ABDAULHAKIM ALI ARHUMA ABDUALLAH
EVALUATION OF BUILDING ENVIRONMENTAL ASSESSMENT: A THEORETICAL FRAMEWORK
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A THESIS SUBMITTED TO THE INSTITUTE OF GRADUATE STUDIES OF NEAR EAST UNIVERSITY

By

ABDUALHAKIM ALI ARHUMA ABDUALLAH

In Partial Fulfilment of the Requirements for the Degree of Master of Science

in

Department of Architecture

NICOSIA, 2021

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DECLARATION

I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that I have fully cited and referenced all material and results that are not original to this work, as required by these rules and conduct.

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ABSTRACT

Different countries is faced with the challenge of adequate urban planning for the increasing population. The urban areas to be densely populated has resulted in agricultural and other types of rural and natural land use reduction. A lot of problems such as congestion, huge energy consumption, noise and air pollution, poor waste management have resulted from this expansion in cities. Green building certification schemes have the potential to be an answer to the problems associated with the environmental dimension of buildings. Therefore the aim of the study is to provide a comprehensive analysis of the certificates used worldwide for the environmental assessment of building performance. There are varying forms of certification schemes within Europe and in other parts of the world. Some other schemes also exist which are not widely accepted but localized within the countries. In this study, the popular ones including the BREEAM, the LEED, the CASBEE and the DGNB which are in use in countries around Europe are evaluated. Within this framework, after the introduction, the study discusses sustainable urban planning and design in second chapter; it examines building environmental assessment tools in third chapter. In fourth chapter, the study involves international cases of projects from Europe, Asia and North America; it ends with conclusion involving recommendations. Conclusively, it is imperative to be mindful of the fact that these schemes must possess a wide range of acceptance and usage in the building construction industry. Concerning the upcoming advancement of these certifications, all governments should intensify its policies for the usage and adoption, should create awareness and improve already existing ones.

Keywords: Sustainability; certification schemes; BREEAM, LEED, CASBEE, DGNB; international cases; theoretical evaluation

ÖZET

Farklı ülkeler, artan nüfus için ihtiyaç duyulan kent planlamanın yetersiz olmasıyla karşı karşıyadır. Kentsel alanların yoğun nüfusla genişlemesi, tarımsal ve diğer kırsal ve doğal arazi varlığının azalmasıyla sonuçlanmıştır. Şehirlerdeki bu genişleme, yoğunluk, aşırı enerji tüketimi, gürültü ve hava kirliliği, kötü atık yönetimi gibi birçok soruna neden olmaktadır. Yeşil bina sertifika programları, binaların çevresel boyutuyla ilgili mevcut sorunlara bir cevap olma potansiyeline sahiptir. Bu nedenle bu çalışmanın amacı, bina performansının çevresel değerlendirmesi için dünya çapında kullanılan sertifikaların kapsamlı bir analizini sağlamaktır. Avrupa'da ve dünyanın diğer bölgelerinde çeşitli yeşil bina sertifika programları vardır. Yaygın olarak kabul edilmeyen ancak ülkeler içinde yerel olarak kullanılan bazı başka başlıklar da mevcuttur. Bu çalışmada, Avrupa ülkelerinde kullanımda olan BREEAM, LEED, CASBEE ve DGNB gibi yaygın olanlar değerlendirilmiştir. Bu çerçevede, giriş bölümünden sonra, çalışma ikinci bölümde sürdürülebilir kentsel planlama ve tasarımı tartışmaktadır; üçüncü bölümde bina çevresel değerlendirme araçlarını incelemektedir. Dördüncü bölümde çalışma Avrupa, Asya ve Kuzey Amerika'dan uluslararası proje örneklerini içermektedir ve sonrasında önerileri de içeren sonuç bölümüyle sona ermektedir. Sonuç olarak, bu sertifikaların yapı inşaat sektöründe geniş bir kabul ve kullanım alanına sahip olması gerktiği gerçeğinin akılda tutulması lazımdır. Bu sertifikaların gelecekteki gelişimi ile ilgili olarak, tüm hükümetler, bu araçların kullanımı ve benimsenmesi için politikalarını yoğunlaştırmalı, farkındalık yaratmalı ve halihazırda mevcut olanları geliştirmelidirler.

Anahtar Kelimeler: Sürdürülebilirlik; sertifika programları; BREEAM, LEED, CASBEE, DGNB; uluslararası örnekler; teorik değerlendirme

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INTRODUCTION

1.1 Research Background

Varying countries is faced with the challenge of adequate urban planning for the increasing population. The possibility of the urban areas to be densely populated has resulted in agricultural and other types of rural and natural land use reduction. A lot of problems such as congestion, huge energy consumption, noise and air pollution, poor waste management have resulted from this expansion (Abou, 2015).

A collective challenge is upon the entire world has the engagement of men, which may be attributed to a conscious or otherwise decision is contributing immensely to the gradual destruction of its place of inhabitance i.e the earth. Even though the knowledge about this has always existed, scientists have consistently arrived at data which serve as evidences that implicate man and his activities in the negative effect on the environment worldwide (Millennium Ecosystem Assessment (MEA) 2005; Steffen *et al*. 2015).

The awareness which has been created and generated by man about the unsustainable nature of man's activities in the last tens of years has been well documented. These issues range from environmental pollution, destruction of the ozone layer, climatic changes, desert encroachment, loss of biodiversity and extinction of species, severe damage to the ecosystems among others (Steffen *et al.* 2015; Stockholm Resilience Centre SRC, 2015). Global warming, caused by the constant and steady release of carbon dioxide (CO_2) and other greenhouse gases into the atmosphere has since been a major topic of interest all over the world with ever increasing and spreading publicity. The result of this has been the frequent occurrence of disastrous natural and other humanity threatening events (IPCC 2014).

These problems emanated from the growing consumption of resources available to people across the universe. The over-consumption of resources could also be attributed to the economic gains attached to the production for such consumptions. Hence, the incentive for overdependence and over-exploitation of finite materials is strong enough to continue to drive the unsustainable models of resource allocation and consumption all over the world.

However, the detrimental effect of such a model on both local and global scales in terms of climate change, resource depletion and environmental degradation has led to the growing interest in sustainable development across the world (ESCWA, 2014).

Urban planning serves as a technical and political technique that deals with land use development and design, the environment, which embodies water and air, and the framework within and outside cities, including transport and logistics, communication channels and routes, with means of circulation links. Urban planning is majorly concerned with the physical arrangement of natural settlement. The fundamental concern is the general welfare, which entails the efficiency, sanitation, protection, and environmental use deliberations, and also how it affects social and economic activities (Fares, 2002).

Invariably, it has been observed that social aspect in sustainable development is of great significant and the previous issues has been suggested to take over 'human centered development'. The building of sustainable cities can only become easy when people consider their city as their own as well as changing their lifestyle in an appropriate manner. (Hossein, 2001).

This thesis set about to look into the various certification schemes that have been produced and regenerated to suit the needs and conditions of different nations and how they have been effectively contributing to the sustainable development goals around the world within the building level.

1.2 Problem Statement

While the certification schemes have become widespread, a heavy gap was known – there's a a lack of agreement among the building sectors in an exceedingly country and among certifications schemes specifically on however property ought to be outlined and therefore not providing a solid methodology of action (Zimmermann, 2005; Berardi, 2013; Torres *et al.* 2013).

The obtainable certification schemes arise from power utilization consumption analysis lifecycles to life cycle analysis (LCA) and overall standard rating systems (Berardi, 2012). It has been established energy performance in residential and industrial buildings would be taken into account foremost as the vital standard in property certification schemes.

The baccalaureate doesn't utilize its limit of ability for growth and development, so therefore the Certification Schemes, together with economical assessment tools and ways, have a vital role therein development; first, in ensuring adherance to energy and environmental rules and regulations so therefore the several laws and bye laws, and second, in measure and promotion property within engineered surroundings (Giama and Papadopoulos, 2012).

Due to the increasing concerns in property of building, the planning and construction of buildings and other structures in the same category has turn to be a sound speciality to venture in together with mechanics, electrical and electronics, communications, sounds, with construction engineering. Property building style unites house owners, builders and designers, suppliers and end users in buildings, however put aside its relevance and improved quality, majority of the revealed analysis to date on “sustainable” building style worries with resources potency (energy, water) and reducing the burning or fossils and carbon let outs.

Property within the baccalaureate ought to be typically made clear as associate degree coupling together of the subsequent 3 connected dimensions in environmental, economic and social well-being (Jrade and Jalaei, 2013). Jrade and Jalaei additional stated that by victimization property style these parts ought to be fussed along at the abstract level and subsequent one, the design expert ought to determine the suitable elements and modifications supported any hand-picked Certification Schemes.

Gibberd (2008) It seem obvious and certain that no overall agreement and applicable measure process for standard allocation and determination for socially and economically based property at world or national scale, this could not be associate degree excuse to depart out social and economic pointers in building property assessment. The author suggests instead that these criteria square measure vital and will be developed, as buildings and construction will build substantial contributions to native economic and social property development.

The Certification Schemes can tentatively serve as an answer to the present and different problems associated with property of buildings and therefore possess a vital duty to support the baccalaureate during the shift (Gibberd, 2008). At a similar time, the known gap – lack

of agreement on however property ought to be outlined – seems to be a heavy obstacle for the execution of certification schemes and therefore the delivery of their design duty.

The continuous release of greenhouse gases into the atmosphere has contributed to some major climatic changes. The global temperature for example has been on an alarming increase with is said to have spiraled by about 0.6°c which is a significant increase from what it uses to be right before the proliferation of industrial institutions in urban settlements (The World Bank, 2012). The rate of occurrence of major environmental disasters like floods and hurricanes has also increased which is as a result of rise in the volume of water bodies and extreme cases of dryness are also witnessed in the form of drought and desertification.

The concept of sustainability is a growing global concern. Population growth amongst other things if highly contributory to the pressure placed on environmental resources due to urbanization. It has therefore become important for every region and country to plan their urban development in the line of sustainability. This will contribute to the existing literature on urban development and sustainability in and around the world and will provide knowledge addition to researchers in the field.

1.3 Aims and Objectives

The aim of the study is to provide a comprehensive analysis of the buildings certification schemes the BREEAM (The Building Research Establishments Environmental Assessment Methodology) LEED the Leadership in Energy and Environmental Design (LEED) CASBEE (The Comprehensive Assessment System for Built Environmental Efficiency) and DGNB (The Deutsche Gesellschaft für Nachhaltiges Bauen) in terms of sustainability assessment.

The objectives of the study however include;

1. To make an extensive evaluation on the major certification schemes and their stretch in selected nations around the world.
2. To determine how the introduction and adoption of these schemes can positively influence the urban planning and architectural designs in developing and third world countries around the world.

1.4 Research Questions

In place of the objectives stated above, the basic research questions are as follows:

1. What is the meaning and scope of urbanization and the sustainable urban plans and designs within and outside Europe?
2. What does the concept of sustainability entails, the sustainability challenge and its relevance to the building sector? Also, what are the sustainability development indicators as it concerns neighborhood, housing and urban planning?
3. What are the main characteristics of the major certification schemes as BREEAM (The Building Research Establishments Environmental Assessment Methodology), LEED (The Leadership in Energy and Environmental Design), CASBEE (The Comprehensive Assessment Systems for Built Environments Efficiency) and DGNB (The Deutsche Gesellschaft für Nachhaltiges Bauen)?
4. Identification of countries within and outside Europe that adopt different housing certification schemes, the features of the scheme and the challenges faced during its implementation.
5. What are recommendations that can be made to serve as initial means for addressing the threats hindering the progress of the building sector in developing nations and utilizing the opportunities for improving them particularly towards a more sustainable housing system?

