point to this argument is that other dimensions or interlinkages between dimensions may exist and not exclusive to the four dimensions and the 15 interrelationships developed. These were actually used because it would be best suited for the development in an African society. However it might be that a three pillar or perhaps five dimensions approach is more relevant to a European or Asian regions. Thus, in chapter 3, it was made clear that depending on theory used, the interpretation of sustainability may change.

An additional limitation is concerning the use of the SPM approach, this was done on the consensus of three reviewers. Nonetheless, it is evident that a consensus between more

reviewers would be needed to strengthen the impact of identifying the DoS a specific HSI possesses.

Moreover, another limitation to this study was that it was not possible to analyze all NSATs currently developed which are about 20 in total. The tools selected were the tools that best fitted the phenomenon to be investigated at that given time. For instance, in chapter 2, where SPM was introduced four tools were examined; for selection of HSI in chapter 4, nine tools were used; to determine the effects of institutional dimension, 15 tools were used. Also time, availability of manuals online or through the developing organization could not always be accessed due to commercial nature of some of the NSATs.

Also, due to the type of the survey study executed and due to the qualitative approach used, societal generalization could not be made, at least not without the support of additional documents (white papers, published journals etc.). Also, a more quantitative approach would have required a large amount of funds and man power to execute which was not readily available. In addition, quantitative techniques such as stratified random sampling and simple random sampling in this situation would only be effective with proper house addresses and numbers. A lot of locations in Lagos suffer inconsistencies, in terms of housing numbers, number of households in a given structure, illegal settlements etc. Also, no reliable local online depository or database of such information was available in Lagos, Nigeria. Thus making it difficult to identify the number of households in development, and difficult to effective implement quantitative sampling. Consequently, since this study was focused on the development of process, with the result being the methodology itself, the survey served a case study and illustration to show the possible impact of communities in the early HSI selections. As such an exploratory approach to this research was taken, especially since such methods are best used for initial studies in field where little known about subject relative to the context in which it is applied; meaning that, despite widespread use of participatory

development frameworks, including in Africa, this approach has not been simultaneously applied to NSATs and region of Africa.

6.3 Implications of the findings

The study presented in this research has explained and enhanced the understanding of HSI selections and the significance or early integrated selection in the development of NSATs. The study has also has brought to lime light the promise and pitfalls that hinder such tools to be developed cities such as Lagos, Nigeria.

The development of the early integration process for NSATs allows practitioners to understand how previous tools have functioned thereby improving on the development of their own tools. Essentially, using the early selection process allows all users to modify the initial short comings of most tools (top-down led). In terms of sustainability generally and African society, it was shown that policies in particular need to addressed in order to improve the implementation success of these tools. It was also shown that the institutional dimension, which policy is a subset of, has largely been misinterpreted and undervalued in the selection of HSI and implementation of NSATs. Hence, it was important to optimize the three dimension approach in order to identify these particular institutional limitations. Thus by optimizing both internal policies, which affect regulations and code and guideline and external policies (subsidies, incentives) which support or enhance the use of NSATs would dramatically increase its use and success in the African regions. A known suggestion was the use of international standards on a temporary basis while more local codes relevant to the context of the region is being developed.

Also, No matter the nation, early and transparent integration of the top-down and bottom-up approach to planning is crucial, particularly for cities that have subscribed to the SDG principles. Key words here are early and transparent as this ensures that the development of the assessment tools are equal and fair and also allows such tools to implemented in a timely and affordable manner. All of which is needed to be successful in

Africa. However the process of integrating the selection process should be done systematically by following guiding and best practice principles to ensure efficacy in the integrated participatory approach

This research is about the development of the method for the starting process which begins with the selection of HSI, if this approach is done haphazardly this would have lasting impact on the development of the whole NSAT. The results provide the starting point for further development of the tool. The methodology also shows that essentially, different HSI will undoubtedly be selected for different regions and even if the name of the HSI is similar the issue the HSI wishes to address would vary across the four dimensions and interrelationship of sustainability.

In sum the development of the methodological process enforces the need of context, transparency, participation, integration, institution, communication, anticipation and promptness in selecting relevant and meaningful HSI for NSATs not only Globally but for Africa in particular.

6.4 Implications for future research and application

The limitations discussed in the above-mentioned sections provides the opportunity for additional research and possible application. Firstly, future research can seek to obtain all developed NSATs and then apply the methodology developed for more optimized results. This can then lead to more concrete investigation on the existence of universal HSI and if so what do they look like.

Also, more reviewer's randomly chosen to determine the DoS of HSI is also an avenue of research worth pursuing to see if there is significant difference in the interpretation of DoS for HSI. This interpretation could also look in to student urban planners, practitioners and general sustainability experts to see the how the DoS is perceived.

Furthermore, this study utilized an Expert-initiated approach to early HSI selection, an alternative route could be the expert-assisted approach. This could also be an avenue worth investigating.

This study was only focused on the selection process of HSI and not of the SI or criterions. Future study needs to follow up the developed method by applying SPM and integrated HSI selection principles to the selection of criterion and to see if truly the use of participatory approach can negate the need of point based system and possibly create pseudo systems that is a cross between current NSATs and the SDG approach to sustainability, especially for the African system. Still on the point system, if the system is to be utilized, perhaps investigation can look into weighting of HSI based on DoS rather than arbitrary numbers that is currently the norm.

Finally in terms of application, with the right funding and man power, a collaborative approach involving the ministry of environment, ministry of works and ministry of housing in Lagos could be organized, where the developed methodology can be put into practice, via quantitative sampling to actually begin a pilot study process for the development of NSATs in Lagos, Nigeria or any other nation willing to practically utilize the methods developed in this research (see Figs. 5.4 and 5.5).

References

BERARDI, U. 2015. Chapter 15 - Sustainability assessments of buildings, communities, and cities A2 - Klemeš, Jiří Jaromír. *Assessing and Measuring Environmental Impact and Sustainability.* Oxford: Butterworth-Heinemann.

FRASER, E. D. G., DOUGILL, A. J., MABEE, W. E., REED, M. and MCALPINE, P. 2006. Bottom up and top down: Analysis of participatory processes for sustainability indicator identification as a pathway to community empowerment and sustainable environmental management. *Journal of Environmental Management,* 78**,** 114-127.

KIRTON, J. J., LARIONOVA, M. and SAVONA, P. 2010. *Making global economic governance effective : hard and soft law institutions in a crowded world,* Farnham, Ashgate.

KOMEILY, A. and 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.

MACLAREN, V. W. 1996. Urban Sustainability Reporting. *Journal of the American Planning Association,* 62**,** 184-202.

PEDRO, J., SILVA, C. and PINHEIRO, M. D. 2017. Scaling up LEED-ND sustainability assessment from the neighborhood towards the city scale with the support of GIS modeling: Lisbon case study. *Sustainable Cities and Society*.

PISSOURIOS, I. 2014. *Top-Down and Bottom-Up Urban and Regional Planning: Towards a Framework for The Use of Planning Standards*.

SHARIFI, A. and MURAYAMA, A. 2013. A critical review of seven selected neighborhood sustainability assessment tools. *Environmental Impact Assessment Review,* 38**,** 73-87.

SPANGENBERG, J. H., PFAHL, S. and DELLER, K. 2002. Towards indicators for institutional sustainability: lessons from an analysis of Agenda 21. *Ecological Indicators,* 2**,** 61-77.

TANGUAY, G. A., RAJAONSON, J., LEFEBVRE, J.-F., LANOIE, P. S. L. E.-G. S. F.-S. P., MSO-BIDI-FONT-SIZE:11.0PT, LINE-HEIGHT:115%, FONT-FAMILY:"VERDANA", S.-S., MSO-FAREAST-FONT-FAMILY:CALIBRI, MSO-BIDI-FONT-FAMILY: and ARIAL"> 2009. Measuring the Sustainability of Cities: A Survey-Based Analysis of the Use of Local Indicators CIRANO - Scientific Publications No. 2009s-02.

TURCU, C. 2013. Re-thinking sustainability indicators: local perspectives of urban sustainability. *Journal of Environmental Planning and Management,* 56**,** 695-719.

VALENTIN, A. and SPANGENBERG, J. H. 2000. A guide to community sustainability indicators. *Environmental Impact Assessment Review,* 20**,** 381-392.

Villanueva, D., and E. Horan, 2018, A Diversity of Eco-Developments: An Overview and Comparison of Sustainability in Six Eco-Developments, Sustainable Development Research in the Asia-Pacific Region: Education, Cities, Infrastructure and Buildings: Cham, Springer International Publishing, p. 237-252.

World commission on environment and development 1987. Our Common Future. Oxford Press.

Appendix

Appendix 1A: Questionnaire developed and participation Information sheet

Participant Information Sheet

Issues which Citizen of Lagos, Nigeria go through in their Community and City

Dear Participant,

Thank you for agreeing to participate in this questionnaire survey in connection with my PhD dissertation/research at the University of Nottingham UK/Ningbo. The project is a study of Issues which citizen of Lagos go through in their community and city. You (participants) are required to please fill the questionnaire as honestly and to the best of your ability. The questionnaire will take 15 -20 mins to fill. The results will be used to develop an indicator tool for planners and policy makers that address these key issues that face Lagos obtained from the questionnaires.

Your participation in the survey is voluntary. You are able to withdraw from the survey at any time and to request that the information you have provided is not used in the project. Any information provided will be confidential. Your identity will not be disclosed in any use of the information you have supplied during the survey.

Should you have any question now or in the future, please contact me or my supervisor. Should you have concerns related to my conduct of the survey or research ethics, please contact my supervisor or the University's Ethics Committee.

Yours truly,

Ayotunde Dawodu

Contact details:

Student Researcher: Ayotunde Dawodu and Ayotunde.Dawodu@nottingham.edu.cn

Supervisor: Ali Cheshmehzangi and Ali.Cheshmehzangi@nottingham.edu.cn>

University Research Ethics Committee Coordinator, Ms Joanna Huang (Joanna.Huang@nottingham.edu.cn)

- I have read the Participant Information Sheet and the nature and purpose of the research project is understood. I understand and agree to take part.
- I understand the purpose of the research project and my involvement in it.
- I understand that I may withdraw from the research project at any stage and that this will not affect my status now or in the future.
- I understand that while information gained during the study may be published, I will not be identified and my personal results will remain confidential.
- I understand that the data collection will be recorded

- I understand that data will be stored in accordance with data protection laws.

- I understand that I may contact the researcher or supervisor if I require more information about the research, and that I may contact the Research Ethics Sub-Committee of the University of Nottingham, Ningbo if I wish to make a complaint related to my involvement in the research.

Signed …… (participant)

Print name …… **Date** ……

Please tick the box that is most applies to you, unless stated do not tick more than 1 box

DEMOGRAPHIC QUESTIONS

How long have you been Leaving in Lagos?	□ Less than a year □ 1-5 years □ 6-10 years □ 11-15 years □ 16-20 □ 21 +
Age	□ 18-24 □ 25-29 □ 30-39 □ 40-49 □ 50-59 □ 60-69 □ 70-79 □ 80+
Gender	□ Male □ Female
Do you rent or own the home you live in,	□ Rent □ Own (direct purchase/inherited □ Own (Mortgage)
How many people live in your home/flat	
How many adults how many children?	_____Adults _____Children
Are you an owner of undeveloped land	□ Yes, I an owner □ No, I do not own land
Highest Level of Education	□ Primary school □ Secondary School □ First degree or bachelors □ Master's Degree or postgraduate □ PhD
What is your own salary?	□ Do not work □ < N80,000 □ N80,00 – N120,000 □ N120,001 – N180,000

	□ N180,001 – N250,000 □ N250,001 – N350,000 □ 350,000 >

TRANSPORT ISSUES

How regularly do you use	**Private car transport** for everyday activities i.e. your personal car

☐ Never	☐ Once a week	☐ Twice a week	☐ Three times a week	☐ Four times a week	☐ Five times a week	☐ Six times a week	☐ Every day
1	2	3	4	5	6	7	8

Public car transport for everyday activities i.e. taxi and Uber etc.)

☐ Never	☐ Once a week	☐ Twice a week	☐ Three times a week	☐ Four times a week	☐ Five times a week	☐ Six times a week	☐ Every day
1	2	3	4	5	6	7	8

Bus transport for everyday activities (bus includes BRT, public buses(Danfo), company buses)

☐ Never	☐ Once a week	☐ Twice a week	☐ Three times a week	☐ Four times a week	☐ Five times a week	☐ Six times a week	☐ Every day
1	2	3	4	5	6	7	8

Motor cycle transport for daily actives (Okada, and Kekenapep)

☐ Never	☐ Once a week	☐ Twice a week	☐ Three times a week	☐ Four times a week	☐ Five times a week	☐ Six times a week	☐ Every day
1	2	3	4	5	6	7	8

Bicycle transport for daily actives

☐ Never	☐ Once a week	☐ Twice a week	☐ Three times a week	☐ Four times a week	☐ Five times a week	☐ Six times a week	☐ Every day
1	2	3	4	5	6	7	8

If you answered never for any of the four questions above please state why?	Private car_____ _____ Public car_____ _____

	Bus_____ _____ Motor cycle_____ _____ Bicycle_____ _____
On scale of 1 to 5 how bad would you rate the level of traffic in Lagos?	☐ Very High level of traffic (terrible) | ☐ High level of traffic (Bad) | ☐ Average or medium level of traffic | ☐ Low level traffic | ☐ No traffic 1 | 2 | 3 | 4 | 5
Cars are known to pollute the air with their smoke and cause traffic. If available, what would motivate you to consider other transports such as efficient BRTs, cycling, electric trains, electric cars a) reducing of pollution on plants, animals and environment b) reducing pollution to improve health and respiratory diseases such as asthma c) reducing the hours you spent in traffic d) not interested in efficient BRTs, cycling, electric trains or electric cars	Choose 1 or 2 options, the first being most important 1) ☐ 2) ☐
Cars also run on fuel which is bad for the environment and in Nigeria is currently expensive with fuel scarcity present and fuel increase	If available, would you consider alternative option of fuel such as electric car or cars that run of cassava oil, and other vegetable oil? ☐ Yes ☐No
Electric car cost 11 million Naira would you buy this vehicle considering the fact that it runs on electricity and has zero pollution/smoke?	☐ No, it is too expensive | ☐ No, Nigeria needs to provide constant electricity first | ☐ Yes, I wouldn't have to worry about fuel scarcity and queuing for fuel | ☐ Yes, it would reduce air pollution in the environment thereby improving health of people and nature 1 | 2 | 3 | 4
If you answered No in the above, would you change your mind, if the government provided, 30% off (7.7 million Naira) any purchased electric vehicle and provided free electricity at filling stations for 1 year	☐ No, it is still too expensive | ☐ No, I don't believe it is still worth it due to irregular power | ☐ Yes I would 1 | 2 | 3

<table>
<tr><td>Would you consider using a bicycle for short distance travel?</td><td>☐ Yes ☐ No</td></tr>
<tr><td>Would the development of bicycle lane improve the likelihood of you using a bicycle</td><td>
<table>
<tr><td>☐ No</td><td>☐ Slightly, I may consider it</td><td>☐ Most likely</td><td>☐ Highly likely</td><td>☐ Yes, Definitely</td></tr>
<tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr>
</table>
</td></tr>
<tr><td>If no or slightly,</td><td>Would providing a safe bicycle storage at shops, offices, homes improve the likelihood of using bicycle
<table>
<tr><td>☐ No</td><td>☐ Slightly, I may consider it</td><td>☐ Most likely</td><td>☐ Highly likely</td><td>☐ Yes, Definitely</td></tr>
<tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr>
</table>
</td></tr>
<tr><td>If trains were made available and connect mainland and island or mainland to another part of mainland would this be your daily transport to work?</td><td>
<table>
<tr><td>☐ No, I don’t see the difference</td><td>☐ No, I prefer the privacy and comfort of my car</td><td>☐ Yes, trains are better for the environment than cars and buses</td><td>☐Yes, If I can avoid the traffic</td><td>☐ Yes, if it was cheaper than using my car</td></tr>
<tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr>
</table>
</td></tr>
<tr><td>Should trailers and freights that transport goods and other products like petrol and diesel be banned from day time movement
a) Goods an products should be moved by trains if possible
b) Policy and law that bans freights and trailers from moving during the day
c) Roads should be widened to make separate lane for trailers and freights
d) A different route should be developed for freights and trailers
e) Trailers and freight should have minimum speed of movement
f) All trailers and freight developed from 2005 downward should be replaced with more efficient model
g) Other (please state the other)</td><td>How do think the government can solve this problem?