1.5 Methodology

This research work is predominantly a theoretical study made into the context of existing certification schemes that already exist all over the world as a way of providing link between these schemes and the current state of urban planning and design in developing nations. As such, an extensive evaluation was made into the peculiarities of the major certification schemes identified in BREEAM (The Building Research Establishments Environmental Assessment Methodology); LEED (The Leadership in Energy and Environmental Design); CASBEE (The Comprehensive Assessment System for Built Environmental Efficiency); and DGNB (The Deutsche Gesellschaft für Nachhaltiges Bauen).

Having considered the acceptance and usage of these schemes in countries majorly in the North America, Asia and Middle East, the main focus of this thesis centers on some prominent buildings in Europe, their structural feature and the detailed information that surrounds their construction and implementation. The buildings considered include;

The Netherlands - De Landtong

Austria - Dieselgasse Residential Development

United Kingdom - Greenwich Millennium Village

Spain - Fort Pienc Housing

Denmark - Gemini Residence

Germany - Berlin Wasserstadt

Belgium - Pandreitje housing

Finland - Kannelniitty

Portugal - Housing in Chiado

France - Montreuil Social Housing

Conclusively, the research applies a qualitative approach to the review of urban planning and development around the world. To achieve this, a systematic review of available urban plans realized from the geographical setup of popular structures in different countries in Europe and the inherent design backdrop. Then a general comparison of the urban planning and development in developing part of the world with other developed cities and regions of the world will made.

1.6 Thesis Outline

The thesis consists of 5 chapters. Chapter (1) offers a succinct brief of this study, its research objectives, potential importance, and the research questions. More insights to the discussion addressing the goals and the objectives are contained in the following chapter.

Chapter (2) consults series of academic and professional literature with a major interest in the related theories upon which the structure of the study is framed. It analyzed the changes in the urban planning system over the years and provides an account of the over-domination of urban areas on the current urban planning system.

Chapter (3) contained a review of international cases of sustainable urban planning, there built environment, and how the advanced nations of the world have arrived at their desired

sustainable destination in an attempt to establish the urban planning and development and subsequently sustainability attempts. Furthermore, different frameworks for sustainability are discussed in the chapter.

The fourth (4) chapter will begin with the review of the built environment and the level of urban planning and development in selected case studies around the world yo comprise majorly of distinct sustainable certification scheme practices in Europe. Consideration was made on the assessment of the urban planning sustainability using the various international framework. It unveiled the continued overpopulation of urban areas despite the efforts taken by the government. It also evaluates the roles of different stakeholders in achieving sustainable urban planning and development. Chapter (5) states the conclusions of this research, guiding to the areas of further research (with recommendations) and the contribution of this thesis.

CHAPTER 2
SUSTAINABLE URBAN PLANNING AND DESIGN

The wave of development has been blowing across advanced nations of the world and the history of most of these places have shown the level of evolution which they have been subjected to. Not only is the marked difference in architectural landscape and terrain been obvious, this has also shown a careful attention to detail of urban planning and careful consultation of relevant parties in necessary cases.

This chapter discusses the literature review and conceptual definition of various terms in the study. The chapter reviews literature from different authors who have researched their opinions and debates on the research study.

2.1 Urbanization

Urbanization serves as a hugely influential player in the game of industrialization in any nation capturing the socially, economically, politically based strategies and environment all over the world. This has to do with the increased in scope of the urban settlements and the advancement in the number of inhabitants effectively migrating in.

Urbanization can be defined as the rise in population of people that reside in cities. Mayhew, (2014) gave his definition to be increase in the population in urban settlements which is caused primarily by movement of people into such places from less developed areas majorly caused by the proliferation of good life, social amenities and facilities or putting it differently, urbanization is the positive shift in societal value and settlements from less advanced parts of a country to cities. The rate of urbanization in a country can be determined by measuring the amount of the population that resides in the cities (Davis, 2012).

Urbanization is also said to have a strong interaction with the rate of growth and development experienced in a nation as shown that countries with high level of development will naturally witness an equally upward rise in the rate of urbanization.

Figure 2.1: The Borgen Project (https://borgenproject.org/urbanization-in-developing-countries)

The great Industrial Revolution that was set into motion at the tail end of the 18th century was spearheaded by England and then a lot more other nations went the same direction. At this period, a slow and gradual build up of population was witnessed in the urban areas even though a huge decrease in that of the rural parts of nations was not pronounced. The effect of these was soon to be felt in such a way that family sized reduced and aged people get concentrated in the rural areas while the young ones move to cities. Together with the shift and adjustment in age distribution, the concentration of industries also changed (Honjo, 2015).

The rate of urbanization in nations is progressing quickly and 96% of all cases if such which is to be witnessed by the year 2030 will be based majorly in the 3rd world countries. This worldwide move in the direction of population rate around the globe had significant impacts on some of the most important and pressing issues of the world which may include food, water, and energy utilization (Runde, 2015).

More than 90% of supposed future increases in population around the world will be traced majorly to the nations where cities are witnessing rapid growth and development.

It has been proclaimed that Africa will be a great contributor to the percentage (60%) of increased population to be witnessed in urban areas by 2050 (Un-Habitat, 2013). Urbanization serves as a catalyst of modernization and industrialization in today's economies of great value and it is virtually impossible to override in the growth process (Bai *et al.,* 2014).

Figure 2.2: Aerial view of a typical urban city (https://www.google.com/amp/s/richmondvale.org/en/blog/6-major-effects-of-urbanization-that-will-make-you-think%3fformat=amp)

The form of urbanization experienced in Africa will possess some important features which include high level of poverty, divisiveness with the structure of economy in place, fragile institutions, huge unemployment rate among other growth and development threatening issues (Clarke, 2014). However, this part of the world has been accused for contributing little or an insignificant level of sustainable growth and human progression to the submissions by the rest of the world (Boadi*et al.*,2015; Fox, 2012).

2.2 Urban planning and design

The way to properly define urban planning and development, as a concept with an interdisciplinary facet, and it thus diversifies through the impact of social, economic and spatial interventions. During the initial phases of the concept, it majorly deals with ways to establish a healthy, attractive, efficient, and secured community. These days, the focus of the concept has thus shifted through to the areas of architectural designs, lands and topography, economic decisions, politics, sociological aspect of life and advocacy.

2.2.1 Urban and regional planning

Urban and regional planning is a concept that entails the entity of social engagements directed towards the anticipation, representation and regulation of the developmental activities in a society or region. It marries careful thought of reasoning and delivery with socially and economically inclined predictions together with precise and reliable execution procedure in the provision of essential amenities, land use and resource management. The scope however, may be different as it can be within a certain community, city, urban settlement or region (Le Galès P, 2002).

In this regards, when the subject region to be planned for is relatively small, the plan to be instituted tend to more restricted and concise and complexities sets in with increase area of coverage.

Figure 2.3: Demonstration of urban planning and design in 3D implementation.

(https://www.google.com/amp/s/www.pinterest.com/amp/pin/535224736937292329)

The sort of evolution that has been witnessed in major places, settlements and how the plans of the settlements are arrived at in the vastly developed regions of the world has not been paid enough attention along history. When international bodies and organizations set about pushing historic writings on urban planning, the resulting publications are usually restricted to the different parts of Europe and north America with very limited work in the

less developed nations and regions of the world (Hall, 1997). Writing on how places have evolved across the years is important when making publications, study materials, articles of any other material for the purpose of knowledge gathering. This pattern of writing will assist in having a clearly view of the origins, ideologies, personalities, chaos, cultural structure, present trend, and scale for potential advancement and how a place has grown down the course of history (Hall, 1998).

Over the years, the goals of urban and regional planning have been subjected to various levels of change. There has been change from demand-side policies to supply-side policies and also form a redistributive point to a competitive and marketing point. The objective of this has not been to manage the upward trajectory of the economy and its influence on urban and regional areas but instead to spurn it on.

Figure 2.4: A typical sketch of urban plan (https://afric.online/12951-urban-planning-in-africa-an-issue-for-development).

Instead of engaging the well-defined land use management criteria, the planning systems employed were shaping up as marketing tools. When it comes to the administration of a area, plans come about in two forms; that which is not specifically directed to the management of individual spaces and places in the area and that which are targeted at specific places for the execution of projects and strategies (Pinson, 2002).

When it comes to putting plans in place, particular considerations are given to decision makers in the economy and the social powers. The planning strategy is not arrived at as an eventual results which are due only to efforts of public urban and regional planners, instead, due to the integration of forces between the public and private sectors and also diverse units of government parastatal.

Rapid urbanization and the growth that comes with it demand that some important components are well understood. These components include the plans that tract sustainable land usage and growth and improving the standard on which an urban settlement is manifested. When the term 'planning' is discussed, it is married with the activities of people that determine community and societal engagements, together with the physical environment. Also, the concept will become incomplete if it's important components are or its determinants are excluded. These include; land suitability, socially and environmentally based justice, and threshold limit which will possibly have influence on any decision making process. The discussion must well cover the components that are well embedded on the schemes and those that are tentatively involved including; water and air quality, criminality, and poverty. Conclusively, the stages of organization and strategizing must cater for the stage itself (Wang *et al.*, 2016).

Urban and regional planners have the responsibility to deliver on a premium basis in matters relating to urban and regional development including sustainable growth, new development, zoned land uses, densities, building characteristics, parking requirements, and others, have significant effects on the inhabitants (Edwards, 2017).

2.2.2 Urban design

Urban planning can be defined as the transformation of a place to a typical urban settlement which encompasses a collection of structures with varying designs together with the spaces and geographical elements between them and also containing a suitable plan for regular growth (Urban Design Group, 2011). In some crude ways, the concept of urban design has been in existence since the old-time civilization, but gains much recognition in the 1950s after the determination of the international conference on the outcomes of urban area which was held at the Harvard Graduate School.

After WWII, major cities needed for the reconstruction and renovation. However the available knowledge and knowhow that exist in architecture, architectural development and urban planning was not sufficient enough to produce a breakthrough in the collection of cities advancements, thus leading to the creation of a novel area of specialization to fill this hole (Krieger, 2004).

The regular upward rise in the population of inhabitants in urban settlements has led to the increased demand for spaces where industries and residential buildings can be sites and effectively managed. This was however to be giving room for the unregulated construction of structures and rise of unwarranted repition of city templates and layouts. Advanced areas gain much ground without coordination or monitoring due to the absence of intelligence to cater for their growth (Rosi, 2004). If thus needed, it will come at a great cost and much difficulty. Urban settlements have been targeted as the focal point for social societal changes in different parts of world history.

Figure 2.5: A perspective painting of urban design (https://www.wsp.com/en-MY/insights/rethinking-urban-planning-in-a-post-covid-world)

The start of this was the 20th century when the conventional way of city expansion was ditched for varying ways which allows for ample time for detailed and organized planning (Lazaro and González, 2012). A new form of evolution has seen planning become the religious guide for any form of sustainable urban growth and development. The act of

planning ideally began this century and involves carefully understudying the sketch and advancement in urban settlements which has also grown to include the collection of different disciplines of knowledge and knowhow greatly assisted by the use and infusion of media as a means of globalization. .

2.3 Sustainability

The world sustainability was coined out in the early 1970's with the needs to respond to the impact of developmental activities on the conditions of environmental practices within cities (Lumley& Armstrong, 2004). Sustainability means “your existence in life should not damage the world in any way that leaves it in a worse form that it was initially, one should always go for their limit and not beyond when taking anything from it, if in any case such happen, efforts should be made to restitute"

Sustainability having been so popular demanded the establishment of a new form of development named 'sustainable urban environment'.

The concept is made up of terms that introduced an appealing the existing terminology. The original concept was based on the management I'd the resources available in this present moment, improving the essence of living while preserving and safe guarding the valuables of this period (Goonetilleke *et al.*, 2014).