In order of preference arrange your solution with top 3

1) ☐

2) ☐

3) ☐</td></tr>
<tr><td>Do you think there are enough sidewalks in Lagos that secure pedestrian safety?</td><td>☐ Yes ☐No</td></tr>
</table>

How accessible is public transport in your community i.e. how close are bus tops to your homes, offices and shops	☐ No bus stops Nearby (I have to either drive, cab or follow a friend)	☐It doesn't matter (because I use my car)	☐ The bus stop is very far (I have to bike or take keke there)	☐ The bus stops are Far (I have to walk at least 15 mins)	☐ The bus stop are not too far (I have to walk a maximum of 10 mins to the bus top)	☐ The bus top it is close (I have walk 5 mins or less)
	1	2	3	4	5	6
Air pollution is quite high in Lagos, which law would you support.	☐ Support laws that removed old vehicles on the road i.e. car, buses made before 2005 ☐ Support laws that places heavy fine vehicles depending on how old they are i.e the older the vehicle the heavier the fine ☐ Support laws one and two above ☐ No law is needed					

CITY ENVIRONMENT ISSUES

Do you agree that a new community or area should be developed where there is already developed route for transporting people?	☐ Yes ☐No				
Should the government (local, state and federal) do more about pedestrian safety on Lagos roads.?	☐ Yes, more needs to be done ☐No, pedestrian safety is fine				
How many different parks have you visited in Lagos to have picnics, play sports and have outdoor activities? Note: A park is an area of grass, vegetation and trees surrounded and sometimes populated by birds and other peaceful animals	☐ 0 parks ☐ 1 park ☐2 parks ☐3 parks ☐4 parks ☐5 parks and above				
Do you feel that Lagos needs more outdoor parks where the public can relax, exercise and have fun?	☐ No I don't see the need	☐ No, it's not safe	☐Yes, it does		
	1	2	3		
Would you encourage the development of public playing grounds for children in your community in Lagos	☐ No, I don't see the need	☐ No, it's not safe	☐ Yes, I would		
	1	2	3		
Any additional reason why you would say, no?					
Would you encourage the development of more open sports fields?	☐ Yes, I would ☐ No, I don't see the need				
How clean and maintained are the beaches you have been to?	☐ No Maintenance at all	☐ Not well maintained /clean	☐ Could be maintai	☐ Clean and maintained enough	☐ Very well maintained and clean

			ned better		
	1	2	3	4	5
Do you consider the beaches enough in terms of open outdoor space for Lagos?	☐ Yes ☐No				
How safe do you feel when at the beach?	Very unsafe				Totally safe
	1	2	3	4	5
How many times in a month do you go to the beach?	☐ Never	☐ One weekend in month	☐ 2 weekends in a month	☐ 3 weekends in a month	☐ Every week	☐ others please fill _____
	1	2	3	4	5	6
If the park or beach were closer to your home or community would you attend more times	☐ Yes ☐ No					
Would safety affect your support for more outdoor spaces like parks and beaches for people and children?	☐ Yes, it would	☐ Yes, but I have other concern	☐ No, it is safe			
	1	2	3			
If 2nd option is chosen please state 1 or 2 of those concerns	1)_____					
	2)_____					

Do you consider it bad to cut down trees and forest to develop more land for more people to live and work i.e. for houses, offices and shops?	Yes ☐ No				
How concerned are you about the wildlife (animals not pets) animal life that exist is Lagos?	☐ Don't care	☐ I have little concern	☐ I have developed more concern	☐ I am concerned	☐ I am very concerned
	1	2	3	4	5
Do you think that undeveloped land	Should be left undisturbed and not used for construction to preserve the environment i.e. save the land that is home to animals and birds? Yes ☐ No				
	Should be used for city expansion and creation of roads, walkable streets and more affordable homes? Yes No				
	Should be used for construction that promotes agriculture and other food production activities? Yes ☐No				
	that has historical meaning and value like trees and unique to Lagos environment should be preserved?				

	Yes ☐No
Would you support a program, policy or law	that protects trees and endangered animals in Lagos i.e. nothing can built in these areas. Yes ☐o
	that ensures that for every tree cut town more trees are planted within the city Yes ☐No
Wood is an important product in Lagos, used for building construction (farming structures and houses, furniture such as table, chairs, beds shelves etc.)	How would you recommend Lagos obtain this wood? Import from other countries ☐Chop down local trees
For the above, give reason for selection?	

Any additional recommendations of issues or solutions please state	

Appendix 2A-1: Description of 15 Aspects of Sustainability

Aspect	Descriptions	Dimensions	Dimension description
Point Aspect	Addresses each dimension of Sustainability	Environment	The natural ecosystem E.g. the natural and built environment in all its totality
		Social	The effects of the inter-relationships of human activity. E.g.: human relationships as defined by cultural practices etc. in a given locale.
		Economic	The mode in which available capital is utilized. Capital as used in this context refers to available resources that could be used to create a desired change (or undertake a given venture), this follows from the modern definition of capital which categorizes capital into: financial, human, natural, social, instructional etc. Note that following this definition when other sustainability dimensions (e.g. environment and social) are interfaced with the economy, then we assume these dimensions, to be a form of capital.
		Institutional	The rules and guidelines that determine human relationships (or interactions). E.g.: a piece of legislature that defines a certain planning procedure that should be undertaken before been allowed to build.
Linear Aspect	Addresses 2 reversible relationships of Sustainability	Enviro-Social	The effects that human interactions have on the environment, and also the human response to certain environmental conditions or state. E.g.: the effects of a certain building format on the environment, or how the environment influences a certain architectural design
		Enviro-Economic	How the usage of various capital influences the environment and also how the state of the environment determine the usage of different capital. In another context, this could also refer specifically to how environmental resources are utilized, thus an attempt to use other capital to make the environment better could be a gain in the environment, however, when environmental resources (capital) are consumed irreversibly, then this capital is diminished, and when there is adverse effects through the utility of this capital, we have a loss in the environmental capital. E.g.: financial input (use of financial capital) on restoring a depleted forest, which probably was depleted from raising financial capital through the utility of human capital (as in human activities).
		Enviro-Institutional	How the guidelines that determine human interactions influence the environment and also the response or modifications to these guidelines to create a particular effect on the environment. E.g.: policy to restrict the use of cars in a certain region, as a response to air pollution.
		Socio-Economic	How the social capital is been utilized and the ensuing effects of social capital utility.
		Socio-Institutional	The dynamics in human interrelationships that creates the structure, and also how the existence of this structure influences human interaction. E.g.: cultural motivated policies or how the culture of groups of people can be influenced by a given policy.

		Econo-Institutional	How the use of available capital informs the creation of guidelines for human interactions, and how these structures affect the utility of available capital.
Planar Aspect	Addresses three reversible relationships of Sustainability	Enviro-Econo-Social	How the utility of social capital affects the environment, and also how the environment defines the utility of social capital.
		Enviro-Socio-Institutional	How the influence of guidelines on social interactions influence the environment.
		Enviro-Econo-Institutional	How the effects of the guidelines that govern human interactions influences the utility of various capital, and how this capital utility affects the environment: i.e. the environmental impacts of the guidelines that led to the utility of capital in a certain way.
		Socio-Econo-Institutional	The utility of social capital as influenced by the guidelines that defines human interactions.
Aggregate (or Summative) Aspect	Sustainability model addresses all 4 relationships Sustainability	Enviro-Econo-Social-Institutional	This is one that simply pictures the *inter-linkages* between the four pillars of sustainability as a singular entity. Essentially, this is a grand picture of sustainability in itself, nevertheless, this aspect cannot be used as a metric to visualise sustainability.

Appendix 2A-2: Dimension placement of NSATs

	CASBEE	**BREEAM**	**Green Township**	**GBI Township**	**CASBEE credit**	**BREEEAM credit**	**Green Township credit**	**GBI Township credit**
E	Recycled material	Energy Strategy	Preserve Existing Trees and Water bodies	Onsite Energy Generation	5	4.1	6	2
	Garbage Recycling	Land Use	Retain Natural Topography	Renewable Energy Generation	5	2.1	6	4
	Treated Water	Adapting to Climate Change	Redevelopment of Contaminated Areas	Reduced Water use	5	2.7	6	4
	In Area Resource Circulation	Low Impact Materials	Green Buildings	Reduction in water Use by Wastewater Treatment	5	2.7	12	4
	Rainwater Utilization	Resource Efficiency	Rainwater Harvesting	Biodiversity Conservation	5	2.7	6	2
	Reduction in Wastewater Discharge amount	Transport Carbon Emissions	Waste Water Treatment	Land Reuse	5	2.7	6	1

	Capacity of Detention Pond	Cycling Network	Waste Water Reuse	Ecology	5	2.1	6	3
	Habitat Space of Species	Cycling Facilities	Energy Efficiency in Infrastructure Equipment	Hill Slope Development	5	1.1	8	1
	Corridor Quality		Onsite Renewable Energy	Light Pollution	5		16	1
	Handling of Brownfield Sites		Construction Waste Reduction	Recycled Facilities	5		6	2
	Environmentally friendly buildings		Off-site Green Power	Site Sedimentation and Pollution Control	5		12	1
	Land Form		Recycled Content	GBI Certified Buildings	5		8	6
	Total				**60**	**20.2**	**98**	**31**
S	Execution of Separating Pedestrians and Vehicles	Consultation Plan	Social and Cultural Initiatives	Provision of Universal Accessibility	5	2.3	6	3
	Crime Prevention - security measures	Consultation and Engagement	Pedestrian Network	Secure Design	5	3.5	6	2
	Information Service Performance	Design Review		Community Diversity	5	2.3		1
	Cooperation with Local Community	Safe and Appealing Streets		Facilities for Public Transportation	5	3.2		1
		Inclusive Design				1.8		
	Total				**20**	**13.1**	**12**	**7**
Ec	Staying Population				5			
	Inhabitant Population				5			
	Utilization level of standard floor area ratio				5			
	Total				**15**	**0**	**0**	**0**
I								
	Total				**0**		0	0
E-S	Ground greening	Noise Pollution	Public Landscape Areas	Heat Island Design Principles	5	1.8	6	4
	Rooftop Greening	Existing Buildings and Infrastructure	Urban Heat Island Effect	Efficient Street and Parking Lighting	5	2.7	8	2
	Wall Greening	Water Strategy	Public Transporta	Flood Managemen	5	2.7	6	1

			tion Facilities	t and Avoidance				
	Consideration of regionality	Ecology Strategy	Eco-Friendly Transportation Services	Wetland and Water Body Conservation	5	3.2	6	1
	Understanding of Hazard Map	Microclimate	Bicycle Lane Network	Agricultural Land Preserve	5	1.8	6	1
	Convenience/ Welfare	Green Infrastructure		Sustainable Storm water Design and Management	20	1.8		2
	Usability of Public Transport	Local Parking		Green Spaces	5	0.9		3
	Disaster Prevention of Various Infrastructure	Flood Risk Management		Health in Design	5	1.8		2
	Natural Resources	Water Pollution		Availability and Frequency of Public Transport	5	1.1		1
		Enhancement of Ecological value		Pedestrian Networks		3.2		1
		Landscape		Cycling Network		2.1		2
		Light Pollution		Sustainable Construction Practice		0.9		2
		Sustainable Buildings				4.1		
		Rainwater Harvesting				1.1		
	Total				**60**	**29.2**	**32**	**22**
E-Ec	Updability and Expandability			Low Impact Material (Infrastructure)	5			1
	Possibility to make Demand /Supply System Smart			Low Impact Material (Buildings and Structures)	5			1
				Construction Waste Management				1
	Wood material			Regional Materials	5			1
	Total				**15**	**0**	**0**	**4**
E-I	Harmonization with Periphery			Quality in Construction	5			2
	Compliance		Measurement and Verification Plan		5		2	

	Rainwater Permeable Surface and Equipment		Innovation in Design and Technology		5		12	
	Total				**15**	**0**	**14**	**2**
S-EC	History and Culture	Economic impact	Mixed Use Development	Affordable Housing	5	8.9	10	1
	Development of Traffic Facilities	Housing Provision	Housing Typologies	Business	5	2.7	8	3
	Logistics Management	Delivery of Service Facilities and Amenities	Employment Opportunities		5	2.7	8	
	Revitalization Activities (Housing System)	Public Realm			5	2.7		
	Revitalization Activities (non-Housing System)	Utilities+A57:D64B5 D61:F61			5	0.9		
	Continuity of Business and Life in the Block	Community Management of Facilities			5	1.2		
		Training and Skill				5.9		
	Total				**30**	**25**	**26**	**4**
S–I	Consistency with and Complimenting of Upper Level Planning		Road and Street Network	Community Thrust	5		6	4
				Governance				4
	Total				**5**	**0**	**6**	**8**
EC–I			IGBC Accredited Professional	GBI Facilitator	0		4	1
	Total				**0**	**0**	**4**	**1**
E-EC-S	Block Management	Flood Risk Assessment	Local Fruits and Vegetable Produce	Proximity to Existing Infrastructure	5	1.8	8	1
		Transport Assessment		Services Infrastructure Provision		3.2		1
		Access to Public transport		Amenities for the Community		2.1		3
		Local Vernacular		Green Transport Master Plan		0.9		8
		Public Transport Facilities		Innovation		2.1		6
				Alternative Transport Options				1
	Total				**5**	**10.1**	**8**	**20**