Figure 2.6: Components and impacts of climate change on the environment (https://sustainablehealthcare.org.uk/blog/sustainability-series-role-education-sustainable-occupational-therapy)

Nowadays, sustainability now exists in like manner to urban design. It is this the responsibility of the urban and regional planners to arrive at sustainable areas with “triple bottom line” which entails the 3 major components of sustainable living in economy e.g. high earning employment opportunity, social e.g. sound education and fitness facilities and environmental e.g. unpolluted air, pure water sources, habitable nice settlements residence, job engagement and enjoyment, thus making the inclusion of the sustainable urban design in any nation's growth paramount (Ritchie and Thomas, 2009).

Adapting a scheme that marries sustainability together with urban design will aid in providing environmental quality, economic & social benefits. Walton*et al.* (2017) describe the urban design as a branch of urban planning and development that see to the creation of sustainable communities.

There are three (3) pillars of sustainability which are: (i) Economic sustainability (sectoral to cross-sectoral business); (ii) Environmental Sustainability (balance between resource consumption by human and natural replenishment) and; (iii) Social Sustainability (equitable, diverse, connected, democratic communities) serve as the 3 strongholds of sustainability. This very theory started out to keep with the notion that term sustainability has 3 distinct dimensions which function independently from the other. The scope has now been widened to recognize the components that serve to bridge any loophole in the functioning and workability of the phenomenon.

2.3.1 Sustainability challenge

The awareness which has been created and generated by man about the unsustainable nature of man's activities in the last few tens of years has been well documented. These issues range from pollutants in air and water, depleting ozone layer, rise in sea level desert encroachment, destruction of biodiversity, destruction of ecosystems and more (Steffen et al. 2015; Stockholm Resilience Centre 2015). Global warming, caused by the constant and steady release of carbon dioxide and other greenhouse gases into the atmosphere has since been a major topic of interest all over the world with ever increasing and spreading publicity. The result of this has been the frequent occurrence of disastrous natural and other humanity threatening events (IPCC 2014).

Findings are regularly been made to find out the causes, impact, effects and solution to this menace of events rocking the humans world, but despite the outcomes and results of these researches being inconclusive, it won't be out of place to say that our society is facing a Sustainability Challenge.

To scale these challenges and its impending impacts on the home of man and the mist viable part of the environment that supports man and its activities, there is the need for man to shift its attention to the creation and use of socially and economically society with its very components sustainable alwhile not eroding its fundamental life supporting systems (Robèrt et al. 2002).

2.3.2 The building sector in terms of the sustainability challenge

Different sectors of the economy have had its contribution to the different developments that has arose in the fight against sustainability. A major sector which has been in existence since the beginning of life is the building sector. This sector is so culpable in that the introduction of new structures and buildings has been a strong bone of evidence that signals the rise of any nation on the ladder of civilization and demonstration of her achievements. Throughout history, the mode and forms of buildings and architectural structures have changed considerably albeit they are constructed to be inclined to get the clear picture on sone certain needs and standards (WBDG 2011). The initial part of history has made us to understand that the construction of a building is usually with the use of simple tools and materials which are easily sourced and recycled by nature, thereby posing little danger to the eco-systems. However, since the world starts witnessing and benefitting from the dawn of industrial revolution, building materials have become considerably more complex (e.g. reinforced concretes, metal alloys, synthetic polymers and other chemical substances), this is added to the contribution of fossils fuel which is burnt regularly due to the use of large machineries and equipment (IEA and UNDP 2013).

The International Energy Agency (IEA) and the United Nations Development Programme (UNDP) have both listed built structures to be the single sector that consumes the most energy throughout the world. This amounts to about 40% of the total energy available for use and it has been on the increase and this is bound to happen considering the increase in population and economic growth. About 70 million tons of waste is generated during

construction works throughout the year which account for almost 17% of the entire waste from the economy worldwide (Tamburini et al. 2009). It has been projected that by the year 2035, the continual rise in population figures will lead to increase in the number of buildings all over the world to about 30% more, thus piling more unnecessary pressure on the energy demand and usage (IEA and UNDP 2013).

Due to this, the building se for has been identified by the International Energy Agency as a sector where which can be exploited in a plot at reducing global energy consumption. It was gathered that if well tapped into, an estimated energy of around the equivalent of 1 509 Mt of oil will be saved at the turn of 2050, worldwide. And as a result, energy expended in buildings will be reduced and there will be and improvement in energy utilization which will greatly push down the carbon monoxide generated from these structures and eventually leading to the worldwide reduction or curbing of the generation of some12.6 Gt of CO emissions by 2050 (IEA 2010a; 2010b). The two points mentioned above in high energy consumption and waste generation are just some of the issues which are being inherited from architectural structures all over the world. As listed by Doerr (2011), other issues include;

(1) Worldwide climate change - this serves as an outcome of setting up fossils that temd to shoot up the atmospheric presence of greenhouse gasses in the atmosphere

(2) Reduction in resources - due to persistent usage of the available resources with plans for renewable utilization and management

(3) The natural habitat of some animals is destroyed - so many species at tge brink of extinction are also lost forever due to lack of conservative practices

(4) Air and water pollution - tge continual reliance in manmade substances and the abandoning of the natural substitutes definitely possess a boomeranging effect as long as they are released into the atmosphere. As at the time when a building is fully functional, the social components of such structure is also called for check. There is tendency for there to be growth in social equity, community building, self-provisioning, and local empowerment, of the inhabitants of such places, but all these are secondary to the main objective of making an architectural piece sustainable (Dempsey 2011; Jensen 2012). The

3 major components of sustainability having been given to be environmental, economic and social, in most cases, buildings have failed to meet social arm of the sustainability which it should ordinarily entail including facts and figures as regards the usage of a built structure and establishing "ownership" with respect to sustainability measures for the settlements are yet to be resolved and addressed (Jensen 2012). Leading health organizations including World Health Organization (WHO) (2010), have identified strong links of buildings with health problems.

2.4 Sustainable urban development

Sustainability is gaining more grounds and increased regions and places are adopting sustainable plans every year. Despite this, the area that are sustainable are majorly urban centres which are now witnessing rapid growth in population and the influx of people into these places is not looking like settling down any time soon as people trrod in largely in search of good livelihood and also put an end to their unemployment problems. The UN has estimated that the population figure of concentrations within urban Ares will vloch around 5.1 billion by the year 2025. This and coupled with the fact that industrialization has swung into full trottle in the last 20 years or more has led to these figures. The awareness and consciousness about sustainability and sustainable development has also been intensified and the general public realize the need to engage and adopt sustainable practices in their day-to-day activities and ensure the safety and health of the world and planet earth.

From another point of view, it is an established fact that just 2% of the world covered by cities and urban settlements are responsible for the consumption and usage of 3/4th of the world's natural resources (Newman & Kenworthy, 2009).

The Gross Domestic Product (GDP) of a nation serve as an important tool in calculating the growth of a nation. This however measures the development within a country without considering the standard of operation with which the fruits are bared. A better detailed estimation will factor in the 3 dimensions of sustainability which are environment, economy, and society.

Despite the goods which are offered by industrialization, sadly, it comes with some huge level of side effects that negatively impact the human face and the natural environment at

large because they introduce fuels and other chemically based which are regarded as being hazardous (White 2001). After the WWII, a great industrial revolution which is focused on improving the entire structure and state of the economies are pushed into play by introducing advancements in different areas of life such as technological knowhows, transport channels and networks, and housing facilities. In the 60s and 70s of thus century, the natural environment was almost merged with the cities as a form of proposal by different researchers and environmentalists and they all back up their submissions with strong arguments on how both can be linked concurrently with amicable existence (Bass, 2013). Globally, sustainable urban development is recognized to be a possible solution in curbing the series. of environment related issues envoi yered in urban areas by building resilience, safeguarding the ecosystem, and promoting the use of renewable energy, to achieve a symbiotic relationship between the environment, economy, and society. Subsequently, sustainable development tends to grow as a strong initiative spreading rapidly and has been applied by various international and national institutions, corporate enterprises, and sustainable settlements. Concepts of sustainable development have been studied in terms of the names (economy, society, and environment), resources and productive assets (manufactured, natural, human and social capitals), wellbeing (quality of life, needs, and strenghts) and norms (efficiency, fairness, prudence, etc.).

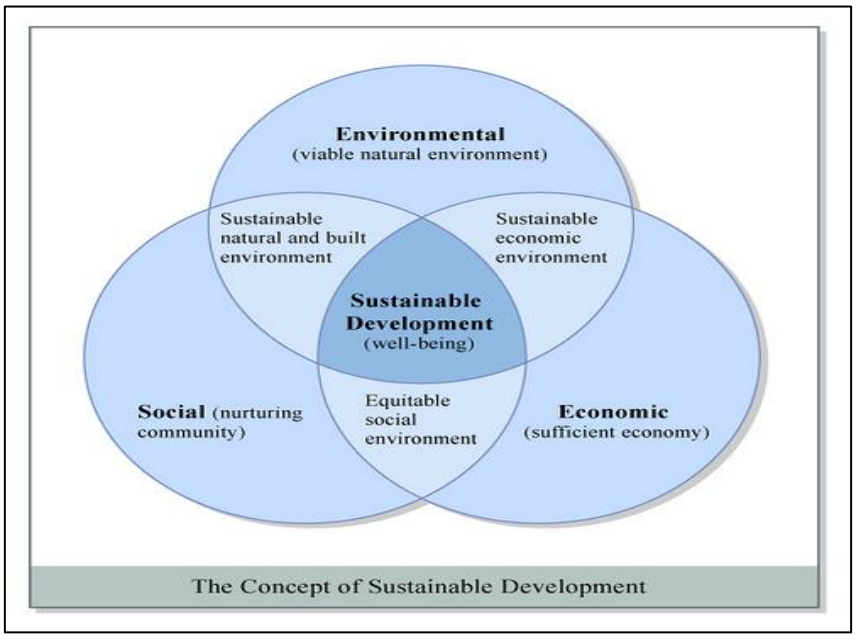

Figure 2.7: Concept of Sustainable Development (Gallopin, 2014).

For a long while, the components of sustainability have been just been 3 (three); social, economic and environmental. The need for there to be an additional component that oversees the existing tridents is arrived at by the necessity of regulation and management (UN, 2007). This function is served effectively by an institution (which may be a state or nation) whose activities include the provision of basic amenities, raising the quality and standard of living of its citizens, securing their rights and serving justice and creating a tenable template for their proper involvement and participation of their civic duties towards societal growth (European Commission, Eurostat, 2009). It is imperative that the governance component of sustainability depict the dispensation of the its constitutional duties to the people and such should be reciprocated in like manner as this will ensure appropriate growth and development in achieving a sustainable environment (UN, 2007; Deeb and Mhana, 2009).

On the account of Deeb and Mhana (2009), in other to keep close watch of the dimensions of sustainability and ensure their affective application, adequate attention should be paid to the principles and indicators of sustainability.

2.5 Sustainable Development Indicators

Sustainable development indicators are set of estimation and evaluation systems which are used to profer solutions to some relevant and like issues. These indicators serve or still represents the best and most utilized tools for the evaluation of the impact of sustainable development. They involve set of indexes which monitors the achivability and extent of attainment of the aims and goals of sustainable development. They also help to detail our or identify the components of sustainability with respect to a settlement. These indicators however, should be in a way that incorporate the essential components of sustainability including environment, economy, and society, to be effective (Maclaren, 2016).