E-S–I	Disaster Prevention vacant space and evacuation route			Compact Development	5			1
	Consideration for Formation of townscape and Landscape in district				5			
	Total				**10**	**0**	**0**	**1**
E-EC-I								
	Total				**0**	**0**	**0**	0
S-EC–I		Demographic Needs and Priorities				2.7		
	Total				0	2.7	0	
	Absolute Total				**235**	**100**	**200**	**100**

Appendix 2A-3: SPM percentage analysis of NSATs

	SP	**CASBEE**	**BREEAM**	**IGBC**
Environmental	E	26%	20%	49%
Social	S	9%	13%	6%
Economic	EC	6%	0%	0%
Institutional	I	0%	0%	0%
Enviro Social	E-S	26%	29%	16%
Enviro-Ecomonic	E-EC	6%	0%	0%
Enviro-Institutional	E-I	6%	0%	7%
Socio-Economic	S-EC	13%	25%	13%
Socio – Institutional	S-I	2%	0%	3%
Econo – Institutional	EC-I	0%	0%	2%
Enviro - Econo - Social	E-EC-S	2%	10%	4%
Enviro - Socio – Institutional	E-S-I	4%	0%	0%
Enviro - Econo- Institutional	E-EC-I	0%	0%	0%
Socio - Econo – Institutional	S-EC-I	0%	3%	0%
Total	100%	100%	100%	100%

Appendix 2A-4: SPM Aspect analysis of NSATs

	CASBEE	BREEAM	IGBC	GBI
Point Model	40%	33%	55%	38%
Linear Model	53%	54%	41%	41%
Phase Model	6%	13%	4%	21%

Appendix 3B-1: Keys to the classification of energy based institutions

	Organizations and policies	INTL Standards and codes	
CNT	COMNET (LEED)	ASH_1	ASHRAE Standard 90.1–2010, Appendix G (LEED)
GCO	Green E certification organization (Pearl)	ASH_2	ASHRAE guide 22: Instrumentation For Monitoring Central Chilled-Water Plant Efficiency (GM)
DET	Department of Energy buildings Technology office (Enterprise)	CIBSE	Chartered Institute of Building Services Engineers (CIBSE) Applications Manual 10: Natural Ventilation in Non-Domestic Buildings.
HKP	The government of Hong Kong China, the planning Department: Wind Availability Data for Air Ventilation Assessment In Hong Kong	ASTM_1	ASTM E1980 - 01 Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces
HKE	Electrical and Mechanical Services Department (EMSD): the Government of Hong Kong special administrative region - Energy Utilization Indexes and Benchmarks for Residential, Commercial and Transport Sectors (BEAM)	ASTM_2	ASTM E1918-06, Standard Test Method for Measuring Solar Reflectance of Horizontal and Low-Sloped Surfaces in the Field
USDE	U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy Enterprise (Enterprise)	ASTM_3	ASTM C1549-09, Standard Test Method for Determination of Solar Reflectance Near
ASES	American Solar Energy Society (ASES) (Enterprise)	ASTM_4	Ambient Temperature Using a Portable Solar Reflectometer
FSEC	Florida Solar Energy Center (FSEC) (Enterprise)	ASTM_5	ASTM E 408-71(2008), Standard Test Methods for Total Normal Emittance of Surfaces Using Inspection-Meter Techniques
NREL	National Renewable Energy Laboratory (NREL) (Enterprise)	ASTM_6	ASTM C1371-04a, Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissions meters (PEARL)
USEPA	U.S. Environmental Protection Agency, Heat Island Effect	ASH_3	ASHRAE Standard 90.1–2010 (LEED)
CRRC	Cool Roof Rating Council (CRRC) (non-binding)(Enterprise),	ASH_4	ASHRAE Standard 90.1–2010, Appendixes B and D (LEED)
LBNL	Lawrence Berkeley National Laboratory, Heat Island Group (Partnered with EPA) (Enterprise)		
ES_1	ENERGY STAR (partnered with EPA) (Enterprise)		
IDA	International Dark-Sky Association (IDA) (Enterprise		
ES_2	Energy Star: Duct sealing (partnered with EPA)(Entire)		
ABC	Australian Building Codes Board (Enviro)		
USDOE	US DOE Zero Energy Ready Home (Enterprise)		
PHIUS	Passive House Institute US (PHIUS)(supported by US DOE)		
LBC	Living Building Challenge Net Zero Energy Building Certification (Alliance with USGBC)		
RERH	ENERGY STAR products (Partnered with EPA)		
DSIRE	Database of State Incentives for Renewables and Efficiency (DSIRE): developed by DOE and the North Carolina Clean Energy Technology Center		

SEI	South face Energy Institute (Partnered with ECC, Atlanta , Georgia etc)		
NCDC	EPA: National Clean Diesel Campaign and verification		
	Guides Local governing bodies, codes, guidelines		**Third party assessment tools**
COMG	COMNET modeling guidelines	LEED	LEED ND (US)
ANSI_1	ANSI Standard 90.1–2010, Appendix G,	EGC	Enterprise green communities (US)
IESNA_1	Standard 90.1–2010, Appendix G, (LEED)	ECC	Earth community craft (US)
SS_530	SS 530: Code of practice for energy efficiency standard for building services and equipment	SCRS	Star Community Rating System (US)
SS_553	SS 553 Code of practice for air-conditioning and mechanical ventilation in buildings	BEAM	BEAM Plus Neighborhood (Hong Kong)
CP_13	CP 13: code of practice for mechanical ventilation and air-conditioning in building - Legionella	BERDE	BERDE Clustered Development (Philippines)
AHRI	AHRI:Performance Rating of Water-chilling and Heat Pump Water-heating Packages Using the Vapor Compression Cycle (GM)	GBIT	Green Building Index Township (Malaysia)
HKC_1	Hong Kong Buildings Department: Sustainable Building Design Guidelines APP-152 (BEAM)	GMD	Green Mark for Districts (Singapore)
CNC	Ministry of Housing and urban-rural development 2013, Design Standard for thermal environment of urban residential areas (JGJ 286-2013), MOH, People's Republic of China.	CASBEE	CASBEE UD (Japan)
PNS	Phillipenes National standard (PNS) for Lighting products (partnered with International Electrotechnical Commission IEC)(BERDE)	IGBC	IGBC Green Township (India)
IESNA_2	IESNA RP 33 99 Lighting for Exterior Environments (PEARL)	TPC	The Pearl Community (UAE)
IESNA_3	IESNA RP 8 Roadway Lighting (PEARL)	GSASD	GSAS Dsitrict (Qatar)
MS_825_1	Malaysian Standards: MS 825 : Part 1 Code of Practice for the Design of Road Lighting; Part 1 Lighting of Roads and Public Amenity Areas (GBI)	EDM	EnviroDevelopment Master planned community (Australia)
MS_825_2	MS 825 : Part 2 Code of Practice for the Design of Road Lighting; Part 2 Lighting of Tunnels(GBI)	GSC	Green Star Communities (Australia)
IESNA_4	standards for Lighting Zone 2 as detailed in the IESNA publication RP-33-1999, Lighting for Exterior Environments (ECC)	BREEAM	BREEAM Communities (UK)
IESNA_5	IESNA Manual: Lighting for Exterior Environments includes lighting design guidelines.(Lighting for Exterior Environments, IESNA publication, RP-33-1999) (Enterprise)		
USAC_1	Air Conditioning Contractors of America, Manuals J: Residential Load Calculation and Manual S: Residential Equipment Selection (Entire)		
USAC_2	Air Conditioning Contractors of America, "HVAC Quality Installation Specification: Residential and Commercial Heating, Ventilating, and Air Conditioning Applications" (Entire)		**Peer review journals**
ASH_5	ASHRAE handbooks(cahpter not specified) (Entire)	J1	Santamouris M. 2001, 'On the impact of urban climate on the energy consumption of buildings', Solar Energy, vol. 70, pp. 201-216.
DOE_1	DOE Guidelines on Energy Conserving Design of Buildings: the Minimum Performance Rating of Various Air Conditioning System (BERDE)	J2	Oke TR. 1988, 'The urban energy balance', Progress in Physical Geography, vol.12, pp. 471-508.
ANSI_2	ANSI Standard 90.1–2010	J3	Shashua-Bar, L. Hoffman, M. E. 2002, 'The Green CTTC model for predicting the air temperature in

			small urban wooded sites', Building and Environment, vol. 37, pp. 1279 –1288
IESNA_6	IESNA Standard 90.1–2010	J4	Elnahas, M. M., Willimanson, T. J. 1997, 'An improvement of the CTTC model for predicting urban air temperatures', Energy and Building, vol. 25, pp. 41–49.
IESNA_7	IESNA Standard 90.1–2010, Appendixes B and D (LEED)	J5	Unger, J. 2004, 'Intra-urban relationship between surface geometry and urban heat island : Review and new approach', Climate Research, vol. 27, No, 3, pp. 253-264 (HKBEAM
DOE_2	DOE Guidelines on Energy Conserving Design of Buildings: minimum efficiency requirement of the air-conditioning system (BERDE)		
DOE_3	DOE Guidelines on Energy Conserving Design of Buildings: thermal wall transfer(BERDE)		
HKC_2	Hong Kong Buildings Department: Sustainable Building Design Guidelines APP-152 (BEAM)		
NREL	National Renewable Energy Laboratory, "Solar Ready Buildings Planning Guide," NREL Technical		
	Report (NREL/TP-7A2-46078): A paper published by NREL in December 2009 that details design		
	guidelines and checklists for designing solar-ready buildings.		
USGBC	Urban Green Council (New York affiliate of the U.S. Green Building Council (USGBC)): Building Resiliency Task Force Full Report, Backup Power Chapter;		
ASH_6	ASHRAE energy audit: Procedures For Commercial Building Energy Audits manual		
EPA	PA emissions standards of Tier 2		

Appendix 3B-2: Energy based –headline sustainability indicator and frequency

Energy based –Headline Sustainability Indicator (E-HSI)	Frequency	E-HSI	Frequency
Energy Strategy	7	**Energy efficient building envelope**	**2**
Energy Infrastructure	5	**Reduction in greenhouse gas emissions**	**1**
Certified Green buildings	12	**Nearing net zero**	**1**
Renewable Energy: Offsite	3	**Energy star appliances**	**1**
Passive energy design	8	**Electricity Meter**	**1**
Building Energy Guidelines	1	**Photovoltaic/Solar Hot Water Ready**	**1**
Renewable Energy: Onsite	9	**Resilient Energy Systems: Flood proofing**	**1**
Peak Electricity Demand	6	**Resilient Energy Systems: Islandable Power E-S-I**	**1**
Urban Heat Island Effect	11	**Earth Craft Builder Training**	**1**
Energy Efficient Lighting	5	**Renovation of Existing Commercial**	**1**
Energy Monitoring and Management	2	**Alternative Thermal Production E**	**1**
District Heating / Cooling	6	**Clean Emissions Protocol for Heavy Equipment**	**1**
Energy efficient improvement in performance of buildings	4	**Industrial Sector Resource Efficiency**	**1**
		Total E-HSI	**93**

Appendix 3B-3: Theme based comparison and Procedure, Feature and performance based placements

CASBEE UD (Japan)	BREEAM Communities (UK)	LEED ND (US)	IGBC Green Township (India)	Green Building Index Township (Malaysia)	GSAS District (Qatar)	Green Star Communities (Australia)	The Pearl Community (UAE)	Green Mark for Districts (Singapore)	BEAM Plus neighborhood (Hong Kong)	BERDE Clustered Development (Philippines)	Enviro Development Masterplanned community (Australia)	Enterprise green communities (US)	Earth community craft (US)	Star Community Rating System (US)	Combined title
Sustainable Energy (Design. Technology, Building and Infrastructure)															
	Energy Strategy PE	MINIMUM BUILDING ENERGY PERFORMANCE P			Energy Delivery Performance, Fossil fuel conservation, CO2 emission, Nox, Sox and particulate matter PE	Greenhouse Gas Strategy – Prescriptive Pathway and performance Strategy PE	Community Energy Strategy P				climate responsive design pe			Greenhouse Gas Mitigation P	**Energy strategy**
		Infrastructure Energy Efficiency F	Energy Efficiency in Infrastructural Equipment F					Energy Efficiency for Infrastructure and Public Ameniti es P			community facilities pe			Resource Efficient Public Infrastructure P	**Energy infrastructure**
Environmentally	Sustainable	Certified Green	Green Buildings F	GBI Certified	GSAS Rated Typol	Sustainable	Pearl Rated Building	Green Building within	Certified Sustainable			Building Performance	Earth Craft		**Certified green buildings**

Friendly Buildings F	buildings P	building P		Building F	ogies F	buildings F	s Within Communities F	District F	Buildings F			Standard P	Construction P		
			Offsite Green power PE	Onsite Energy Generation PE			Renewable Energy: Offsite PE								**Renewable energy: offsite**
		Solar Orientation F			Air Flow P		Community Strategies for Passive Cooling F	Site Planning and Building Orientation PE	Passive Design F	NATURAL VENTILATION PE		Additional Reductions in Energy Use PE	Solar Orientation F		**Passive energy design**
							Building Energy Guidelines P								**Building energy guidelines**
		Renewable Energy Production F	Onsite Renewable Energy PE	Renewable Energy PE			Renewable Energy: Onsite PE	Onsite Energy Generation PE	Renewable Energy PE	ON-SITE RENEWABLE ENERGY GENERATION PE		Renewable Energy PE	Renewable Electric Generation PE		**Renewable energy: onsite**
Possibility to make demand /supply system smart F			Measurement and Verification Plans P			Peak Electricity Demand PE	Efficient Infrastructure: Smart Grid Technology F	Minimize Energy Consumption During Off-Peak Hours PE			peak load p				**Peak electricity demand**
Ground greening and Building top greening (combined) F		Heat Island Reduction F	Urban Heat Island Effect F	Heat Island Design Principles F	Heat Island Effect F	Heat Island Effect F	Urban Heat Reduction F	Outdoor Thermal Environment F	Intra Urban Temperature and Urban heat island effect F	HEAT ISLAND EFFECT: NON-ROOF and Building Roof (combined) F		Reduced Heat-Island Effect: Roofing and paving F			**Urban heat island effect**

				Efficient Street and Park Lighting F			Efficient Infrastructure: Lighting F			ENERGY EFFICIENT LIGHTING F		Lighting F	Efficient Site Lighting F		**Energy efficient lighting**
							Energy Monitoring and Reporting P	Energy Management System F							**Energy monitoring and management**
		District heating or cooling F					Efficient Infrastructure: District Cooling F		Energy Efficient Infrastructure F	ENERGY EFFICIENT EQUIPMENT PE		Sizing of Heating and Cooling Equipment P	District Heating / Cooling F		**District heating / cooling**
		Optimize Building Energy Performance PE					Energy Efficient buildings PE			ENERGY EFFICIENCY IMPROVEMENT PE				Resource Efficient Buildings P	**Energy efficient improvement in performance of buildings**
									Neighborhood daylight access P	ENERGY EFFICIENT BUILDING ENVELOPE F					**Energy efficient building envelope**
											reduction in greenhouse gas emissions pe				**Reduction in greenhouse gas emission**
												Nearing Net Zero PE			**Nearing net zero**
												ENERGY STAR Appliances F			**Energy star appliances**
												Electricity Meter F			**Electricity meter**