This present day, so many sustainability development indicators have been developed with none comprehensively addressing which it is meant to be boarded around. As it stands, well brancged certification schemes have targeted environment-based indicators to evaluate property (Berardi, 2013). Moreover, strides to evaluate property and coming up with new forms of evaluation protocols have multiplied in the not too far back years. Turcu

(2012) planned 2 methodologies for arriving at rating features. The primary method is that the results of choices made by government supported masterly input ("expert-led"), whereas the other method is made by partner voters in their choice of indicators that is often referred to as the grassroots approach ("citizen-led").

Indicators are quantitative tools that change the synthesis of knowledge that are associated with the relevant state or the event of some phenomena. They function tools for human action, evaluating, and creating qualitative or quantitative choices. in step with Gallopin (2014), the property development indicators additionally function indicators of progress that aim to realize property development by desegregation the environmental, economic, and social issues of humanitarian efforts.

The property obstacles (e.g., greenbacks backed with publically transport than in road and rail rehabilitation) which {are|ar|area unit|square live} known by these indicators is wont to quantify the state of occurrences within a settlement or atmosphere (for example., range of recent cancerous cases and range of used in an environment with poor air quality). Each input and output features keeps track of the level of importance of various regulations also because the activeness embedded in general efforts in tackling economic, social, or environment related problems.

Existing features may also be categorized as being subjective or objective. The subjective features are based on the feelings and thought of people on numerous situations, issues, and trends, whereas objective indicators are facts that are freelance of private perceptions (Maclaren, 2016). In different words, subjective indicators live the perspective of individuals with respect to their neighbourhoods, whereas objective indicators make note of theft and trespasses that have occurred in and space. The indicators also can have a lot of other subdivisions and classes in step with their topic, like environment health, reduction of system issues, transport channels and means, sound educational, housing, and land use.

2.5.1 Sustainable urban planning indicators

Generally, indicators are essential for establishing goals and keeping tab of progression (Ndeke, 2011). When sustainability in a particular localized setting is assessed, it is so as to evaluate the beaming influence of global occurrences on the society in question with the mind of going beyond the immediate requirements. Indicators of sustainability are

important tools which come handy to decision makers when they are to set policies for the future while deriving valuable experimental form past occurrences (Rowan, 2002; Ndeke, 2011). In the nutshell, information relating to all dimensions of sustainability serve as a decisive tool which passes stringent intelligence to stakeholders and decision makers as well as providing the public with valuable information in a clearly defined manner (Haapio and Viitaniemi, 2007).The creation of a single basis for harnessing the economic, social and environmental components of sustainability is the most important reason for evaluating the platform of growth and development on which a settlement is planned.

Therefore, an avenue is given to the different stakeholders, decision makers, departments and components to establish a sustainable environment (D'Acci and Lombardi, 2010). Generally speaking, indicators in any form which they are presented can be used to determine the level of operation for projects and architectural structures in states and nationwide (Xing et al., 2009). It however becomes challenging when it comes down to choosing the group of indicators where a properly planned foundation is missing for how urban and regional sustainability should entail (Cocca and Alberti, 2010; Brandon and Lombardi, 2011). In other to identify the actual indicators that are in play as it concerns urban sustainability, it is important to point out that the decision makers and their agenda of operation is a hugely deciding factor (Bell and Morse, 2008). They identify the decision makers to include;

•Contributors

• Project directors and supervisors

• Reference points for concerned departments

• National and international non-governmental organizations NGOs

• Academics and other non-academic experts

• Representatives from society and community development associations (CDAs)

• External and private collaborative bodies

• Project executioners

• End users.

The surroundings are within the brink of combating mishaps initiated by selections which are not right or misdirection of the endowment by nature. Instead, it'll lead to a coming up with predetermined and a precondition for any activity in the region. As a result of this, enhancing property cities or property urban settlements will serve as a deviation away from the purpose of read that urban coming up with actions, which may be for absolutely new city areas or for urban renovation and rebranding, ought to possess the effect of human intervention evaluated with respect to the surroundings in the slightest degree scales: inside, local, regional and world.

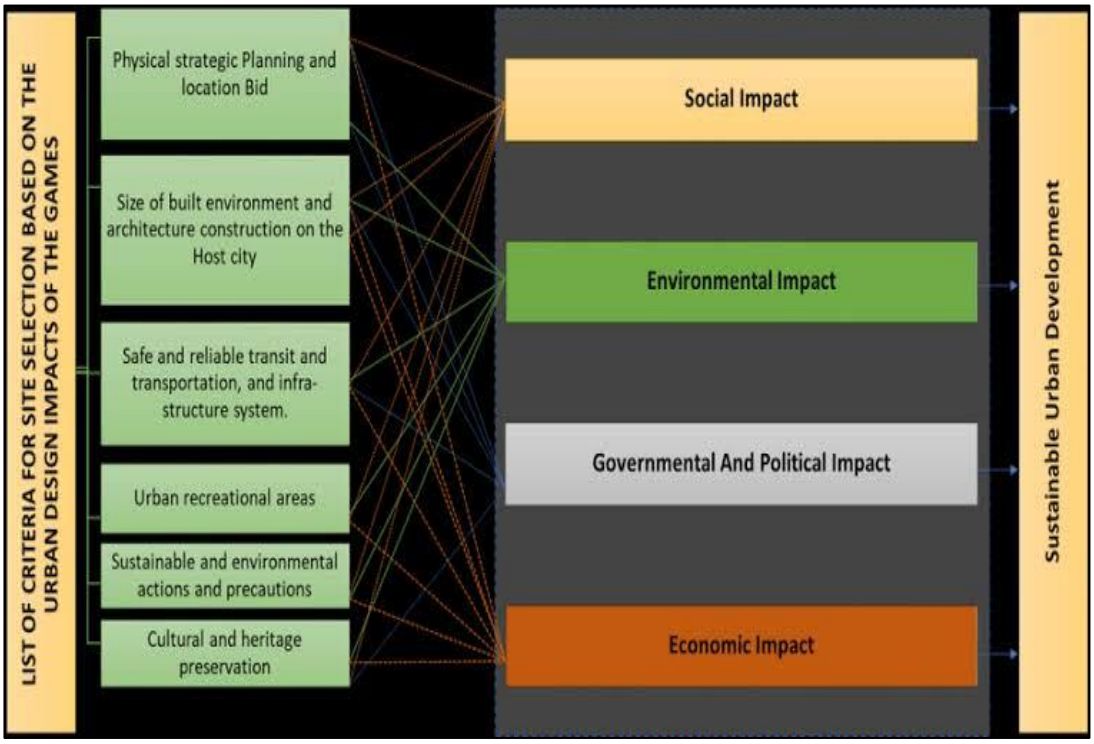

Figure 2.8: Sustainable urban planning indicators (Hanafi *et al*., 2019).

In any urban area, there exist a desire to be wary of the output aspect. Architectural experts, have always specialize in the city entity with surroundings in its close proximity like the road or the sq., and ignore in most times the relevance of the environment to their choices away from the sq. or the plot. there's an absence of awareness concerning the effects of the choices taken at the native level on the world surroundings via the alternatives relating to the energy usage. An analogous state of affairs happens within the perspective of urban planners. The latter square measure referred to as to subsume a good range of determining

factors or knowledge that sometimes isn't figured out for usage and adoption by the urban designing field of expertise

2.5.2 Sustainable housing indicators

Of the varying objectives of the components of sustainable development in social, economic, cultural, institutional and environmental, sustainable housing still represents a major component which serve as an indicator when scaling the extent of development that is witnessed in a country.

Nations all over the world have arrived at different types of indicators which are being presented through series of literature, publications and conferences. The methodology through which these indicators are measured is a vital issue of increasing priority. Precise data on the housing status of a nation may not be readily available with regards some settlements. This still remains one of the limiting factors when the indicators of sustainable housing are to be identified with the components of sustainable development. However, the closely knitted nature of the housing sector with the areas of sustainable development as it concerns aiming to better the livelihood of people as the initial step in improving their essence of existence for stability and a safe and healthy environment with sharp focuses has made it imperative for planners and urban designers an advocate of it correct implementation.

When properly managed and implemented, sustainable housing can make the establishment of good quality housing at affordable costs available both for the present time and subsequent period. Therefore, sustainable housing targets economic, social and environmental sustainability from strategizing to execution. The most salient characteristics of sustainable development are

i. Assisting the less privileged.
ii. The concept of cost-efficient and management, that suggests such growth promoting effort shouldn't cause backwardness in the quality of the environment nor ought to it at a similar time scale back production activities within the future.
iii. Sickness management problems, food security, portable good water and shelter for everyone.

iv. Societal engagement.

Therefore, so as to be property, housing initiatives should be economically, socially acceptable, affordable, technologically possible and environmentally friendly.

2.5.3 Sustainable neighbourhood indicators

Sustainable neighbourhood indicators do encompass several important factors within the environmental, social stratification, economic, health and good livelihood. It can also be stated that the sustainable indicators help to evaluate some of the most important values in life. As a form of illustration, these features covers issues relating to the extent to which the atmosphere is contaminated by pollutants, the rate of usage of manmade resources and the renewal or recycling processes involved an so on. Keeping proper monitoring evaluation in the social environment may have to do with the willingness of people to participate in growth and developmental activities within communities and the availability of affordable housing units. These 2 factors can have a positive changes in the economy (Bristol Accord, 2015). The shift is however not limited to this as it eats into other forma of indicators like, level of unemployment and business initiation. Indexes calculates the progress of efforts in line with the sustainability of urban areas and also pinpoint the region that need urgent attention (MacLaren, 2016).

According to Sharifi, 2003 and Li et al., 2008, the work of different planners and writers alike has revealed in past publications that a good Neighborhood Sustainability Assessment (NSA) must have the following features;

(a) Sustainability width: observing the prominent token points of NSA as regards their delivery which is to be monitored and determined comprehensively in an integrated fashion

(b) Laying of approximate basis: establishing standards to ensure some degree of functionality

(c) Adaptation to settlement: putting the goals and objectives of the theme on the front burner

(d) Grading: scoring methodology for grading and weighing different indicators

(e) Involvement: strategies to ensure the participation of different stakeholders along the initial stages of execution

(f) Submission of outcomes: presenting of evaluation outcomes in a format that is easily handled and utilized by decision makers and stakeholders.

(g) Application of stakeholders decisions making.

There exist 3 stages of indicators which are employed in Neighborhood Sustainability Assessment tools, the include individual indicators, thematic indicators and composite indicators (Li *et al*., 2008). The individual indicators refer to the the stage where data are gatherers with regards to any possible criteria which may find its way into the coalition of pressing concerns of an area. Thematic indicators on the other hand are those token points are categorised around major issues of sustainability while composite indicators are arrived at when thematic indicators are compiled into a synthetic index, and presented as a single composite measure.

It is important to adopt a top-down and ground-up approach when developing sustainability indicators *i.e* both the methodology that encourage decisions influenced by experts by through the government and that with is influenced by the people that will serve as the major beneficiaries of any improvement project.

It is essential for the individuals in a nation to be involved in any issue of development when it concerns Neighborhood Sustainability Assessment and their involvement can be at 3 different levels. The initial stage is when the sustainability target and goals i.e indicators are been identified and earmarked. The mid stage of their engagement is during the careful consideration of the identified points. Arriving at a a set of particular indicators to be employed in a collective and community-based manner will ensure improvement to the general evaluation process. The final stage of citizens participation is that which will ensure that adequate feedbacks are provided to planners and decision makers (Sharifi, 2013).