												Photovoltaic/Solar Hot Water Ready F			**Photovoltaic/solar hot water ready**
												Resilient Energy Systems: Flood proofing F			**Resilient energy systems: flood proofing**
												Resilient Energy Systems: Islandable Power F			**Resilient energy systems: islandable power**
													Earth Craft Builder Training P		**Earth craft builder training**
													Renovation of Existing Commercial P		**Renovation of existing commercial**
													Alternative Thermal Production PE		**Alternative thermal production**
													Clean Emissions Protocol for Heavy Equipment PE		**clean emissions protocol for heavy equipment**
														Industrial Sector Resource Efficiency P	industrial sector resource efficiency

Appendix 3B-4: Number of E-HSI for each NSAT

NSATs	CASBEEUD (Japan)	BREEAM Communities (UK)	LEED ND (US)	IGBC Green Township (India)	Green Building Index Township (Malaysia)	GSAS District (Qatar)	Green Star Communities (Australia)	The Pearl Community (UAE)	Green Mark for Districts (Singapore)	BEAM Plus Neighborhood (Hong Kong)	BERDE Clustered Development (Philippines)	Enviro Development Masterplanned community (Australia)	Enterprise green communities (US)	Earth community craft (US)	Star Community Rating System (US)	Total
Number of E-HSI	3	2	8	6	5	4	4	12	7	6	7	4	12	9	4	93

Appendix 3B-5: Frequency of collated theme and SPM analysis of each E-HSI

	Frequency	E	EC	S	I	E-EC	E-S	E-I	EC-S	EC-I	S-I	E-EC-S	E-S-I	E-EC-I	EC-S-I	E-S-EC-I	
Energy Strategy	7	3					1	2								1	
Energy Infrastructure	5	3						1					1				
Certified Green buildings	12							11					1				
Renewable Energy: Offsite	3	2						1									
Passive energy design	8	4						3				1					
Building Energy Guidelines	1	1															
Renewable Energy: Onsite	9	4				3		2									
Peak Electricity Demand	6	5				1											
Urban Heat Island Effect	11	2					6	3									
Energy Efficient Lighting	5							2					2	1			
Energy Monitoring and Management	2	2															
District Heating / Cooling	6	2						4									
Energy efficient improvement in perfomance of buildings	4	1						1						1		1	
ENERGY EFFICIENT BUILDING ENVELOPE	2							1					1				
REDUCTION IN GREENHOUSE GAS EMISSIONS E-S-I	1												1				
Nearing Net Zero E-I	1							1									
ENERGY STAR Appliances E-I	1							1									

Electricity Meter E-EC	1					1											
Photovoltaic/Solar Hot Water Ready E-I	1							1									
Resilient Energy Systems: Flood proofing E-S-EC	1											1					
Resilient Energy Systems: Islandable Power E-S-I	1												1				
EarthCraft Builder Training E-I	1							1									
Renovation of Existing Commercial E-I	1							1									
Alternative Thermal Production E	1	1															
Clean Emissions Protocol for Heavy Equipment E-I	1							1									
Industrial Sector Resource Efficiency	1															1	
TotaL	93	30	0	0	0	5	7	37	0	0	0	2	7	2	0	3	Informal Consideration
		42	0	0	0	5	7	25	0	0	0	2	7	2	0	3	Business as usual

Appendix 3B-6: Allocation of institutional dimensions according to region of the world

			Business as usual indicators	**Informal institution indicators**	**Institutional indicators by tool**	**Institutional indicators by region**
America	**US**	LEED ND (US)	2	1	3	23
		Enterprise green communities (US)	9	1	10	
		Earth community craft (US)	5	1	6	
		Star Community	4	0	4	

		Rating System (US)				
Asia	**HK**	BEAM Plus Neighborhood (Hong Kong)	4	1	5	16
	Philippines	BERDE Clustered Development (Philippines)	5		5	
	Malaysia	Green Building Index Township (Malaysia)	1	1	2	
	Singapore	Green Mark for Districts (Singapore)	1	1	2	
	Japan	CASBEE UD (Japan)	0	1	1	
	India	IGBC Green Township (India)	0	1	1	
Middle east	**UAE**	The Pearl Community (UAE)	5	1	6	7
	Qatar	GSAS District (Qatar)	0	1	1	
Euro Asia	**Australia**	Enviro Development Master planned community (Australia)	1	0	1	2
		Green Star Communities (Australia)		1	1	
Europe	**UK**	BREEAM Communities (UK)	0	1	1	1
			37	12	49	

Appendix 4C-1: least used indicators (1, 2 occurrences)

Water Management Including Waste Water	**Sustainable Material use and Solid Waste Management E**	**Sustainable Transport**	**Sustainable Site and Urban Form**
Water Monitoring and Leak Detection	Timber utilisation	Cycling facilities	Connected and Open community
Community Water Use Reduction: Water Features	Minimized Site Disturbance in Design and construction	Traffic Safety	Active Urban Environments
	Modular Pavement and Hardscape Cover	Logistics management	
	Green and Gracious Builders Scheme Certification	Neighborhood Connectivity	
	Hazardous Waste Management		
	Waste Conveyance		
Sustainable Sustenance	**Inclusive Design and Public Consideration**	**Sustainable Energy (Design. Technology, Building and Infrastructure)**	**Sustainable Urban Ecology**
Agricultural Land Preserve	Consultation plan and Engagement	Building Energy Guidelines	Wetland and Water Body Conservation
	Urban Systems Assessment	Measurement and Verification	Restoration of Habitat or Wetlands and Water Bodies
	Acoustic Conditions and Acoustic Quality	Efficient Infrastructure: Lighting	Hill Slope Development
	Sustainable Building Guidelines	Regionally Responsive Planning	
	Guest Worker Accommodation	Energy Management System	
		Community Water Use Reduction: Heat Rejection	
		District heating or cooling	
		Energy Efficient buildings	
Institutional Governance - Governance, Maintenance and Management	**Disaster Prevention**	**Economic Prosperity**	**Innovation**
Community Thrust	Understanding Hazard maps	Population: Inhabitant Population and Staying Population	Regional Priorities
Health in Design	Disaster Prevention vacant space and evacuation route	Continuity of business and life in the block	Cooperate Responsibility
Governance	Flood risk assessment	Continuity of business and life in the block	Innovation Challenges
Incentive Programs	Desertification	Housing and Job proximity	Global Sustainability
Neighborhood schools and education development	Adverse Wind Conditions	Return on Investment	Plan 2030
Updateability and Expandability		Support of National Economy	
Consistency with and complimenting upper level planning		Community Investment	

Services Infrastructure Provision		Utilization level of standard floor area ratio	
Consideration for Formation of townscape and Landscape in district		Revitalisation activity (efforts on economic revitalization for housing and non-housing)	
Harmonisation with Periphery		Green Lease	

Appendix 4C-3: theme placement of nine NSATs

CASBEE	BREEAM 2012	LEED 2014	IGBC	GBI	GSAS	Green star	The Pearl Community	Green mark	Combined title
Water Management Including Waste Water									
Rainwater Utilization and Rain water Permeable surface equipment	Rainwater harvesting	Rainwater management	Rainwater Harvesting, 75%,95%					Alternative Water Sources	**Rainwater Management**
Treated Water and Capacity Pond E		Outdoor Water Use reduction		Reduced Water Use			Community Water Use Reduction: Landscaping	Water Efficient Landscaping	**Outdoor Water Use Reduction**
	Water Strategy					Integrated Water Cycle – Performance Pathway	Community Water Strategy		**Community Water Strategy**
		Indoor Water Use reduction					Building Water Guidelines and Water Efficient Buildings and Plots	Water Efficient Fittings for Infrastructure and Public Amenities	**Indoor Water Use**
	Water pollution			Sustainable Storm water Design and Management		Integrated Water Cycle – Prescriptive Pathway	Storm water Management	Storm water Management	**Sustainable Storm water Design and Management**
Reduction of Waste water discharge amount		Wastewater management	Wastewater Treatment 100% and Waste Water Reuse, 75%, 95%	Reduction in Water Use by Waste Water Treatment	Wastewater Management Plan				**Wastewater management**
							Water Monitoring and Leak Detection	Water Efficiency Management	**Water Monitoring and Leak Detection**

							Community Water Use Reduction: Water Features		**Community Water Use Reduction: Water Features**
Sustainable Material use and Solid Waste Management									
Garbage Separation		Solid Waste Management Infrastructure		Recycling Facilities	Solid Waste Load		Improved and Basic Operational Waste Management	Waste Management and Segregation	**Solid Waste Management**
	Existing building and Infrastructure	Building Reuse E	Construction Waste Reduction (Civil works)	Construction Waste Management	Materials Re-use	Waste Management	Construction Environmental Management	Minimize Cut and Fill in Earthworks	**Construction Waste Management**
				Regional Material	Regional Material		Regional Materials		**Regional Materials**
				Sustainable Construction Practice and Side Sedimentation and Pollution Control	Construction Plan		Improved and Basic Construction Waste Management	Sustainable Construction for Infrastructure and Public Amenities	**Construction Plan**
				Quality in construction	Responsible Sourcing of Materials			Sustainable Products for Infrastructure and Public Amenities	**Responsible Sourcing of Materials**
	Resource Efficiency				Life cycle Assessment	Life Cycle Assessment	Life Cycle Costing		**Life Cycle Assessment**
Wood Material							Reused or Certified Timber and CCA Treated Timber Elimination		**Timber utilization**

Recycled Material	Low impact materials	Recycled and Re-used Infrastructure	Recycled Content (Civil Works)	Low impact Material (Building or Structures or Infrastructure)	Recycled Material		Recycled Materials		**Recycled Materials**
In Area resource Circulation					Organic Waste Management		Organic Waste Management	Waste Reuse and Processing	**Organic Waste Management**
		Minimized Site Disturbance in Design and construction						Minimize Site Disturbance	**Minimized Site Disturbance in Design and construction**
							Modular Pavement and Hardscape Cover		**Modular Pavement and Hardscape Cover**
								Green and Gracious Builders Scheme Certification	**Green and Gracious Builders Scheme Certification**
							Hazardous Waste Management		**Hazardous Waste Management**
								Waste Conveyance	**Waste Conveyance**
Sustainable Transport									
Traffic Facilities in District	Transport Assessment			Green Transport Master plan		Sustainable Transport and Movement	Travel Plan	Green Transport Within District	**Sustainable Transport**
	Transport carbon emissions	Transportation demand management	Eco-Friendly Transportation service	Alternative Transport Option					**Eco-Friendly Transportation service**

Usability of Public Transportation	Access to public transport		Public Transportation Facilities	Availability and Frequency of Public Transport					**Access to public transport**
	Cycling network		Bicycle Lane Network	Cycling Networks	Bikeability				**Bikeability**
	Cycling facilities	Bicycle Facilities							**Cycling facilities**
	Safe and Appealing streets	Walkable streets	Pedestrian Network	Pedestrian Networks	Walkability		Community Walkability		**Walkability**
	Public transport facilities	Transit Facilities		Facilities for Public Transportation			Transit Supportive Practices		**Facilities for Public Transportation**
Traffic Safety									**Traffic Safety**
Logistics management									**Logistics management**
		Access to Quality Transit					Neighborhood Connectivity		**Neighborhood Connectivity**
	Local Parking	Reduced Parking Footprint			Parking Footprint				**Reduced Parking Footprint**
Sustainable Site and Urban Form									
Handling of brownfield sites	Land Use	Brownfield Remediation	Redevelopment of contaminated Areas	Land Reuse		Sustainable Sites	Reuse of Land and Remediation of Contaminated land	Site selection	**Sustainable site**
		Compact Development	Land Use Optimization (M)	Compact Development			Accessible Community Facilities		**Compact Development**
		Smart Location and Preferred Location		Proximity to Existing Infrastructure	Proximity to Existing Districts			Future Provision and Connections	**Proximity to Existing Infrastructure and District**
	Public realm	Access To Civic and Public Space	Public landscape Areas	Greenspaces	Pubic Space	Healthy and Active Living	Active Urban Environments	Green and Blue Spaces for the Public	**Pubic Space**

		Connected and Open community	Road and Street Network						**Connected and Open community**
		Access to Recreation facilities					Open Space Network		**Active Urban Environments**
Convenience/Health Welfare Education E-S	Delivery of Services, facilities and amenities	Mixed Use Neighborhoods	Mixed Use Development	Amenities for Communities	Mixed Use	Walkable Access to Amenities	Provision of Amenities and Facilities	Self-sufficiency and Accessibility within District	**Mixed Use Development**
	Green Infrastructure	Tree lined and Shaded Streets			Vegetation				**Green Infrastructure**
Sustainable Sustenance									
		Local Food Production	Local Fruit and Vegetable Produce			Access To Fresh Food	Food Systems		**Access to Fresh Food**
				Agricultural Land Preserve					**Agricultural Land Preservation**
Crime and Public Safety									
Crime Prevention S				Secure Design	Crime Prevention	Safe Places	Safe and Secure Community	Safe Environment	**Crime Prevention**
	Light pollution	Light pollution Reduction		Light Pollution		Light pollution		Light Pollution Reduction	**Light pollution Reduction**
Inclusive Design and Public Consideration									
	Inclusive design S	Visit-ability and Universal Design		Provision for Universal Accessibility					**Provision for Universal Accessibility**
	Consultation and Engagement					Community Development	Community-Dedicated Infrastructure Basic Commissioning		**Consultation and Engagement**

History and Culture S-EC	Local Vernacular	Historic Resource Preservation and Adaptive Use			Heritage and Cultural Identity	Culture, Heritage, and Identity		Conservation an Integration of Existing Structures and Assets	**Heritage and Cultural Identity**
	Design Review	Community Outreach and Involvement				Design Review	Integrated Development Strategy	Stakeholder Engagement, Feedback and Evaluation	**Design Review**
	Consultation Plan					Engagement			**Consultation plan and Engagement**
	Demographic needs and priorities						Urban Systems Assessment		**Urban Systems Assessment**
	Noise Pollution				Acoustic Conditions and Acoustic Quality				**Acoustic Conditions and Acoustic Quality**
							Sustainable Building Guidelines		**Sustainable Building Guidelines**
							Guest Worker Accommodation		**Guest Worker Accommodation**
Sustainable Energy (Design. Technology, Building and Infrastructure)									
	Energy Strategy				Energy Delivery Performance, Fossil fuel conservation, CO2 emission	Greenhouse Gas Strategy – Prescriptive Pathway and performance Strategy	Community Energy Strategy	Minimize Energy Consumption During Off-Peak Hours	**Community Energy Strategy**
		Infrastructure	Energy Efficiency in Infrastructu					Energy Efficiency for	

		Energy Efficiency	ral Equipment					Infrastructure and Public Amenities	**Energy Efficiency in Infrastructural Equipment**
Environmentally Friendly Buildings	Sustainable buildings	Certified Green building	Green Buildings	GBI Certified Building	GSAS Rated Typologies	Sustainable buildings	Minimum, high Pearl Rated Buildings Within Communities	Green Building within District	**Green Buildings**
			Offsite Green power	Onsite/offsite Energy Generation			Renewable Energy: Offsite		**Offsite Renewable Energy**
		Solar Orientation			Air Flow		Community Strategies for Passive Cooling	Site Planning and Building Orientation	**Community Strategies for Passive Cooling and Solar Orientation**
		Optimize Building Energy Performance					Building Energy Guidelines		**Building Energy Guidelines**
		Renewable Energy Production	Onsite Renewable Energy	Renewable Energy			Renewable Energy: Onsite	Onsite Energy Generation	**Renewable Energy Production**
Possibility to make demand/supply system smart						Peak Electricity Demand	Efficient Infrastructure: Smart Grid Technology		**Efficient Infrastructure: Smart Grid Technology**
Greening Ratio, Rooftop Greening, Wall greening	Microclimate	Heat Island Reduction	Urban Heat Island Effect	Heat Island Design Principles	Heat Island Effect	Heat Island Effect	Urban Heat Reduction and Outdoor Thermal Comfort Strategy	Microclimate Optimization and Outdoor Thermal Environment house of cards	**Urban Heat Reduction and Outdoor Thermal Comfort Strategy**
			Measurement and Verification Plans						**Measurement and Verification Plans**

				Efficient Street and Park Lighting			Efficient Infrastructure : Lighting		**Efficient Infrastructure: Lighting**
							Regionally Responsive Planning		**Regionally Responsive Planning**
							Energy Monitoring and Reporting	Energy Management System	**Energy Management System**
							Community Water Use Reduction: Heat Rejection		**Community Water Use Reduction: Heat Rejection**
		District heating or cooling					Efficient Infrastructure : District Cooling		**District heating or cooling**
							Energy Efficient buildings		**Energy Efficient buildings**
Sustainable Urban Ecology									
Natural Resources	Ecology Strategy		Retain Natural Topography	Ecology			Natural Systems Assessment	Green Urban Design Guidelines	**Ecology Strategy**
Habitat Space of Species		Site Design for Habitat or Wetland and Water Body Conservation	Preserve Existing Trees and Water Bodies	Biodiversity Conservation		Habitat Conservation and Restoration	Natural System Protection		**Biodiversity and Habitat Conservation/Restoration**
				Wetland and Water Body Conservation					**Wetland and Water Body Conservation**
		Restoration of Habitat or Wetlands and Water Bodies							**Restoration of Habitat or Wetlands and Water Bodies**

Land Form and Corridor	Enhancement of ecological value					Ecological Enhancement	Habitat Creation and Restoration		**Ecological Enhancement**
		steep slope selection		Hill Slope Development					**Hill Slope Development**
		Long Term Conservation Management of Habitat or Wetlands and Water Bodies	Avoid development on Inappropriate sites		Water Body Preservation				**Wetlands and Water Body Preservation**
Consideration of Regionality	Landscape						Ecological Enhancement		**Ecological Preservation**
Compliance					Environmental Management Systems	Environmental Management Plan	Natural Systems Design and Management Strategy	Environmental Management System	**Environmental Management System**
Institutional Governance - Governance, Maintenance and Management									
Area Management	Community management of facilities				Management Plan	Operational Governance			**Area Management**
				Community Thrust					**Community Thrust**
				Health in Design					**Health in Design**
				Governance					**Governance**
						Incentive Programs S-EC-I			
		Neighborhood schools				Education and Skills Development			**Neighborhood schools and education development**
Updatebility and Expandability E-EC									**Updatebility and Expandability**
Consistency with and complimenting									**Consistency with and complimenting**

upper level planning S-I									**upper level planning**
			Social and Cultural Initiatives			Sustainability Awareness	Sustainability Awareness	Public Awareness, Education and Community Involvement	**Sustainability Awareness**
	Utilities			Services Infrastructure Provision					**Services Infrastructure Provision**
Consideration for Formation of townscape and Landscape in district									**Consideration for Formation of townscape and Landscape in district**
Harmonization with Periphery									**Harmonization with Periphery**
Block Management									**Block Management**
Disaster Prevention									
Understanding Hazard maps									**Understanding Hazard maps**
Disaster Prevention of Various Infrastructure	Adapting to climate change					Adaptation and Resilience			**Disaster Resilience and Climate Adaptation**
Disaster Prevention vacant space and evacuation route									**Flood Avoidance**
	Flood risk assessment								**Flood risk assessment**
					Desertification				**Desertification**
					Adverse Wind Conditions				**Adverse Wind Conditions**
	Flood risk management	Flood Plain Avoidance		Flood Management					**Flood Avoidance**

				and Avoidance					
Economic Prosperity									
				Community Diversity	Housing Diversity		Housing Diversity		**Housing Diversity**
Population: Inhabitant Population and Staying Population									**Population: Inhabitant Population and Staying Population**
Continuity of business and life in the block									**Continuity of business and life in the block**
	Training and Skills								**Training and Skills**
	Housing Provision	Housing Type and Affordability	Housing Typologies	Affordable Housing		Affordability			**Affordable Housing**
	Economic impact S-EC		Employment Opportunities (Post Occupancy)	Business		Employment and Economic Resilience			**Employment and Economic Resilience**
		Housing and Job proximity							**Housing and Job proximity**
						Return on Investment			**Return on Investment**
					Support of National Economy				**Support of National Economy**
						Community Investment			**Community Investment**
Information service Performance						Digital Infrastructure		Intelligent Infrastructure	**Digital Infrastructure**
Utilization level of standard floor area ratio									**Utilization level of standard floor area ratio**
Revitalization activity (efforts on economic revitalization for									**Revitalization activity (efforts on economic revitalization for**

housing and non-housing)									**housing and non-housing)**
						Green Lease			**Green Lease**
Innovation									
		Innovation	Innovation in Design and Technology	Innovation		Innovative Technology or Process	Innovating Practice E-EC-S	Other Green Features and Innovation	**Innovating Practice**
		Regional Priorities					Innovative Cultural and Regional Practices		**Regional Priorities**
						Cooperate Responsibility			**Cooperate Responsibility**
						Innovation Challenges			**Innovation Challenges**
						Global Sustainability E-EC-S			**Global Sustainability**
		LEED accredited Professional	IGBC Accredited Professional	GBI Facilitator		Improving on Green star Bench Marks			**Accredited Assessors**
							Plan 2030		**Plan 2030**

Appendix 5D-1: Participants general information (SPSS)

How long have you been living in Lagos?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than a year	16	8.0	8.0	8.0
	1-10 years	36	18.0	18.0	26.0
	11-20 years	36	18.0	18.0	44.0
	21 + years	112	56.0	56.0	100.0
	Total	200	100.0	100.0	

Age

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	18-24 years	35	17.5	17.5	17.5
	25-29 years	73	36.5	36.5	54.0
	30-39 years	58	29.0	29.0	83.0
	40 and above	34	17.0	17.0	100.0
	Total	200	100.0	100.0	

Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	122	61.0	61.0	61.0
	Female	78	39.0	39.0	100.0
	Total	200	100.0	100.0	

Highest Level of Education

	Frequency	Percent	Valid Percent	Cumulative Percent

Valid	Secondary School and below	11	5.5	5.6	5.6
	First degree or bachelors	101	50.5	51.0	56.6
	Master's Degree or postgraduate	79	39.5	39.9	96.5
	PhD	7	3.5	3.5	100.0
	Total	198	99.0	100.0	
Missing	9.00	2	1.0		
Total		200	100.0		

What is your own salary?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Do not work	27	13.5	14.1	14.1
	< N80,000	39	19.5	20.3	34.4
	N80,00 – N120,000	26	13.0	13.5	47.9
	N120,001 – N180,000	28	14.0	14.6	62.5
	N180,001 – N250,000	27	13.5	14.1	76.6
	N250,001 – N350,000	10	5.0	5.2	81.8
	N350,000 >	35	17.5	18.2	100.0
	Total	192	96.0	100.0	
Missing	.00	2	1.0		
	9.00	6	3.0		
	Total	8	4.0		
Total		200	100.0		

Appendix 5D-2: Transport data and Land use data from (SPSS)

How regularly do you use Private car transport for everyday activities i.e. your personal car

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	35	17.5	17.9	17.9
	Once a week	27	13.5	13.8	31.8
	Twice a week	16	8.0	8.2	40.0
	Three times a week	4	2.0	2.1	42.1
	Four times a week	7	3.5	3.6	45.6
	Five times a week	6	3.0	3.1	48.7
	six times a week	15	7.5	7.7	56.4
	Every day	85	42.5	43.6	100.0
	Total	195	97.5	100.0	
Missing	9.00	5	2.5		
Total		200	100.0		

How regularly do you use Public car transport for everyday activities i.e. taxi and Uber etc.)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	90	45.0	46.4	46.4
	Once a week	46	23.0	23.7	70.1
	Twice a week	8	4.0	4.1	74.2
	Three times a week	10	5.0	5.2	79.4
	Four times a week	4	2.0	2.1	81.4
	Five times a week	6	3.0	3.1	84.5
	six times a week	8	4.0	4.1	88.7
	Every day	22	11.0	11.3	100.0

	Total	194	97.0	100.0	
Missing	9.00	6	3.0		
Total		200	100.0		

How regularly do you use Bus transport for everyday activities (bus includes BRT, public buses(Danfo), company buses)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	76	38.0	39.4	39.4
	Once a week	31	15.5	16.1	55.4
	Twice a week	7	3.5	3.6	59.1
	Three times a week	7	3.5	3.6	62.7
	Four times a week	9	4.5	4.7	67.4
	Five times a week	19	9.5	9.8	77.2
	six times a week	10	5.0	5.2	82.4
	Every day	34	17.0	17.6	100.0
	Total	193	96.5	100.0	
Missing	9.00	7	3.5		
Total		200	100.0		

How regularly do you use Motor cycle transport for daily actives (Okada, and Kekenapep)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	89	44.5	46.8	46.8
	Once a week	28	14.0	14.7	61.6
	Twice a week	18	9.0	9.5	71.1
	Three times a week	12	6.0	6.3	77.4
	Four times a week	3	1.5	1.6	78.9
	Five times a week	8	4.0	4.2	83.2

	six times a week	9	4.5	4.7	87.9
	Every day	23	11.5	12.1	100.0
	Total	190	95.0	100.0	
Missing	9.00	10	5.0		
Total		200	100.0		

How regularly do you use Bicycle transport for daily actives

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	167	83.5	85.6	85.6
	Once a week	11	5.5	5.6	91.3
	Twice a week	3	1.5	1.5	92.8
	Three times a week	5	2.5	2.6	95.4
	Every day	9	4.5	4.6	100.0
	Total	195	97.5	100.0	
Missing	9.00	5	2.5		
Total		200	100.0		

If you answered never for any of the five questions above please state why? Private car

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	I dont have one	22	11.0	95.7	95.7
	I dont know how to drive	1	.5	4.3	100.0
	Total	23	11.5	100.0	
Missing	.00	158	79.0		
	9.00	19	9.5		
	Total	177	88.5		
Total		200	100.0		

If you answered never for any of the four questions above please state why? Public car

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	I don't need to use (other options avalable)	12	6.0	22.6	22.6
	I have a car	23	11.5	43.4	66.0
	Cost too much	16	8.0	30.2	96.2
	Poorly organised public tranport	1	.5	1.9	98.1
	not comfortable	1	.5	1.9	100.0
	Total	53	26.5	100.0	
Missing	.00	114	57.0		
	9.00	33	16.5		
	Total	147	73.5		
Total		200	100.0		

If you answered never for any of the four questions above please state why? Bus

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Unsafe and dangerous (robbery, accidents, etc)	8	4.0	17.4	17.4
	I have a car	23	11.5	50.0	67.4
	Not efficient (too slow)	3	1.5	6.5	73.9
	No bus route	4	2.0	8.7	82.6
	Stressfull/uncomfortable	5	2.5	10.9	93.5
	Not respectable	1	.5	2.2	95.7
	Crowded	1	.5	2.2	97.8
	Bad roads	1	.5	2.2	100.0
	Total	46	23.0	100.0	
Missing	.00	119	59.5		
	9.00	35	17.5		
	Total	154	77.0		

Total		200	100.0		

If you answered never for any of the four questions above please state why? Motor cycle

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Unsafe and dangerous (robbery, accidents, etc)	23	11.5	43.4	43.4
	I have a car	18	9.0	34.0	77.4
	Banned is some areas	2	1.0	3.8	81.1
	Other options available	1	.5	1.9	83.0
	5.00	9	4.5	17.0	100.0
	Total	53	26.5	100.0	
Missing	.00	114	57.0		
	9.00	33	16.5		
	Total	147	73.5		
Total		200	100.0		

If you answered never for any of the four questions above please state why? Bicycle

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	I don't have one	40	20.0	36.0	36.0
	I don't know how to ride a bicycle	13	6.5	11.7	47.7
	No cycle lanes available	13	6.5	11.7	59.5
	Other options more convenient(faster, comfortable etc)	7	3.5	6.3	65.8
	I don't like it	2	1.0	1.8	67.6
	I have a car	11	5.5	9.9	77.5

	Limited for long distance travel	7	3.5	6.3	83.8
	Not safe	17	8.5	15.3	99.1
	Hot	1	.5	.9	100.0
	Total	111	55.5	100.0	
Missing	.00	51	25.5		
	9.00	38	19.0		
	Total	89	44.5		
Total		200	100.0		

On scale of 1 to 5 how bad would you rate the level of traffic in Lagos?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.00	1	.5	.5	.5
	Very High level of traffic (Terrible)	98	49.0	49.2	49.7
	High level of traffic (Bad)	76	38.0	38.2	87.9
	Average or medium level of traffic	24	12.0	12.1	100.0
	Total	199	99.5	100.0	
Missing	9.00	1	.5		
Total		200	100.0		

If available, what would motivate you to consider other transports: reducing of pollution on plants, animals and environment

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1st Priority	22	11.0	40.7	40.7
	2nd Priority	32	16.0	59.3	100.0
	Total	54	27.0	100.0	
Missing	3.00	124	62.0		

	9.00	22	11.0		
	Total	146	73.0		
Total		200	100.0		

If available, what would motivate you to consider other transports: reducing pollution to improve health and respiratory diseases such as asthma