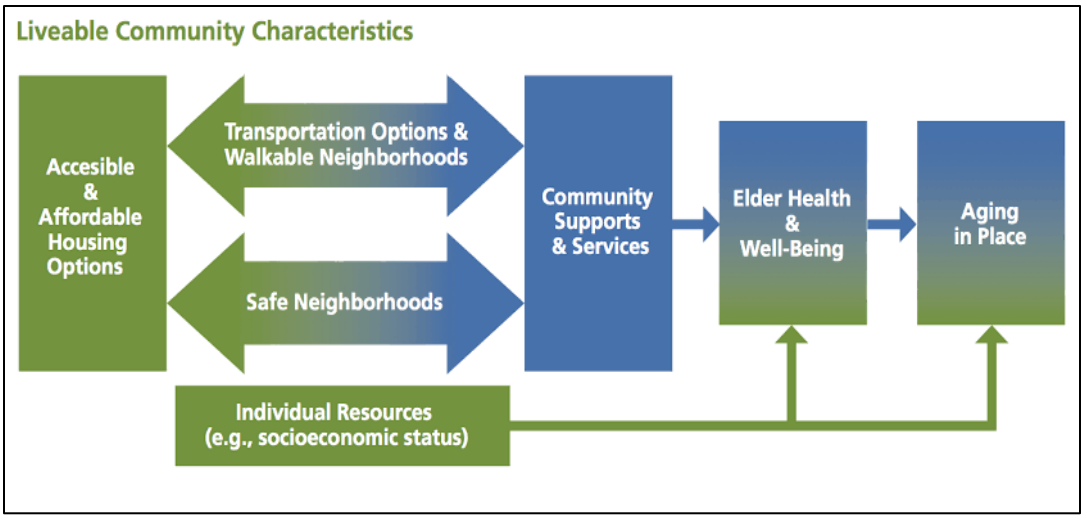

Figure 2.10: Sustainable neighbourhood indicators (https://longevity.stanford.edu/indicators-for-successful-aging-in-place)

The recognized features cover necessary dimensions of a portion to judge its relevant situation and growth. So, these features should be made in a way that allows the community, stakeholders and residents to have access to it. the decision-makers, and therefore the residents (Bossel, 2009). Indicator information are often created in simple clear languages and formats for good readability and understanding, like graphs, barcharts and pictogram. This information indicates the native scenario and trends by avoiding excessively technical language and analyses. the event of those indicators will encourage the active involvement of voters, regional teams, higher institutions, and regime parasterters in making certain the property of their neighbourhoods. These indicators conjointly orient the people that reside in an area regarding the environmental, social, and economic problems related to their settlement several research woks exist on city property in numerous countries and as a result arrive at many features to search out an equilibrum across the economic, social, and environment factors of those nations. The determinants are thereafter juxtaposed around many nations, as well as African country. However, the property of towns, cities or residency neighbourhoods in African country had gained restricted analysis attention.

The inclusion of property principles in property neighbourhood style has been established important as a result of most of the problems that ar visaged by cities ar accumulative as a

result of poor coming up with the smaller category. A neighbourhood-based evaluation will facilitate and ensure economical and property native inexperienced amenities, like built structures, transport means and channels, city, and water network (i.e., tap water, waste-water, and rainwater (Engel–Yan, 2015).

The principles of property development will notice a property neighbourhood style that's characterised by a balance among its environmental, social, and economic factors (Churchill and Baetz, 2009).

The relationship between engineers and building experts in property neighbourhood style is additionally necessary as a result of which they are meant to form a localized amenities processes and a well-planned city style. Although, the dearth of property neighbourhood features should be initially profer solution to addressed within the style and coming up with methoologies as a result of this limiting factor influence a big coverage of land that give prime access from and at intervals the neighbourhood likewise because the major selections on the problems at intervals the neighbourhood (Engel–Yan, 2015).

The development of property neighbourhoods in African country should be tracked by the country wide policy on setting, that preaches for a clean, healthy, and productive setting for gift and future generations. {the planning|the style|the look} and planning stages should contemplate all necessary property neighbourhood parts within the design to initiate the execution of sure neighbourhood features (National Policy on setting, 2001).

CHAPTER 3
EXAMINING SUSTAINABILITY ASSESSMENT TOOLS

3.1 Sustainability assessment tools

Urban settlements are culprits in major environmental issues which have their sour es in the built society including a surge in energy usage, global warming and ozone layer depletion, higher volume of waste generation and the eroding of historical and cultural heritage. Data generated by the United Nations (2011) revealed that average of the world demographic number reside in the urban areas and due to the rapid rate of evolution that is been experienced in these parts of the world, the number is subjected to an upward rise of 1.85% (CIA, 2013) and as a result, sustainability is bound to be a persistent issue for time to come.

If a good level of sustainability has to be achieved in the cities, a sort of equilibrium has to be established between urban growth development, protecting the environment and the particular clamor of the people and this include basic health and transportation facilities, essential amenities, improved employment status, good homes and other social needs (Hiremath *et al.,* 2013; Aschkenazi *et al.,* 2012). In relation to the built environment, architectural contribution towards achieving a sustainable state will involve levels of buildings, neighborhoods and urban settlements.

Neighborhood can be referred to as parts and portions of urban settlements that possess its specific modality for architecture, culture and the economy (Vercseg, 1992). The inhabitants are not proliferated beyond this environment and in most cases, they share similar ideology as a way of life and existence (Berg and Nylander, 1997). When the sustainability of a neighborhood is to be improved, a thorough synchronization between different factors and their building elements like the built environment general openings and basic amenities (Mattarozzi and Antonini, 2011), establishing a code of conduct (Luederitz et al., 2013) and their operation in tandem is essential.

The latest part of the 20th century ushered in an era of acceptance and incorporation of sustainability through building sustainability assessment systems into the building and construction industry with the fact being that their existence has spread across the whole

wide globe. Despite the key cog which a neighborhood represents in an urban area (Choguill, 2008), the tools with which the neighborhoods are assessed are just gaining a broad attention (Kiss, 2012). Therefore, in light of this, it is of paramount importance to subject the existing neighborhood assessment system to adequate evaluation so as to identify their strong and weak points and device ways to make them better.

Despite the vast shift of focus to assessment and certification of neighborhoods, in the past years, their still exist not much research work carried out in the area of the already existing neighborhood sustainability assessment tools, although notable work are common around those seals with its form, approach of usage, effectiveness when casted in view (Garde, 2009).

Numerous researches have been carried out on the methods of sustainability assessment of different neighborhood for different forms of buildings around the world. The initiative to prioritize the need for buildings to be in the best possible condition based on some set criteria was first identified and fronted by governments (Shen et al., 2011). Not until now that private and independent building contractors and developers have also begin to fully recognise the importance of sustainability assessment systems. The impact of sustainability assessment systems as a major tool in achieving environmental sustainability in the way of providing data which will be valuable to policy makers and decision takers (Aschkenazi et al., 2012) and directly influence policy making through the provision of grants and aids (Langdon, 2007). Decisions on which of the sustainability assessment systems to be taken should best be based on which is not market driven but instead most sustainable and erstwhile best cost management way out for urban growth and development (Garde, 2009).

3.2 Overview of Sustainable Housing Rating Schemes

A neighborhood sustainability assessment system is an organized criterion for evaluating the output posted by a particular settlement on a present benchmark (Sharifi and Murayama, 2012). Over time, there have been a lots of assessment systems designed by environmentalists. With respect to what they each address, they can be grouped into two namely; the decision making assessment tools including HQE2R; Ecocity; SCR; EcoDistricts; SPeAR; One Planet Living; Cascadia Scorecard; EcoDistricts Performance and Assessment Toolkit and those systems that are generated from present methods of

assessment which includes LEED/ND; ECC; BREEAM branches; CASBEE; Qatar Sustainability Assessment System; (QSAS) Neighborhoods; Green Star Communities; Green Mark for Districts and Green Neighborhood Index (GNI). For the peculiarity of this study, our focus is on selected five (5) relevant tools.

Assessment systems are usually created by non-governmental institutions with the aim of arriving at environment-sensitive system which are in line with players of the market. This is achieved without hindering the freedom of architectural design, putting a check on the effects of development in the society and establishing a sustainable, moral-conscious society among others (BREEAM Communities, 2012; LEED, 2009).

For the purpose of this study, four certification schemes, CASBEE whose origin is Japan; the 2009 and 2012 versions of the BREEAM Communities from the UK; LEED-ND from USGBC, and DGNB-UD developed in Germany, are those that were chosen depending on how accessible important information on them were, the level of acceptance and adoption around the globe and their popularity.

When defined, it is usually made clear that any action, process or system must duly involve the 3 important components that sums up to stainability. These are the social, economic and environmental components. While any indicator which is in use or thought be designed may clover or consider just 2 of the dimensions listed above, the very one which is considered to be comprehensive is that which duly involve the 3 dimensions (Tanguay et al., 2009). With respect to the analysis of these sustainability features supported, the appliance of this idea, the study makes an attempt to prove answers, however the system indicators perform in mensuration property.

3.2.1 Building Research Establishment Environmental Assessment Method (BREEAM)

History and Overview

BREEAM has been around for a while and happens to be the first rating method for the sustainability of the building structures established by the Building Research Establishment (BRE) in the United Kingdom. Having been subjected to various test runs before being made available for use in 1990s, it was originally suited for offices and residential

structures. However, its usage has been more encompassing and been adapted to defect forms of structures around the world.

Certification Schemes

With respect to the United Kingdom where the BREEAM originates, the schemes vary when the form of building to be rated is considered.

Nonresidential buildings (BREEAM);

1. Offices
2. Retail
3. Industrial production plants & ware houses
4. Educational (schooling places)
5. Healthcare centers
6. Courts
7. Prisons
8. Labs, hotel centers, restaurants and lounges and any other buildings that are not covered by the forms listed above
9. Residential buildings
10. EcoHomes
11. EcoHomes XB
12. Rating symbols sustainable buildings (new single-family houses and building structures in England)
13. Multi student residential buildings
14. Domestic Renovation of existing buildings
15. International for built structures beyond the United Kingdon. These includes;

Assessment Criteria

The 2011 version of BREEAM is an upgraded version of the 2008 edition with significant modifications and adaptation to the prevailing needs of buildings and environments. There are ten (10) major sections under which buildings are scored during evaluation and in other for the performance of buildings to scale the assessment, a minimum level of standard has to be met. The said ten (10) sectors are:

- Ene (Energy)
- Mat (Materials)
- Inn (Innovation)
- Wst (Waste)
- Pol (Pollution)
- Hea (Health & well-being)
- Wat (Water)
- Tra (Transport)
- (Man) Management
- LE (Land Use and Ecology)

Certification Process

There are certain professionals that are engaged in BREEAM schemes called assessors. They are trained and well-educated set of people whose work is to subjected buildings to grading with the guide and protocols of BREEAM, putting together a comprehensive report and submitting such outcome to the Building Research Establishment (BRE). They ensure that a built structure has met and is able to maintain a certain level of standard in quality along the line of being certified. They work in tandem with other construction team to be able to successfully arrive at their goal.

Calculation Methods

When scoring or assessing a building using the BREEAM system, it is important to follow the procedure as duly prescribed. It should always begin with the evaluation based on some criteria for which no score is awarded before proceeding to the creditable once. It is however important to note that if a building or structure falls short of any standard for a no creditable criteria, then a zero rating will be awarded irrespective of the score attained in the creditable factors.

All class included, the amount of point scored will be split by the overall offered, increased by the class-weighing issue to relinquish a decimal form of scoring for that particular level. This range ought to be rounded all the way to 2 figures after the decimal point prior to any progressive step. The weight factors depict the influence offered by every class to the

overall score identified with and rewarded by the certification scheme. it's necessary to notice that weightings exist in the class category but not for individual factors to avoid estimation mistakes.

The rounded decimal point scores for every class square measure and added to make the overall share point's score obtained by a structure. the overall decimal point score should be rounded all the way down to the closest integer. The property category is hence to be arrived at from the overall share points the table. For each sector, the score amassed is divided by the possible attainable score then times the category-weighting factor which gives the percentage point score for the category.

3.2.2 LEADERSHIP IN ENERGY AND ENVIRONMENTAL DESIGN (LEED)

History and Overview

LEED is another building certification scheme which was created by USGBC (U.S. Green Building Council) in the late 1990s. This system was created based on the need for a method of assessment that can in addition to the estimation of the sustainability of a building can also compare the sustainability of buildings of different forms and functionality. The sum of the creation of the LEED assessment tool for buildings is ensure that first-hand information is available to developers, owners and operators which will aid their decision making when tackling challenges that may arise from building and construction instances.

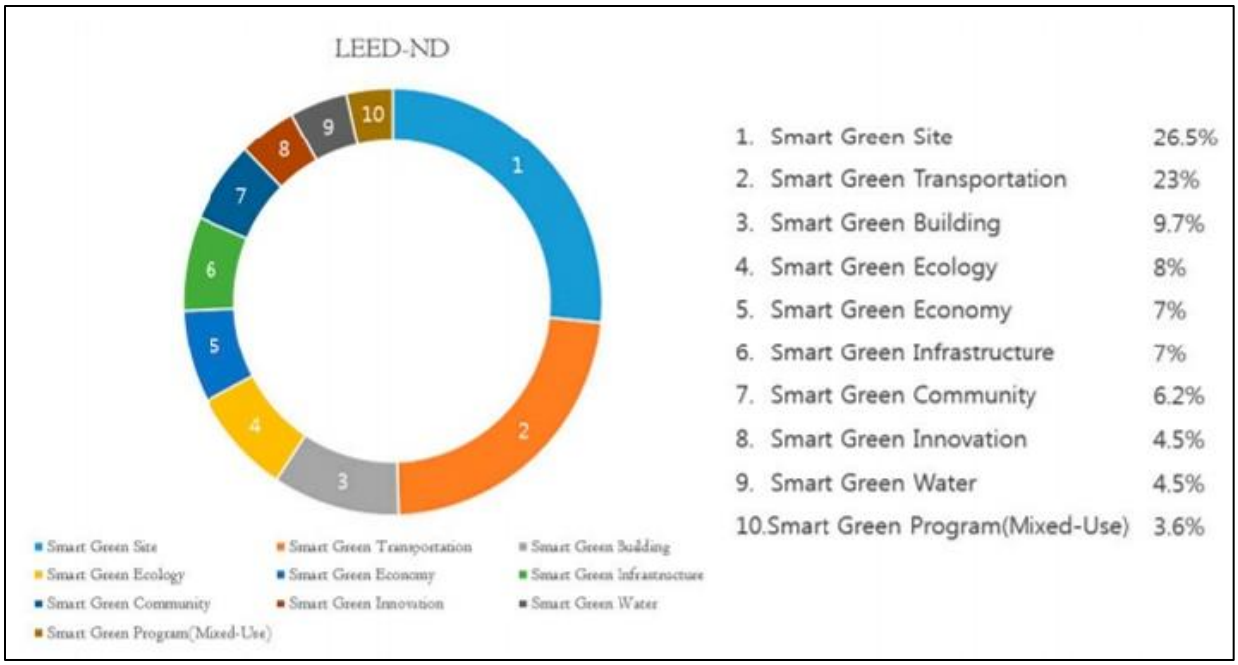

Figure 3.1: Statistical Table of LEED-NDs Overall Points Allocation to Smart Green Criteria.

The LEED rating system has had its fair share of coverage and its adoption is spreading to different parts of the world albeit with different countries modifying it to meet certain requirements and criteria. These includes;

1. India
2. Italy
3. Canada

Assessment Criteria

The LEED system of building certification as a sustainability assessment tool is system whereby points are allocated to each criterion in which an evaluation is based. The system is designed in such a way that there are 7 major sections that houses 43 factors altogether. The seven (7) major divisions including;

1. (EA) Energy & Atmosphere
2. (WE) Water Efficiency
3. (SS) Sustainable-Sites
4. (MR) Materials & Resources

5. (IEQ) Indoor/Environment Quality
6. (ID) Innovation and Design
7. (RP) Regional Priority

Certification Process

The way in which the certification process is performed with this method of assessment LEED, is similar to that of BREEAM. Assessment officials which have been professionally trained and equipped with necessary knowhow are discharged by the GBCI (Green Building Certification Institutes) to score the performance of buildings with the collected information sent back to the institution in charge for evaluation and decision making.

Initially, the USGBC (U.S. Green Building Council) a government agency, is the only one tasked with the certification of buildings with the LEED system of rating, but since the beginning of 2008, a support non-profit organization has extended a collaborative arm and is now responsible for the developing the rating system to educating, examinations and issuing the certificates.

Calculation Methods

To award marks for this certification scheme, it is usually done via the use of a check list that provides the planning teams a large differing form of technology to think about victimization.

With respect to LEED, a multiplying process almost like BREEAM and grades are ditched out in retrospect. add of all grades in all classes are achievable overall points. The all-performances levels consistent with the quantity of grades gathered shows the amount of property.

3.2.3 THE COMPREHENSIVE ASSESSMENT SYSTEM FOR BUILT ENVIRONMENT EFFICIENCY (CASBEE)

History and overview

The-Comprehensive-Assessment-System-for-Building-Environmental-Efficiency (CASBEE) is a certification scheme initiated by the Japanese Ministry of Lands, Infrastructures and Transportation which was launched in 2001. Till this present moment,

so much criteria have been utilized when it comes to CASBEE in evaluating diverse forms of buildings and structures.

Building Lifecycle and CASBEE-Family

CASBEE Family is the collective name for the four criteria for evaluation and they are basically arrived at to estimate the performance of lone buildings. The Comprehensive Assessment System for Building Environmental Efficiency (CASBEE) has 4 essential criteria for evaluation that includes;

CASBEE for Pre-design (CASBEE-PD) comes to play in the stages that proceeds the construction of a building. It is used for arriving at appropriate decisions when considering the impact of different activities in erection of structures.

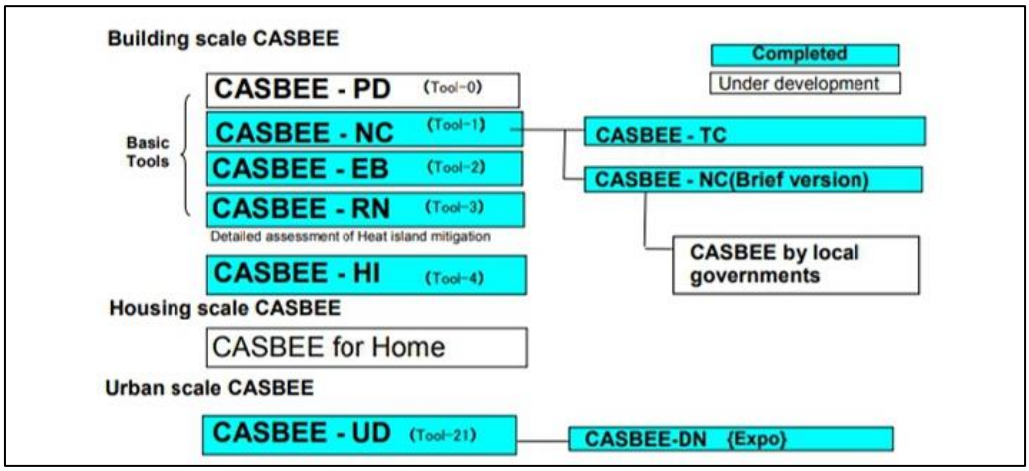

Figure 3.2: Scope of CASBEE-Family

CASBEE for New Construction (CASBEE-NC) is an essential tool used by professionals in architecture and engineering for making assessments pertaining to the design specifications and the anticipated performance. The validity of a CASBEE-NC only extends to about three (3) after a building is completed.

CASBEE for Existing Buildings (CASBEE-EB) is in place to assess the performance level of structures which have been built not earlier than one (1) year post completion. This tool after been awarded is valid across a five (5) period and as such can be used by decision makers in buildings maintenance for self-evaluation of individual structures and subsequent outcomes.

CASBEE for Renovation (CASBEE-RN) is developed frontage evaluation of the statuses of existing buildings with respect to renovator and upgrade works going on therein. The validity last up to three (3) years after the renovation of a building is completed. It can be used to measure the level of upgrade and transformation which is experienced by a building with respect to its previous state.

These classes of grades is applicable to wide range of buildings, residential and non-residential including office, school or educational centers, retail store, lounges, halls, health center, hotel/motel and residential buildings.

Certification schemes

Taking Japan for example, local governments there happen to be different level of reception to the adoption and implementation of the assessment procedure for evaluating buildings. The standard of buildings are now been raised as settlements in the country have resorted to the use of "Sustainable building reporting systems" to be a key cog of building management as an environment based issue. For these to be an achievable goal, environment performance assessment methods have to be well utilized.

In and beyond Japan, countries have selected the CASBEE performance evaluation procedure as a suitable assessment tool. The administrative heads of buildings are required to subject their newly erected structures to performance tests. The outcome of the evaluation process is reported to the relevant authority which will be published along with effort posted by those that possess such buildings to ensure environment sustainability. This rating method has been crafted to absit such people in proper decision making to ensure the buildings that are arrived at are environmentally sustainable.

Assessment Criteria

The tool measures the sustainability of cities across the following criteria:

– Nature conservation

– Local environment quality

– Resource recycling

– CO2 sinks

– Living environment

– Social services
– Social, industrial & financial vitality
– Emission trading

Certification process

The possible ratings in which a building can be awarded depending on the environmental assessment tool and criteria used can be; Superior (S), Very Good (A), Good (B+), Fairly Poor (B-) and Poor (C). Together with the use of a performance assessment procedure being a suitable way for architectural structures to be certified, the use of a tool like CASBEE can be helpful when determining the state which different cities and settlement are in and how they are faring in their strive towards achieving a sustainable environment.

3.2.4 THE GERMAN SUSTAINABLE BUILDING COUNCIL (DGNB)

History and overview

The German Sustainable Building Council (DGNB) is a nonprofit and non-governmental agency in Stuttgart, Germany established in 2007 and tasked with the realization of better standard for residential and non-residential buildings. They ensure that structures that are built are done while being mindful of their state and performance in the future. They're driving goal include promoting dynamism in the construction industry and placing adequate emphasis on the need to appropriately involve quality above anything else when erecting structures as a way of achieving sustainability. Throughout Germany and other parts of the world, the German Sustainable Building Council (DGNB) has now been accepted as a yardstick for ensuring lasting and enriching qualities for buildings.

Certification schemes

The interior and external features of a building are evaluated in accordance to the laying principles and well laid criteria which are contained in construction, buildings and sustainability practices. The agency has aided its course by putting in place strategies which will assist it in its pursuit including;

The establishment of a learning institution which will equip people with the necessary knowledge of how to understand the requirements of arriving at a sustainable structure.

The creation of an online navigator which is an avenue for obtaining the breakdown of the building products that are certified to be sustainable.

The organization is also continually involved in research practices so as to keep track of the challenges encountered by sustainability in the construction industry and ways to ensure progression.