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1st Priority	62	31.0	44.3	44.3
	2nd Priority	78	39.0	55.7	100.0
	Total	140	70.0	100.0	
Missing	3.00	38	19.0		
	9.00	22	11.0		
	Total	60	30.0		
Total		200	100.0		

If available, what would motivate you to consider other transports: reducing the hours you spent in traffic

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1st Priority	91	45.5	65.9	65.9
	2nd Priority	47	23.5	34.1	100.0
	Total	138	69.0	100.0	
Missing	3.00	40	20.0		
	9.00	22	11.0		
	Total	62	31.0		
Total		200	100.0		

If available, what would motivate you to consider other transports: not interested in efficient BRTs, cycling, electric trains or electric cars

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1st Priority	5	2.5	41.7	41.7
	2nd Priority	7	3.5	58.3	100.0
	Total	12	6.0	100.0	
Missing	3.00	166	83.0		
	9.00	22	11.0		
	Total	188	94.0		
Total		200	100.0		

If available, would you consider alternative option of fuel such as electric car or cars that run of cassava oil, and other vegetable oil?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	179	89.5	89.9	89.9
	no	20	10.0	10.1	100.0
	Total	199	99.5	100.0	
Missing	9.00	1	.5		
Total		200	100.0		

Electric car cost 11 million Naira would you buy this vehicle considering the fact that it runs on electricity and has zero pollution/smoke?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No, it is too expensive	68	34.0	35.4	35.4
	No, Nigeria needs to provide constant electricity first	94	47.0	49.0	84.4

	Yes, I wouldn't have to worry about fuel scarcity and queuing for fuel	17	8.5	8.9	93.2
	Yes, it would reduce air pollution in the environment thereby improving health of people and nature	13	6.5	6.8	100.0
	Total	192	96.0	100.0	
Missing	9.00	8	4.0		
Total		200	100.0		

If you answered No in the above, would you change your mind, if the government provided, 30% off (7.7 million Naira) any purchased electric vehicle and provided free electricity at filling stations for 1 year

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No, it is still too expensive	47	23.5	26.7	26.7
	No, I don't believe it is still worth it due to irregular power	88	44.0	50.0	76.7
	Yes I would	41	20.5	23.3	100.0
	Total	176	88.0	100.0	
Missing	.00	12	6.0		
	9.00	12	6.0		
	Total	24	12.0		
Total		200	100.0		

Would you consider using a bicycle for short distance travel?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	110	55.0	57.3	57.3
	Slightly, I may consider it	82	41.0	42.7	100.0
	Total	192	96.0	100.0	
Missing	.00	1	.5		
	9.00	7	3.5		
	Total	8	4.0		
Total		200	100.0		

Would the development of bicycle lane improve the likelihood of you using a bicycle

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	37	18.5	18.8	18.8
	Slightly, I may consider it	53	26.5	26.9	45.7
	Most likely	49	24.5	24.9	70.6
	Highly likely	15	7.5	7.6	78.2
	Yes, Definitely	43	21.5	21.8	100.0
	Total	197	98.5	100.0	
Missing	9.00	3	1.5		
Total		200	100.0		

If no or slightly, Would providing a safe bicycle storage at shops, offices, homes improve the likelihood of using bicycle

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	46	23.0	36.2	36.2
	Slightly, I may consider it	46	23.0	36.2	72.4
	Most likely	24	12.0	18.9	91.3
	Highly likely	4	2.0	3.1	94.5

	Yes, Definitely	7	3.5	5.5	100.0
	Total	127	63.5	100.0	
Missing	.00	56	28.0		
	9.00	17	8.5		
	Total	73	36.5		
Total		200	100.0		

If trains were made available and connect mainland and island or mainland to another part of mainland would this be your daily transport to work?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No, I don't see the difference	4	2.0	2.0	2.0
	No, I prefer the privacy and comfort of my car	22	11.0	11.2	13.3
	Yes, trains are better for the environment than	50	25.0	25.5	38.8
	Yes, If I can avoid the traffic	85	42.5	43.4	82.1
	Yes, if it was cheaper than using my car	35	17.5	17.9	100.0
	Total	196	98.0	100.0	
Missing	9.00	4	2.0		
Total		200	100.0		

Goods and products should be moved by trains if possible

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1st Priority	41	22.0	58.7	58.7
	2nd Priority	12	6.5	17.3	76.0
	3rd Priority	18	9.0	24.0	100.0

	Total	75	37.5	100.0	
Missing	9.00	129	62.5		
Total		200	100.0		

Policy and law that bans freights and trailers from moving during the day

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1st Priority	57	28.5	41.9	41.9
	2nd Priority	65	32.5	47.8	89.7
	3rd Priority	14	7.0	10.3	100.0
	Total	136	68.0	100.0	
Missing	9.00	64	32.0		
Total		200	100.0		

Roads should be widened to make separate lane for trailers and freights

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1st Priority	13	6.5	17.1	17.1
	2nd Priority	28	14.0	36.8	53.9
	3rd Priority	35	17.5	46.1	100.0
	Total	76	38.0	100.0	
Missing	9.00	124	62.0		
Total		200	100.0		

A different route should be developed for freights and trailers

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1st Priority	18	9.0	25.0	25.0
	2nd Priority	28	14.0	38.9	63.9
	3rd Priority	26	13.0	36.1	100.0

	Total	72	36.0	100.0	
Missing	9.00	128	64.0		
Total		200	100.0		

Trailers and freight should have minimum speed of movement

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1st Priority	39	19.5	43.3	43.3
	2nd Priority	28	14.0	31.1	74.4
	3rd Priority	23	11.5	25.6	100.0
	Total	90	45.0	100.0	
Missing	9.00	110	55.0		
Total		200	100.0		

All trailers and freight developed from 2005 downward should be replaced with more efficient model

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1st Priority	7	3.5	12.5	12.5
	2nd Priority	9	4.5	16.1	28.6
	3rd Priority	40	20.0	71.4	100.0
	Total	56	28.0	100.0	
Missing	9.00	144	72.0		
Total		200	100.0		

Other (please state the other)

	Frequency	Percent	Valid Percent	Cumulative Percent

Valid	1st Priority	4	2.0	28.6	28.6
	2nd Priority	2	1.0	14.3	42.9
	3rd Priority	2	4.0	57.1	100.0
	Total	8	7.0	100.0	
Missing	9.00	192	93.0		
Total		200	100.0		

Do you think there are enough sidewalks in Lagos that secure pedestrian safety?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	36	18.0	18.5	18.5
	No	159	79.5	81.5	100.0
	Total	195	97.5	100.0	
Missing	9.00	5	2.5		
Total		200	100.0		

How accessible is public transport in your community i.e. how close are bus stops to your homes, offices and shops

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No bus stops Nearby (I have to either drive, cab or follow a friend	8	4.0	4.1	4.1
	It doesn't matter (because I use my car)	37	18.5	19.2	23.3
	The bus stop is very far (I have to bike or take keke there)	33	16.5	17.1	40.4
	The bus stop is far (I have to walk at least 15 mins)	13	6.5	6.7	47.2

	The bus stop is not too far (I have to walk a maximum of 10 mins to the bus top)	54	27.0	28.0	75.1
	The bus stop is close (I have walk 5 mins or less)	48	24.0	24.9	100.0
	Total	193	96.5	100.0	
Missing	9.00	7	3.5		
Total		200	100.0		

Air pollution is quite high in Lagos, which law would you support.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Support laws that removed old vehicles on the road i.e. car, buses made before 2005	46	23.0	24.5	24.5
	Support laws that places heavy fine vehicles depending on how old they are i.e older vehicles incur heavier fines	35	17.5	18.6	43.1
	Support laws one and two above	79	39.5	42.0	85.1
	No law is needed	28	14.0	14.9	100.0
	Total	188	94.0	100.0	
Missing	9.00	12	6.0		
Total		200	100.0		

Would you encourage Lagos state planners to mix residential houses to jobs,offices

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	115	57.5	65.3	65.3
	No	61	30.5	34.7	100.0
	Total	176	88.0	100.0	
Missing	9.00	24	12.0		
Total		200	100.0		

Would support government investment funds in nonresidential communuty infrasturcture such as business hubs, public libraries

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	177	88.5	91.7	91.7
	No	16	8.0	8.3	100.0
	Total	193	96.5	100.0	
Missing	9.00	7	3.5		
Total		200	100.0		

Would you support the conservation of lakes, swamps, native plants and trees in Lagos?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No, it should be removed for other important things like land for food	20	10.0	10.6	10.6
	No, it should be removed for important things like affordable homes	8	4.0	4.2	14.8

	No, it would be too expensive to maintain	8	4.0	4.2	19.0
	Yes, it should be conserved to save the environment	57	28.5	30.2	49.2
	Yes, it should be conserved and maintained because it is part of our identity	18	9.0	9.5	58.7
	Yes, it should be conserved and maintained to boost tourism an increase Lagos revenue	48	24.0	25.4	84.1
	Yes, It should be conserved and renovated for the Lagosians to visit, rest and relax	30	15.0	15.9	100.0
	Total	189	94.5	100.0	
Missing	.00	5	2.5		
	9.00	6	3.0		
	Total	11	5.5		
Total		200	100.0		

In order of preference arrange your priorities to be developed in community (Sport center and gyms in your community)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1st Priority	84	42.0	46.7	46.7
	2nd Priority	69	34.5	38.3	85.0
	3rd Priority	25	12.5	13.9	98.9

	4th Priority	2	1.0	1.1	100.0
	Total	180	90.0	100.0	
Missing	9.00	20	10.0		
Total		200	100.0		

In order of preference arrange your priorities to be developed in community (Public parks and playgrounds)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1st Priority	73	36.5	40.6	40.6
	2nd Priority	90	45.0	50.0	90.6
	3rd Priority	16	8.0	8.9	99.4
	4th Priority	1	.5	.6	100.0
	Total	180	90.0	100.0	
Missing	9.00	20	10.0		
Total		200	100.0		

In order of preference arrange your priorities to be developed in community (More shopping malls)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1st Priority	15	7.5	8.3	8.3
	2nd Priority	21	10.5	11.7	20.0
	3rd Priority	134	67.0	74.4	94.4
	4th Priority	10	5.0	5.6	100.0
	Total	180	90.0	100.0	
Missing	9.00	20	10.0		
Total		200	100.0		

In order of preference arrange your priorities to be developed in community (Others)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1st Priority	8	4.0	40.0	40.0
	3rd Priority	5	2.5	25.0	65.0
	4th Priority	7	3.5	35.0	100.0
	Total	20	10.0	100.0	
Missing	.00	160	80.0		
	9.00	20	10.0		
	Total	180	90.0		
Total		200	100.0		

Do you consider it bad to cut down trees and forest to develop more land for more people to live and work i.e. for houses, offices and shops?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	112	56.0	56.9	56.9
	no	85	42.5	43.1	100.0
	Total	197	98.5	100.0	
Missing	9.0	3	1.5		
Total		200	100.0		

How concerned are you about the wildlife (animals not pets)animal life that exist is Lagos?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Dont care	11	5.5	5.6	5.6
	I have little concern	102	51.0	52.3	57.9

	I have developed more concern	16	8.0	8.2	66.2
	I am concerned	52	26.0	26.7	92.8
	I am very concerned	14	7.0	7.2	100.0
	Total	195	97.5	100.0	
Missing	9.00	5	2.5		
Total		200	100.0		

Should be left undisturbed and not used for contruction but to preserve the environment i.e animanals and birds

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	87	43.5	45.3	45.3
	no	105	52.5	54.7	100.0
	Total	192	96.0	100.0	
Missing	9.00	8	4.0		
Total		200	100.0		

Should be used for city expansion and creation of roads, walkable streets and more affordable homes?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	105	52.5	54.4	54.4
	no	88	44.0	45.6	100.0
	Total	193	96.5	100.0	
Missing	9.00	7	3.5		
Total		200	100.0		

Should be used for construction that promotes agriculture and other food production activities?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	149	74.5	80.1	80.1
	no	37	18.5	19.9	100.0
	Total	186	93.0	100.0	
Missing	9.00	14	7.0		
Total		200	100.0		

that has historical meaning and value like trees and unique to Lagos environment should be preserved?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.00	1	.5	.5	.5
	yes	174	87.0	91.6	92.1
	no	15	7.5	7.9	100.0
	Total	190	95.0	100.0	
Missing	9.00	10	5.0		
Total		200	100.0		

that protects trees and endangered animals in Lagos? i.e. nothing can built in these areas.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	145	72.5	75.1	75.1
	no	48	24.0	24.9	100.0
	Total	193	96.5	100.0	
Missing	9.00	7	3.5		
Total		200	100.0		

that ensures that for every tree cut town more trees are planted within the city

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	151	75.5	77.0	77.0
	no	45	22.5	23.0	100.0
	Total	196	98.0	100.0	
Missing	9.00	4	2.0		
Total		200	100.0		

How would you recommend Lagos obtain this wood?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Import from other countries	96	48.0	49.5	49.5
	Chop down local trees	98	49.0	50.5	100.0
	Total	194	97.0	100.0	
Missing	9.00	6	3.0		
Total		200	100.0		

$ReasonsForWoodInportOrExportvalidesponseonly Frequencies

		Responses		Percent of Cases
		N	Percent	
Reasons For Wood Inport Or Export VRonly[a]	Use locally produced wood because of reduction of environmnetal impact	27	18.5%	22.5%

Use locally produced wood because of developemnt of local industry	26	17.8%	21.7%
Use locally produced wood because of reduction in rate of importation (high cost)	66	45.2%	55.0%
Use locally produced wood because of large availability of trees	10	6.8%	8.3%
Use imported wood because of cutting down trees indiscremenatly lead to climate change	2	1.4%	1.7%
Use imported wood because of trees are scarce in lagos	4	2.7%	3.3%
Use imported wood because until unsustainble practices are stopped first	1	.7%	.8%
Import from countries with replanting programs (preserervation of local trees)	4	2.7%	3.3%
Use imported wood because of certainty of quality	1	.7%	.8%
Cheaper to obtain wood locally	5	3.4%	4.2%

Do you agree that a new community or area should be developed where there is already developed route for transporting people?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	141	70.5	75.4	75.4
	No	46	23.0	24.6	100.0
	Total	187	93.5	100.0	
Missing	9.00	13	6.5		
Total		200	100.0		

Should the government (local, state and federal) do more about pedestrian safety on Lagos roads?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes, more needs to be done	175	87.5	88.8	88.8
	No, pedestrian safety is fine	22	11.0	11.2	100.0
	Total	197	98.5	100.0	
Missing	9.00	3	1.5		
Total		200	100.0		

How many different parks have you visited in Lagos to have picnics, play sports and have outdoor activities?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0 parks	94	47.0	48.5	48.5
	1 park	36	18.0	18.6	67.0
	2 parks	39	19.5	20.1	87.1
	3 parks	14	7.0	7.2	94.3