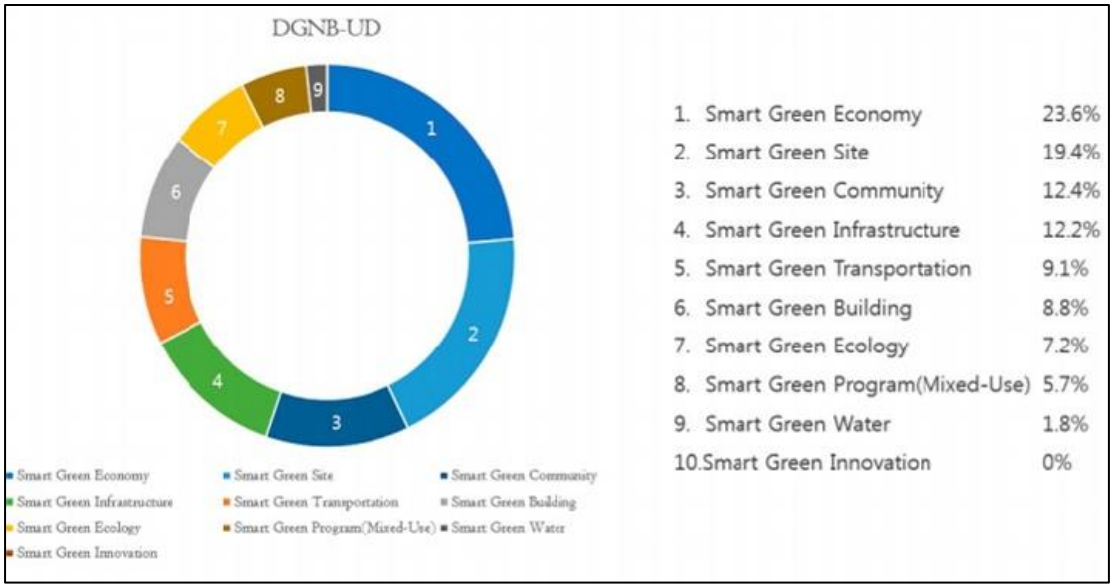

Figure 3.3: Statistical Table of LEED-ND's Overall Points Allocation to Smart Green Criteria.

The encompassing characteristic of the German Sustainable Building Council (DGNB) is based primarily on sustainability practices which includes all its environmental, economic and sociocultural factors components. As a consequence, for the DGNB sustainability is synonymous with quality and future viability.

Assessment criteria

The structure which is been evaluated should cater for certain requirements beforehand so as to be awarded a CSC certificate. Prerequisites (all credits starting with an 'P'), no point can be achieved

The structure that is been evaluated can be scored with respect to some of the divisions listed below;

- Management-(every score beginning with a'M')

- Environmental (every score beginning with an ‘E’)
- Social (every score beginning with a ‘S’)
- Economics (every score beginning with a ‘B’)
- Chain of custody (every score beginning with a ‘C’)

Certification process

The CASBEE rating method targets the point to ensure continual betterment of what is already available on ground which may even reach the point of securing concretes. The system has 4 categories of certifications, to ensure regular striving to reach the next advancement level.

- Bronze
- Silver
- Gold
- Platinum [the Platinum level will be made achievable at a later point in time]

Comparison between the Four Existing Tools of Sustainability Assessment

The features of the four certification schemes which have been discussed in detail are put into a similar perspective which are presented thus;

Table 3.1**:** Comparison between the four existing tools

s/n	Property	BREEAM	LEED	CASBEE	DGNB
1	Origin	United Kingdom	United States of America	Japan	Germany
		1990s	1998	2001	2007
2	Target buildings	New building, extension, existing building, major	New building, extension, existing building, major renovations shell and core.	New building, existing building, renovations.	New building, extension, existing building, major

		renovations shell and core.			renovations In-Use.
3	Rating system	Comparative label	Comparative label	Endorsement label	Comparative label
4	Scoring	Unclassified, passable, good, very good, excellent, outstanding	Certified, silver, gold, platinum	Passable, very good, excellent, exceptional	Bronze, silver, gold

3.3 Green Building Assessment Tools in Asia

Energy building codes set the minimum efficiency requirements for new and renovated buildings in order to guarantee a reduction in energy consumption and GHG emissions along the buildings' life cycle. By ensuring that information on energy consumption is taken into account during the stage of design of a building, energy codes represent a significant opportunity for savings during the building's operation. The development and implementation of energy building codes in different Asian countries is taking place at a different pace. Mongolia for example has not established its own energy code yet. In China, in turn, the codes have been through many revisions and address different kinds of buildings for different climatic zones. In countries such as Thailand and India only some parts of the buildings are covered by a building code.
The compliance and enforcement mechanisms vary across the selected countries, with codes being mandatory for all urban residential and public buildings in China whereas in Thailand and Malaysia restrictions are established depending on the type of buildings or area. Table 1 presents information on energy building codes in the selected countries.

Green building certification systems are tools applied for assessing and recognizing buildings that achieve certain green requirements and standards. Rating and certification

systems may vary in their approach and are designed to meet the local demands. These systems can be applied to different stages of the building value chain, as well as to different building types, with a specific set of tools being employed in the evaluation of each type of construction. Rating systems offer different levels of certification that can be reached by a project, which signify how many prerequisites and requirements it fulfils. The highest levels of certification require incorporating new and innovative technologies to the project, encouraging developers to invest in these features and stimulating the market for green buildings. Many green building programmers and rating systems have been developed in Asia in the last decade.

Projects with Building Research Establishment Environmental Assessment Method (BREEAM)

The BREEAM system of housing certification is extremely unpopular in the Asian part of the world. The tendencies not to adopt this system as comprehensive and widely accepted as it is and the probability of not engaging it is deep rooted in various sectors of the economy. The government of some countries holds the sole responsibility of instituting and recommending the housing certification schemes that is in play in their nation. The fault however falls on the laps non-functioning of some so called government agencies. Other reasons are also in place but in essence, the situation is not easy to turn around has the scales of obstacles to surmount are enormous.

Projects with Leadership in Energy and Environmental Design (*LEED)*

Discussed below are some of the nations in Asia that adopt the LEED housing certification scheme to some degrees, fully or partially;

- ***Laos***

The factors that are in play for the 2030 agenda are;

No specific targets for the building sector.

- Laos is very climate-vulnerable and should desperately take steps to create resilience by enhancing adaptation efforts.

- Flood's area unit a serious risk with adverse impacts on housing, inflicting damages to property and infrastructure.

There is no energy code in situ in Laos.

The National Energy Potency Policy from 2016 targets the reduction of total final energy consumption by around one-hundredth annually, compared to BAU.

The sole LEED certified building within the country is that the Embassy of the U. S. The country conjointly doesn't have any comes that area unit BREEAM certified.

Table 3.2: Features of the assessment scheme in Laos

Structure	Certification Scheme	Aims	Challenges
Laos	Embassy of the U. S	i) No specific targets for the building sector.	i) Lack of legislation and policy environment for housing development and energy efficient/green buildings.
		ii) Laos is highly climate	ii) Laos is a net importer of construction materials.
		iii) Vulnerable and must urgently take steps to build resilience by enhancing adaptation efforts.	iii) Limited governmental budget and lack of capacities regarding sustainable housing.
		iv) Floods are a major risk with adverse impacts on housing, causing damages to property and infrastructure	

The majority of the population lives in rural areas.

- National Shelter Strategy (1991): didn't end in specific actions, laws or budgets for housing. Recommendations concern largely land use and accessibility, infrastructure and building materials.

- No formal mortgage marketplace for personal or business housing finance. Country is very prone to climate hazards, above all floods and droughts, Lack of legislation and policy setting for development and energy efficient/green buildings, Laos could be a web businessperson of construction materials, restricted governmental budget and lack of capacities relating to property housing.

- ***Uzbekistan***

The factors that are in play for the 2030 agenda are;

The housing systems in the country is highly susceptible to climate change

The adaptation to ensuing housing conditions in topmost in the country's housing activities.

Sustainable measures are in place for the usage of low carbon gadget and appliances and also to establish measures that reduce emissions from key sectors, including housing, thermal energy and utilities.

Energy efficiency building standards were initially introduced to the market in 1997, albeit with little compliance and adoption as a result of nature of the construction market with the low publicity involved also playing against its success. The energy codes are made compulsory for residential and non-residential existing and new construction, and also addresses important factors which include heating, cooling, hot water, lighting and ventilation. Uzbekistan uses the international LEED certification scheme on a single building with no national green building rating system of its own in place and there is no BREEAM certified buildings.

The provision of affordable housing does not satisfy the demand in large cities and the contribution of the public sector to the supply remains very low. Almost all investments in housing are undertaken through private funds.

Table 3.3: Features of the assessment scheme in Uzbekistan

Structure	Certification Scheme	Aims	Challenges
Uzbekistan	A single building	ii) The adaptation to ensuing housing conditions in topmost	ii) High rates of home ownership.

	in the country's housing activities. iii) Sustainable measures are in place for the usage of low carbon gadget and appliances and also to establish measures that reduce emissions from key sectors, including housing, thermal energy and utilities.	iii) Affordable housing provision remains a challenge due to the increasing urbanisation process.

The available housing provisions made in the country is generally- The government prioritizes rural development and rural housing provision as a long-term strategy, aiming at increasing quality of life in rural areas and decreasing rural-urban migration; High rates of home ownership; Housing market is constrained by insufficient financing and lack of government incentives; Affordable housing provision remains a challenge due to the increasing urbanization process; Lack of supply of energy efficient products, materials and technologies and lastly, Lack of data on housing prevents the government from developing targeted policies.

Projects with the Comprehensive Assessment System for Built Environment Efficiency (CASBEE) and the German Sustainable Building Council (DGNB)

As previously stated in the preceding chapters of this thesis, there exist a lot of housing certification schemes all around the world with different ones adopted by in varying countries for diverse reasons and purposes. While there has to be some extent if peculiarity for any scheme to be identified as ideal for any nation, countries even go to the length of tailoring existing ones to their desire or even creating a new scheme altogether. The use of the Comprehensive Assessment System for Built Environment Efficiency (CASBEE) and The German Sustainable Building Council (DGNB) in this case is not predominant and no

literature was found on the documentation of the said schemes in any part of Asia and North America.

Popular Projects with other Certification Schemes in Asia

- ***Bangladesh***

Bangladesh is determined to develop the economy of its nation on a relatively low carbon pathway. Efforts was in place by the government of the country to reduce greenhouse gases emission in the energy and transportation industry by 5% in a broad agenda by 2030. The country is on a path to create a 10-year sustainable consumption and production framework by 2020.

The building code which is in operation in Bangladesh, makes provision for regulations and the least requirements of building forms, size, structure, strength, interior situation, construction material, that are recommended when erecting buildings. Efforts are in place to include energy efficiency requirements for buildings on heat insulation/ ventilation, HVAC, water efficiency and sanitation.

Presently, there is no national green building rating system in Bangladesh, there is however a popular demand for the application of USGBC LEED certification by building developers and engineers, which is signaled by the presence of more than 300 LEED certified structures. BREEAM being another prominent certification scheme with others are absent.

The challenges which are faced by the nation with regards the use and adoption of a reliable building certification scheme include; The government of Bangladesh are lagging behind in the provision of necessary housing facilities yo the citizens with only 7% of the nation's requirement usually being met. This has made the burden fall exclusively on the private sector to fill the gap; Corruption in Bangladesh has also eaten deep in these sectors that are responsible for policy creation and implementation. Another issue is the fact that going about registration and enrollment is usually not without its complications.

Table 3.4: Features of the assessment scheme in Bangladesh

Structure	Certification Scheme	Aims	Challenges

Bangladesh	Popular demand for USGBC LEED	Bangladesh is committed to lifting its economy on a with respect to low carbon footprint.	i) The government of Bangladesh are lagging behind in the provision of necessary housing facilities to the citizens with only 7% of the nation's requirement usually being met. This has made the burden fall exclusively on the private sector to fill the gap.
		The country bent on limiting greenhouse gases emissions in the power, industry and transport sectors by 5% scenario by 2030. Bangladesh aims to develop a 10-year sustainable consumption and production framework by 2020.	ii) Corruption in Bangladesh has also eaten deep in these sectors that are responsible for policy creation and implementation. iii) Another issue is the fact that going about registration and enrollment is usually not without its complications

- ***Indonesia***

The factors that are in play for the 2030 agenda are; - No specific targets for the building sector.