	4 parks	4	2.0	2.1	96.4
	5 parks and above	7	3.5	3.6	100.0
	Total	194	97.0	100.0	
Missing	9.00	6	3.0		
Total		200	100.0		

Do you feel that Lagos needs more outdoor parks where the public can relax, exercise and have fun?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No, I don't see the need	19	9.5	9.6	9.6
	No, it's not safe	20	10.0	10.2	19.8
	Yes, it does	158	79.0	80.2	100.0
	Total	197	98.5	100.0	
Missing	9.00	3	1.5		
Total		200	100.0		

Would you encourage the development of public playing grounds for children in your community in Lagos?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No, I don't see the need	12	6.0	6.4	6.4
	No, it's not safe	21	10.5	11.2	17.6
	Yes, I would	155	77.5	82.4	100.0
	Total	188	94.0	100.0	
Missing	9.00	12	6.0		
Total		200	100.0		

Any additional reason why you would say, no?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Security and supervision needs to improve	7	3.5	70.0	70.0
	Not clean or hygienic	1	.5	10.0	80.0
	Polluted Air	1	.5	10.0	90.0
	Poor Maintenance	1	.5	10.0	100.0
	Total	10	5.0	100.0	
Missing	.00	154	77.0		
	9.00	36	18.0		
	Total	190	95.0		
Total		200	100.0		

Would you encourage the development of more open sports fields?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes, I would	182	91.0	94.3	94.3
	No, I don't see the need	11	5.5	5.7	100.0
	Total	193	96.5	100.0	
Missing	9.00	7	3.5		
Total		200	100.0		

How clean and maintained are the beaches you have been to?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No Maintenance at all	23	11.5	11.9	11.9
	Not well maintained/clean	60	30.0	30.9	42.8
	Could be maintained better	96	48.0	49.5	92.3

	Clean and maintained enough	11	5.5	5.7	97.9
	Very well maintained & clean	4	2.0	2.1	100.0
	Total	194	97.0	100.0	
Missing	9.00	6	3.0		
Total		200	100.0		

Do you consider the beaches enough in terms of open outdoor space for Lagos?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	101	50.5	52.3	52.3
	No	92	46.0	47.7	100.0
	Total	193	96.5	100.0	
Missing	9.00	7	3.5		
Total		200	100.0		

How safe do you feel when at the beach?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very unsafe	23	11.5	14.3	14.3
	Unsafe	35	17.5	21.7	36.0
	Quiet safe	71	35.5	44.1	80.1
	Safe	22	11.0	13.7	93.8
	Totally safe	10	5.0	6.2	100.0
	Total	161	80.5	100.0	
Missing	9.00	39	19.5		
Total		200	100.0		

How many times in a month do you go to the beach?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	32	16.0	16.6	16.6
	One weekend in month	43	21.5	22.3	38.9
	2 weekends in a month	17	8.5	8.8	47.7
	3 weekends in a month	4	2.0	2.1	49.7
	Every week	3	1.5	1.6	51.3
	Less than 5 times a year	56	28.0	29.0	80.3
	Occasionally	22	11.0	11.4	91.7
	Often	5	2.5	2.6	94.3
	Rarely	11	5.5	5.7	100.0
	Total	193	96.5	100.0	
Missing	9.00	7	3.5		
Total		200	100.0		

If the park or beach were closer to your home or community would you attend more times?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	160	80.0	81.2	81.2
	No	37	18.5	18.8	100.0
	Total	197	98.5	100.0	
Missing	9.00	3	1.5		
Total		200	100.0		

Would safety affect your support for more outdoor spaces like parks and beaches for people and children?

	Frequency	Percent	Valid Percent	Cumulative Percent

Valid	Yes, it would	164	82.0	84.5	84.5
	Yes, but i have other concern	19	9.5	9.8	94.3
	No, it is a safe	11	5.5	5.7	100.0
	Total	194	97.0	100.0	
Missing	9.00	6	3.0		
Total		200	100.0		

If 2nd option is chosen please state 1 or 2 of those concerns

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Improving Security at Beaches and Park (hooiganism, kidnappings, safety)	6	3.0	60.0	60.0
	Lack of a Clean Environment	2	1.0	20.0	80.0
	More activities are required	2	1.0	20.0	100.0
	Total	10	5.0	100.0	
Missing	.00	152	76.0		
	9.00	38	19.0		
	Total	190	95.0		
Total		200	100.0		

Appendix 6E-1: Breakdown of Verification process of Integrated Approach

The breakdown of the statistics of Appendix 6E-1 can be viewed in 6E-2 below: also those HSI classified as non-applicable indicate that context of the HSI is not relevant to this region or the basis of the HSI is beyond the scope and understanding of the participants.

HSI	Question(s)	Respondents verification
Water Management Including Waste Water		
Water Monitoring and Leak Detection	Would you?Consider using water monitors to know how much water you use at home?	Debatable - relevant
Community Water Use Reduction: Water Features	Would you like to see water fountains in parks and malls of Lagos or your local community?	Relevant
Indoor Water Use	Do you have access to government provided water or is this sourced privately via borehole and other means like water delivery?	Relevant
Sustainable Material use and Solid Waste Management		
Timber utilisation	Wood is an important product in Lagos, used for building construction (farming structures and houses, furniture such as table, chairs, beds shelves etc.)	Relevant
Minimized Site Disturbance in Design and construction	Do construction activities in Lagos bother/disturb you from your day to day work or at home or in the office	Relevant
*Modular Pavement and Hardscape Cover		not applicable
*Green and Gracious Builders Scheme Certification		not applicable
Hazardous Waste Management	Is there a place or bin to dispose of hazardous waste such as paint, batteries and oil in your community	Mandatory
Waste Conveyance	Are bins currently provided on the roads, street or outside shops to allow waste to be properly disposed of in your community?	Relevant
Sustainable Transport		
Cycling facilities	Would providing a safe bicycle storage at shops, offices, homes improve the likelihood of using bicycle	Relevant
Traffic Safety	Do you think there are enough sidewalks in Lagos that secure pedestrian safety?	Mandatory

Logistics management - (policy Approach)	How do you think the government can solve the problem of trailers and freights that transport goods and other products like petrol and diesel in Lagos - Policy or Infrastructure approach	Relevant
Neighborhood Connectivity	If trains were made available and connect mainland and island or mainland to another part of mainland would this be your daily transport to work?Do you agree that a new community or area should be developed where there is already developed route for transporting people?	Mandatory
Sustainable Site and Urban Form		
Connected and Open community	How accessible is public transport in your community i.e. how close are bus stops to your homes, offices and shops	Debatable
Active Urban Environments	Do you feel that Lagos needs more outdoor parks where the public can relax, exercise and have fun? Would you encourage the development of more open sports fields? Would you encourage the development of public playing grounds for children in your community in Lagos? Would you encourage the development of more open sports fields? Would you encourage the development of public playing grounds for children in your community in Lagos?	Mandatory
Sustainable Sustenance		
Agricultural Land Preserve	Do you think enough is being invested on agriculture in Lagos? i.e. creating more locally made foods either from farm lands or processed foods from industriesDo you think land should be set aside specifically for locally grown foods?	Mandatory

Inclusive Design and Public Consideration		
Consultation plan and Engagement	In terms of land development, has the government or other private officials ever approached you to get a better idea of your opinion in terms of land development//When an area is to be developed or refurbished would you like input into how this should be done?	Mandatory
Urban Systems Assessment	Before land is developed do you believe that the government authority does a proper survey? Environment, financial	Relevant
Acoustic Conditions and Acoustic Quality	On a scale of 1 to 10, how noisy is Lagos city.Does outside noise during night or day affect you at work/School?.Does outside noise affect you at home?	Relevant
Sustainable Building Guidelines	Do you feel that the government and other professionals consider Lagos cities climatic, landscape and historic urban design traditions when developing land	Relevant
*Guest Worker Accommodation		
Sustainable Energy (Design. Technology, Building and Infrastructure)		
Building Energy Guidelines	In fixing your home/flat has the architect, engineer, electrician recommended more energy efficient options for you to consider? For example 1) Low energy lights (LED, CFLs) 2) solar heater (using the sun for hot water) 3) solar panel (using sun to create electricity) 4) energy efficient materials 5) larger or more windows/or sun roof for daylight to get into your building 6) Recycling rainwater (can be used for flushing etc.) 7) Planting trees and vegetation 8) Automatic controls for windows lights and condition.	Relevant
Measurement and Verification	Would you allow the ministry to use your energy data in your home to come up with strategies to reduce your energy use?	Mandatory

Efficient Infrastructure: Lighting	In your community or neighborhood how often/well do the street lights work at night?//How efficient do you think the street lights are i.e. do you see clearly when they are used	Relevant
Regionally Responsive Planning	In the development practice do you think Lagos have architects, engineers and planners that fully consider these needs and wants of the people and the environment before planning for a community?	Debatable
Energy Management System	Would you find an electricity meter system that told you how much you were spending per day useful?//Would this motivate you to use less electricity?	Mandatory
Community Water Use Reduction: Heat Rejection	Do you agree that water needs to be recycled and re-used?	Relevant
District heating or cooling	Would you consider investing in new technology such as district cooling to cool your buildings?	Relevant
Energy Efficient buildings	Would you pay an additional N 2 million for an energy efficient flat/home/office, which would save you N 5 million over 20 years/ If buildings were made cooler through the use of more windows or better/cooler building materials, would that reduce the possibility of using AC frequently thus reducing impact on the environment	Relevant
Sustainable Urban Ecology		
Wetland and Water Body Conservation	Would you support the conservation of lakes, swamps, native plants and trees in Lagos?	Mandatory
Restoration of Habitat or Wetlands and Water Bodies	Would you support the conservation of lakes, swamps, native plants and trees in Lagos?	Mandatory
Hill Slope Development	Would you support the conservation of lakes, swamps, native plants and trees in Lagos?	Mandatory
Institutional Governance - Governance, Maintenance and Management		
Community Thrust	Would you support community participation programs? for example collaboration btw police and residential	Relevant

	community to address community issues//This would require financial assistance of N10, 000 a month.	
Health in Design	Do you believe Lagos government does enough about physical health awareness for lagosians?	Relevant
Governance	Should program be created to train developers, engineers and planners on how to fully consider the wants of the people the environment when developing a land or site?	Mandatory
Incentive Programs	Please state government community development programs you aware are off in Lagos?	Relevant
Neighborhood schools and education development	Do you think that universities in Nigeria prepare students for the real world?	Relevant
*Updateability and Expandability		not applicable
*Consistency with and complimenting upper level planning		not applicable
Services Infrastructure Provision	Are you aware of any government (ministry of transport, work and energy) plan of how streets lights should be maintained and protected from vandalism?	Relevant
Consideration for Formation of townscape and Landscape in district	How many different parks have you visited in Lagos to have picnics, play sports and have outdoor activities? Note: A park is an area of grass, vegetation and trees surrounded and sometimes populated by birds and other peaceful animal	Relevant
Harmonisation with Periphery	Do you feel that Lagos needs more outdoor parks where the public can relax, exercise and have fun?	Relevant
Disaster Prevention		
Understanding Hazard maps	Do you know Where you can get information about the potential hazard and the ways of preparing for them in your community?	Relevant
Disaster Prevention vacant space and evacuation route	Is there any form of local warning that exists in your community?	Mandatory

Flood risk assessment	In your opinion, what is the level of preparedness of thegovernment to reduce the risk of natural hazards in Lagos?	Relevant
*Desertification		not applicable
*Adverse Wind Conditions		not applicable
Economic Prosperity		
Population: Inhabitant Population and Staying Population	Would you say Lagos is over populated//Population increase is said to come from citizens of other states and villagers looking to make a living in Lagos?	Relevant
Continuity of business and life in the block		Relevant
Housing and Job proximity	Would you encourage Lagos state planners to mix residential houses close to jobs and offices	Mandatory
Return on Investment	Would you support law and policy that makes sure a percentage of industries and companies in your neighborhood must be local?	Mandatory
Support of National Economy	Would you support law and policy that makes sure a percentage of industries and companies in your neighborhood must be local?	Mandatory
Community Investment	Would you support investment of government funds in nonresidential community infrastructure such as business hubs, public libraries etc	Relevant
*Utilization level of standard floor area ratio	Would you refurbish and rebuild places like Yaba and Ikeja or would you rather expand areas like Lekki and Aja	Relevant
Revitalisation activity (efforts on economic revitalization for housing and non-housing)	If a total of 50 houses were built on available land in Lagos would you encourage the mix of expensive, affordable and cheap houses within the same place?	Relevant
Green Lease	If by law you were required to A) To have energy efficient lights B) Have at least one bicycle for your house/flat C) Recycle waste in in your compound D) reuse rainwater	Relevant
Innovation		
Regional Priorities		not applicable

Cooperate Responsibility		not applicable
Innovation Challenges		not applicable
Global Sustainability		not applicable
Plan 2030		not applicable

Appendix 6E-2: Breakdown of Verification process of Integrated Approach

Consider using water monitors to know how much water you use at home?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	123	61.5	65.8	65.8
	no	63	31.5	33.7	99.5
	3.00	1	.5	.5	100.0
	Total	187	93.5	100.0	
Missing	9.00	13	6.5		
Total		200	100.0		

If yes to Q5, Would you pay to have water monitoring systems in homes (to know how much water is being used), or/and if there are issues with your water service, considering this would cost (N200, 000)?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	N.A	25	12.5	14.2	14.2
	yes	45	22.5	25.6	39.8
	no	105	52.5	59.7	99.4
	4.00	1	.5	.6	100.0
	Total	176	88.0	100.0	
Missing	9.00	24	12.0		
Total		200	100.0		

	Frequency	Percent	Valid Percent	Cumulative Percent

Valid	I have full access to Government water	34	17.0	17.3	17.3
	I have limited access to Government water	38	19.0	19.3	36.5
	I have no access to Government water	125	62.5	63.5	100.0
	Total	197	98.5	100.0	
Missing	.00	1	.5		
	9.00	2	1.0		
	Total	3	1.5		
Total		200	100.0		

Do construction activities in Lagos bother/disturb you from your day to day work or at home or in the office

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	117	58.5	58.8	58.8
	no	82	41.0	41.2	100.0
	Total	199	99.5	100.0	
Missing	.00	1	.5		
Total		200	100.0		

Is there a place or bin to dispose of hazardous waste such as paint, batteries and oil in your community

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	28	14.0	14.0	14.0
	no	172	86.0	86.0	100.0

	Total	200	100.0	100.0	

Would the development of bicycle lane improve the likelihood of you using a bicycle

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	37	18.5	18.8	18.8
	Slightly, I may consider it	53	26.5	26.9	45.7
	Most likely	49	24.5	24.9	70.6
	Highly likely	15	7.5	7.6	78.2
	Yes, Definitely	43	21.5	21.8	100.0
	Total	197	98.5	100.0	
Missing	9.00	3	1.5		
Total		200	100.0		

Do you think there are enough sidewalks in Lagos that secure pedestrian safety?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	36	18.0	18.5	18.5
	No	159	79.5	81.5	100.0
	Total	195	97.5	100.0	
Missing	9.00	5	2.5		
Total		200	100.0		

If trains were made available and connect mainland and island or mainland to another part of mainland would this be your daily transport to work?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No, I don't see the difference	4	2.0	2.0	2.0

	No, I prefer the privacy and comfort of my car	22	11.0	11.2	13.3
	Yes, trains are better for the environment than	50	25.0	25.5	38.8
	Yes, If I can avoid the traffic	85	42.5	43.4	82.1
	Yes, if it was cheaper than using my car	35	17.5	17.9	100.0
	Total	196	98.0	100.0	
Missing	9.00	4	2.0		
Total		200	100.0		

Do you agree that a new community or area should be developed where there is already developed route for transporting people?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	141	70.5	75.4	75.4
	No	46	23.0	24.6	100.0
	Total	187	93.5	100.0	
Missing	9.00	13	6.5		
Total		200	100.0		

Do you think enough is being invested on agriculture in Lagos? i.e. creating more locally made foods either from farm lands or processed foods from industries

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	13	6.5	6.6	6.6
	No	183	91.5	93.4	100.0
	Total	196	98.0	100.0	
Missing	9.00	4	2.0		
Total		200	100.0		

Do you think land should be set aside specifically for locally grown foods?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	184	92.0	93.9	93.9
	No	12	6.0	6.1	100.0
	Total	196	98.0	100.0	
Missing	9.00	4	2.0		
Total		200	100.0		

In terms of land development, Has the government or other private officials ever approached you to get a better idea of your opinion in terms of land development.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	17	8.5	8.7	8.7
	No	179	89.5	91.3	100.0
	Total	196	98.0	100.0	
Missing	9.00	4	2.0		
Total		200	100.0		

When an area is to be developed or refurbished would you like input into how this should be done?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.00	1	0.5	0.5	0.5

	Yes	155	77.5	79.5	80.0
	No	39	19.5	20.0	100.0
	Total	195	97.5	100.0	
Missing	9.00	5	2.5		
Total		200	100.0		

Before land is developed do you believe that the government authority does a proper survey?of the environmental advantages and disadvantages of the land?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	67	33.5	34.2	34.2
	No	129	64.5	65.8	100.0
	Total	196	98.0	100.0	
Missing	9.00	4	2.0		
Total		200	100.0		

Before land is developed do you believe that the government authority does a proper survey? Social advantages such as development of parks, playgrounds, public libraries e.t.c

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	69	34.5	35.9	35.9
	No	123	61.5	64.1	100.0
	Total	192	96.0	100.0	
Missing	9.00	8	4.0		
Total		200	100.0		

Before land is developed do you believe that the government authority does a proper survey?of the financial implication of developing region that is too expensive

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	61	30.5	31.4	31.4
	No	133	66.5	68.6	100.0
	Total	194	97.0	100.0	
Missing	9.00	6	3.0		

Total		200	100.0		

On a scale of 1 to 10, how noisy is Lagos city.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.00	2	1.0	1.1	1.1
	A little noise	4	2.0	2.3	3.4
	Average noise	19	9.5	10.7	14.1
	Quite loud	53	26.5	29.9	44.1
	Very loud	60	30.0	33.9	78.0
	Way too loud	39	19.5	22.0	100.0
	Total	177	88.5	100.0	
Missing	9.00	23	11.5		
Total		200	100.0		

Does outside noise during night or day affect you at work/School?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all	74	37.0	39.2	39.2
	20% of the time	54	27.0	28.6	67.7
	40% of the time	21	10.5	11.1	78.8
	50% of the time	20	10.0	10.6	89.4
	60% of the time	6	3.0	3.2	92.6
	80% of the time	3	1.5	1.6	94.2
	All the time	10	5.0	5.3	99.5
	8.00	1	0.5	0.5	100.0

	Total	189	94.5	100.0	
Missing	9.00	11	5.5		
Total		200	100.0		

Does outside noise affect you at home?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.00	1	0.5	0.5	0.5
	Not at all	37	18.5	19.5	20.0
	20% of the time	52	26.0	27.4	47.4
	40% of the time	37	18.5	19.5	66.8
	50% of the time	17	8.5	8.9	75.8
	60% of the time	21	10.5	11.1	86.8
	80% of the time	10	5.0	5.3	92.1
	All the time	14	7.0	7.4	99.5
	8.00	1	0.5	0.5	100.0
	Total	190	95.0	100.0	
Missing	9.00	10	5.0		
Total		200	100.0		

Would you allow the ministry to use your energy data in your home to come up with strategies to reduce your energy use?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	169	84.5	89.9	89.9
	No	19	9.5	10.1	100.0
	Total	188	94.0	100.0	
Missing	9.00	12	6.0		
Total		200	100.0		

Would you find an electricity meter system that told you how much you were spending per day useful?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	179	89.5	95.2	95.2
	No	9	4.5	4.8	100.0
	Total	188	94.0	100.0	
Missing	9.00	12	6.0		
Total		200	100.0		

Would this motivate you to use less electricity?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	169	84.5	91.4	91.4
	No	16	8.0	8.6	100.0
	Total	185	92.5	100.0	
Missing	9.00	15	7.5		
Total		200	100.0		

Do you agree that water needs to be recycled and re-used?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	146	73.0	77.2	77.2
	no	43	21.5	22.8	100.0
	Total	189	94.5	100.0	
Missing	9.00	11	5.5		
Total		200	100.0		

District cooling is a type of cooling that cools a whole community through passing cool water under the floor of homes which goes round in a loop)

	Frequency	Percent	Valid Percent	Cumulative Percent

Valid	No, I am ok with the current fan and AC	54	27.0	29.0	29.0
	Yes, if it environmentally more friendlier than the current cooling technology	62	31.0	33.3	62.4
	Yes considering the 4 properties	21	10.5	11.3	73.7
	Yes, if it is cheaper than the current cooling technology	49	24.5	26.3	100.0
	Total	186	93.0	100.0	
Missing	9.00	14	7.0		
Total		200	100.0		

In your community or neighborhood how often/well do the street lights work at night?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.00	1	0.5	0.5	0.5
	They don't work at all	49	24.5	24.9	25.4

		They hardly work	34	17.0	17.3	42.6
		Occasionally they work	66	33.0	33.5	76.1
		Most of the time they	35	17.5	17.8	93.9
		They always work	12	6.0	6.1	100.0
		Total	197	98.5	100.0	
Missing		9.00	3	1.5		
Total			200	100.0		

Would you pay an additional N 2 million for an energy efficient flat/home/office, which would save you N 5 million over 20 years

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	117	58.5	61.3	61.3
	No	74	37.0	38.7	100.0
	Total	191	95.5	100.0	
Missing	9.00	9	4.5		
Total		200	100.0		

In the development practice do you think Lagos have architects, engineers and planners that fully consider these needs and wants of the people and the environment before planning for a community?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	87	43.5	45.5	45.5
	No	104	52.0	54.5	100.0
	Total	191	95.5	100.0	
Missing	9.00	9	4.5		
Total		200	100.0		

If buildings were made cooler through the use of more windows or better/cooler building materials, would that reduce the possibility of using AC frequently thus reducing impact on the environment

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	It would make no difference	20	10.0	10.5	10.5
	It would slightly affect my choice to reduce the use AC	37	18.5	19.5	30.0
	I may consider it reducing AC use	48	24.0	25.3	55.3
	It would significantly increase the possibility of not using AC	45	22.5	23.7	78.9
	Most definitely, I would reduce my AC use	40	20.0	21.1	100.0
	Total	190	95.0	100.0	
Missing	9.00	10	5.0		
Total		200	100.0		

would you support community participation programs?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	112	56.0	58.6	58.6
	No	78	39.0	40.8	99.5
	3.00	1	0.5	0.5	100.0
	Total	191	95.5	100.0	
Missing	9.00	9	4.5		
Total		200	100.0		

This would require financial assistance of 10,000 a month

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	142	71.0	74.3	74.3
	No	48	24.0	25.1	99.5
	3.00	1	0.5	0.5	100.0
	Total	191	95.5	100.0	
Missing	.00	1	0.5		
	9.00	8	4.0		
	Total	9	4.5		
Total		200	100.0		

Do you believe Lagos government does enough about physical health awareness for lagosians?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	16	8.0	21.6	21.6
	No	58	29.0	78.4	100.0
	Total	74	37.0	100.0	
Missing	9.00	6	3.0		
	System	120	60.0		
	Total	126	63.0		
Total		200	100.0		

Should program be created to train developers, engineers and planners on how to fully consider the wants of the people the environment when developing a land or site?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	169	84.5	88.9	88.9
	No	21	10.5	11.1	100.0
	Total	190	95.0	100.0	
Missing	9.00	10	5.0		
Total		200	100.0		

Do you think that universities in Nigeria prepare students for the real worlds

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes, I believe enough is being done by the institutions	35	17.5	19.1	19.1
	No, both small and large scale companies should train and take on more undergraduate during studies	144	72.0	78.7	97.8
	3.00	4	2.0	2.2	100.0
	Total	183	91.5	100.0	
Missing	9.00	16	8.0		

	System	1	0.5		
	Total	17	8.5		
Total		200	100.0		

Are you aware of any government (ministry of transport, work and energy) plan of how streets lights should be maintained and protected from vandalism?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	44	22.0	22.4	22.4
	No	152	76.0	77.6	100.0
	Total	196	98.0	100.0	
Missing	9.00	4	2.0		
Total		200	100.0		

How many different parks have you visited in Lagos to have picnics, play sports and have outdoor activities?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0 parks	94	47.0	48.5	48.5
	1 park	36	18.0	18.6	67.0
	2 parks	39	19.5	20.1	87.1
	3 parks	14	7.0	7.2	94.3
	4 parks	4	2.0	2.1	96.4
	5 parks and above	7	3.5	3.6	100.0
	Total	194	97.0	100.0	
Missing	9.00	6	3.0		
Total		200	100.0		

Where you can get information about the potential hazard and the ways of preparing for them in your community?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	41	20.5	23.2	23.2
	No	136	68.0	76.8	100.0

	Total	177	88.5	100.0	
Missing	9.00	23	11.5		
Total		200	100.0		

Is there any form of local warning that exists in your community?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	23	11.5	12.9	12.9
	No	154	77.0	86.5	99.4
	3.00	1	0.5	0.6	100.0
	Total	178	89.0	100.0	
Missing	9.00	22	11.0		
Total		200	100.0		

In your opinion, what is the level of preparedness of thegovernment to reduce the risk of natural hazards in Lagos?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very high	7	3.5	4.1	4.1
	High	18	9.0	10.5	14.6
	Medium	49	24.5	28.7	43.3
	Low	40	20.0	23.4	66.7
	Very Low	42	21.0	24.6	91.2
	No understanding	15	7.5	8.8	100.0
	Total	171	85.5	100.0	
Missing	9.00	29	14.5		
Total		200	100.0		

Would you encourage Lagos state planners to mix residential houses to jobs,offices

	Frequency	Percent	Valid Percent	Cumulative Percent

Valid	Yes	115	57.2	65.3	65.3
	No	61	30.3	34.7	100.0
	Total	176	87.6	100.0	
Missing	9.00	24	11.9		
	System	1	0.5		
	Total	25	12.4		
Total		201	100.0		

Would support government investment funds in non residential communuty infrasturcture such as business hubs, public libraries

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	177	88.1	91.7	91.7
	No	16	8.0	8.3	100.0
	Total	193	96.0	100.0	
Missing	9.00	7	3.5		
	System	1	0.5		
	Total	8	4.0		
Total		201	100.0		

If by law you were required to A) To have energy efficient lights B) Have at least one bicycle for your house/flat C) Recycle waste in in your compound D) reuse rainwater

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes, I believe this is fair	43	21.4	22.5	22.5
	Yes it is fair but the fine is too high	48	23.9	25.1	47.6

		Yes, it is fair but the fine should be based according to how expensive the area is	43	21.4	22.5	70.2	
		No, I believe Lagosians already take care of their environment	10	5.0	5.2	75.4	
		No, there are other more important issues to worry about	19	9.5	9.9	85.3	
		No, I believe compliance with one or two of the items listed is enough	23	11.4	12.0	97.4	
		Others	5	2.5	2.6	100.0	
		Total	191	95.0	100.0		
	Missing	9.00	9	4.5			
		System	1	0.5			

	Total	10	5.0		
Total		201	100.0		

Would you say Lagos is over populated

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	182	90.5	92.4	92.4
	No	15	7.5	7.6	100.0
	Total	197	98.0	100.0	
Missing	9.00	3	1.5		
	System	1	0.5		
	Total	4	2.0		
Total		201	100.0		

Would you support a law that limited the entrance of citizens have not lived in Lagos

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	101	50.2	51.0	51.0
	No	95	47.3	48.0	99.0
	3.00	1	0.5	0.5	99.5
	12.00	1	0.5	0.5	100.0
	Total	198	98.5	100.0	
Missing	9.00	2	1.0		
	System	1	0.5		
	Total	3	1.5		
Total		201	100.0		

If a total of 50 houses were built on available land in Lagos would you encourage the mix of expensive, affordable and cheap houses within the same place?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	146	72.6	76.0	76.0
	No	46	22.9	24.0	100.0

	Total	192	95.5	100.0	
Missing	9.00	8	4.0		
	System	1	0.5		
	Total	9	4.5		
Total		201	100.0		

Would you support law and policy that makes sure a percentage of industries and companies in your neighborhood must be local?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes, 100% should be local	115	57.2	65.3	65.3
	Yes, 80% should be local	61	30.3	34.7	100.0
	Total	176	87.6	100.0	
Missing	9.00	24	11.9		
	System	1	0.5		
	Total	25	12.4		
Total		201	100.0		

Would you refurbish and rebuild places like Yaba and Ikeja or would you rather expand areas like Lekki and Aja

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Refurbish places like Yaba and Ikeja	139	69.2	74.7	74.7
	Expand Lekki and Aja	47	23.4	25.3	100.0
	Total	186	92.5	100.0	
Missing	9.00	14	7.0		

	System	1	0.5		
	Total	15	7.5		
Total		201	100.0		

In fixing your home/flat has the architect, engineer, electrician recommended more energy efficient options for you to consider? For example 1) Low energy lights (LED, CFLs) 2) solar heater (using the sun for hot water) 3) solar panel (using sun to create

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No, they didn't recommend any item	68	33.8	35.4	35.4
	1 item was considered	37	18.4	19.3	54.7
	2 items were considered	28	13.9	14.6	69.3
	3 items were considered	18	9.0	9.4	78.6
	4 items were considered	14	7.0	7.3	85.9
	5 items were considered	10	5.0	5.2	91.1
	7.00	17	8.5	8.9	100.0
	Total	192	95.5	100.0	
Missing	9.00	8	4.0		
	System	1	0.5		

	Total	9	4.5			
	Total	201	100.0			