- Priority mitigation areas: land use change, energy conservation, renewable energies and waste management.

- Adaptation is an important component of Indonesia's strategy

- Government Regulation 36/2005 mandates new residential and commercial buildings to implement energy conservation measures, according to their area.

- Energy Efficiency & Conservation Standards: cover building envelope, air conditioning system, lighting system and energy auditing.

Through persistent effort, the governing agency tasked with housing related issues, the Green Building Council of Indonesia (GBCI) have arrived at a National green certification scheme called GREENSHIP in the 2011. The scheme considers 5 different forms of certification in its scheme with each having yo meet certain criteria to be accredited. These include; new buildings, existing buildings, interior space, homes and neighborhoods.

Table 3.5: Features of the assessment scheme in Indonesia

Structure	Certification Scheme	Aims	Challenges
Indonesia	GREENSHIP	i) No specific targets for the building sector.	i) The knowledge and technical knowhow relating to green and energy efficient building practices are limited or in some other cases out of reach.
		ii) Priority mitigation areas: land use change, energy conservation, renewable energies and waste management.	iii) Limited possibilities of accessing financial schemes that support green buildings
		iii) Adaptation is an important component of Indonesia's strategy.	

The government agency tasked with managing issues relating to housing through its initiate National Affordable Housing Programmed, has ensured that the accessibility to affordable housing is improved.

Several programmers have also been launched on self-help housing and slum upgrading (7) Another programmed of note in the housing schemes is the Million Homes Programmed which was started in 2014 with the aim to achieving a million houses in each year (8). The knowledge and technical knowhow relating to green and energy efficient building practices

are limited or in some other cases out of reach. There is the general believe among the public that high cost is associated with arriving at a typical green structure and hence the lesser rate of consumer demand for green buildings. Limited possibilities of accessing financial schemes that support green buildings

- ***Philippines***

Department of Energy Guidelines for Energy Conservation of Buildings: key document regarding building energy efficiency. The guidelines cover lighting appliances, electric power and distribution, building envelope, ventilation and air conditioning, among others.

Green Building Rating System

Building for Ecological Responsive Design Excellence (BERDE) (2013): developed as a voluntary rating system and a referral code in the National Building Code. It is applied as a tool to verify and monitor building performance, based on the country existing regulations and standards. (4)

Table 3.6: Features of the assessment scheme in Philippines

Structure	**Certification Scheme**	**Aims**	**Challenges**
Philippines	LOTUS	i) No specific targets on the building sector.	i) Complex institutional coordination for planning, implementation and operation of infrastructure and services.
		ii) Pursuit of mitigation measures is conditioned to financing resources, technology development and capacity building.	ii) Deficient housing development programme and inadequate technical, financial and managerial capacities.
		iii) Public financing will prioritise adaptation to reduce vulnerability	iii) Lack of expertise and capacity in the field of green building.

Urban Development and Housing Act (UDHA) (1992): national vision and guiding principles for housing and urban development sectors.
- Balanced Housing Provision: UDHA requires developers to allocate 20% of project area or project costs for socialized housing.
- National Informal Settlements Upgrading Strategy 2025 (NISUS) (2014): to provide at least one million households living in informal settlements with housing by 2025.

Complex institutional coordination for planning, implementation and operation of infrastructure and services; deficient housing development programmed inadequate technical, financial and managerial capacities; Lack of expertise and capacity in the field of green building.

- ***Vietnam***

The factors that are in play for the 2030 agenda are;

- Energy efficiency and renewable energy applications in the residential building sector are among the mitigation actions.

- Mitigation measures involve also awareness raising, the development of eco-cities, green housing and improvement of energy efficiency.

There exists a compulsory Building code I'm Vietnam called the Vietnam Energy Efficiency Building Code. The implementation of the code began in 2013 and establishes the technical requirements which must be kept to in the erection of buildings, be it new construction or retrofit of civil buildings (commercial, residential and service buildings). The code states that the minimum sizes of buildings should be 25000m2 with requirements for building envelope, ventilation, air conditioning, lighting, etc.

Green Building Rating System

Away from the popular and convectional housing certification schemes in the world, that which is in use in Vietnam is called LOTUS certification. The scheme was introduced in 2010 to serve as an optional rating tool by the Vietnam Green Building Council taking cues

from varying certification schemes around the world. There are criteria for residential, non-residential buildings and also factories.

Table 3.7: Features of the assessment scheme in Vietnam

Structure	Certification Scheme	Aims	Challenges
Vietnam	LOTUS	Rooms are opened to rivers	Masterly planned growth
		Series of architectural connections in the inner balconies	The template of the place has featured that links to nature
		544 apartment rooms	Redesigning of Berlin's modern architecture
			Strong focus on perspectives and sightlines
			Semi-private interior courtyards
			Utilization of native tools and materials

Some of the initiatives by the government of Vietnam on housing schemes include;

The National Housing Development Strategy which was in effect from 2011-2020. This project aims at the construction of up to 100 million m2 of land area yearly.

There is also the housing policy that was initiated in 2015. The government took it up itself again to ensure the provision of residential buildings for its citizens. Subsidies, grants and support was in play for social housing development, such as land use fee exemptions and taxes reductions and exemptions.

The existence of large chains of command in the authority level of the housing industry and no proper channel between them all; Absence of knowledge and knowhow relating to housing certification schemes around the housing projects and lastly, the interest of companies and privates' operators to the green building materials market is not encouraging.

3.4 Green Building Certification Tools in North America

A North Yankee dream for inexperienced resident structure can cause usual method to inexperienced election throughout the 3 North yank nations, either or not or not via the advancement of inexperienced construction activities at the country or native levels, unification of inexperienced construction criteria, and/or encouragement of modification inexperienced housing product and techno inputs. Decisions like this may cause very important environmental, social, and economic rewards for North Yankee nation, Mexico, and additionally the U.S, on a personal basis and put together. the three countries face many of identical social, environmental, and economic issues, considerably with respect to city places similarly as air quality, affordable housing, urban sprawl, aging infrastructure, and rising energy costs. Although, native and governmental institutions have the same aim of properly managing resource, good health and upbeat for voters, and overall economic successes. A North America scope for inexperienced residence areas can further aid the governments in scaling through challenges and encountering the set goals.

As appealing as inexperienced buildings may sound, they presently frame entirely a portion of every recent construction in North America. this is {often|this can be} often due to the varied obstacles already in place that prevents the large-scale utilization of inexperienced housing equally on the huge vary of actors, levels of presidency, and rules involved at intervals the building trade. A North yank vision for inexperienced resident apartment, backed by national and native ways in which, might help in surmounting these obstacles. E.g. a typical foresight will see efficiency in resource and energy utilization, reduced effect, healthy housing as a result of the convectional occurrence instead of the unusual. This machine to fruition via the establishment of a typical group of property principles, accepted inexperienced criteria, and organizing tools for inexperienced build up, with each country having region/context appropriate policies and programs to handle variations in building codes, restrictive environments, and climate. The aforementioned organizing tools are to be used for the improvement in the quality of life and equate environmental, economic, and social problems.

Thus, when a foresight, policies, criteria and tools, square measure needed a united effort providing there are unit presently no inexperienced construction activities, tech advancements, building codes, or building performance criteria prevalent in North Yankee nation, Mexico, and additionally the U.S. Practices, technologies, restrictive desires, and performance benchmark usually differ from one nation to another. As a matter of illustration, in North Yankee nation and additionally the U. S, building codes disagree from region to region and settlement to settlement, sometimes fascinating inexperienced housing practices like airtight construction to boot} suitable to dried areas but area unit almost impossible in rain forests because of the problem associated with much moisture in the air within a structural interior space. As well, identical inexperienced building performance customary may have fully totally different desires in many law binding regions or be applicable entirely in sure locations.

The designed inexperienced customary, e.g., is acceptable entirely in Canadian province and state and insure America states. In Canada, the R 2000 national customary for energy-efficient homes, is true for tract environments, but is also problematic in wet areas. The Leadership in Energy and Environmental vogue (LEED) performance customary, the' documented in the America and North Yankee nation, presently applies entirely to several units' residential apartments and is as a result peculiar entirely in modern areas. Additionally, performance metrics and certification desires disagree for all inexperienced building standards, and interesting inexperienced attributes and technologies differs enough from area to area. A North yank foresight might encourage the use of popular, quality inexperienced building standards that area unit acceptable to a ramification of North yank restrictive environments and climates.

One of the aims of NAFTA is to push trading and unification of sustainable environment protocols all over North America. Modification inexperienced housing techs, though, however, is presently restricted. This may be as a result of requisite examination and analysis duties for accepting materials in many arms of regions is also robust and high-priced. Moreover, check standards do not appear to be uniform across borders, as technology objectives disagree from place to position.

Further, inflated benchmarks throughout North America might prevent bad or fake housing construction product coming from drop, then used, at intervals the market of another. The unification of material certification benchmarks and also the addition of environment goals should ensure and promote higher quality and extra environmentally friendly construction materials and methods within each country and trade of upper product across borders.

At the construction stage, inexperienced apartments are primed to come back up with such economic, environmental, and social rewards as: reduced energy and water pay; reduced impact on the environment; sound interior air quality, improved comfortability for occupants, reduced cost of maintenance and Improved market patronage and promoting value. A North Yankee inhabiting inexperienced housing vision enhancing inexperienced building activities joined to wise development polices and organizational tools might change urbanization ways, and as a result limiting environmental effects and resources necessity, and tributary to the establishment of a lot of inhabitable and property communities.

3.5 Certification Tools in Middle East

As there are numerous building and construction assessment schemes that exist all over the world, there are different ones that are peculiar to varying continents and the countries therein. As far as the Middle East goes, the respective features of these certification standards are listed below;

- *Bahrain - Bahrain Standards & Metrology Directorate (BSMD)*
- *India - Saso Certification*
- *Oman - Directorate General for Specifications and Measurements (DGSM)*
- *Qatar - Qatar General Organization for Standardization (QS)*
- *Kuwait - Kuwait Standards and Industrial Services Affairs (KOWSMD)*
- *Gulf Nations - Gulf Standardization Organization (GSO)*
- *Gulf Conformity Marking (G-mark)*

CHAPTER 4
INTERNATIONAL CASES OF CERTIFIED SCHEMES

A theoretical study was adopted for this research and made into the context of existing certification schemes that already exist all over the world as a way of providing link between these schemes and the current state of urban planning and design in developing nations. As such, an extensive finding was made into the peculiarities of the major certification schemes identified in BREEAM; LEED; CASBEE and DGNB.

Having considered the acceptance and usage of these schemes in countries majorly in the North America, Asia and Middle East in the previous chapter, the main focus of this chapter centers on some prominent buildings in Europe, their structural features and the detailed information that surrounds their construction and implementation. The structures considered include;

- The Netherlands - De Landtong
- Austria - Dieselgasse Residential Development
- United Kingdom - Greenwich Millennium Village
- Spain - Fort Pienc Housing
- Denmark - Gemini Residence
- Germany - Berlin Wasserstadt
- Belgium - Pandreitje housing
- Finland - Kannelniitty
- Portugal - Housing in Chiado
- France - Montreuil Social Housing

4.1 Certified Schemes in Europe

Most of the buildings where in people reside within Europe are without certification. It then becomes obvious that limited number of nations in Europe are yet to possess or adopt a sustainable housing certification scheme. There exist some of these schemes in the well-advanced countries like United Kingdom, France and Sweden. However, outside these few nations, insubstantial backings are found of other voluntary schemes. What can be found

are Energy Performance Certificates (EPC's) which governmental and private owned users rely on. Countries that are yet to have a building certification scheme with which they rate their structures use the schemes which exist and that are of international standards. Examples of these schemes include; BREEAM, LEED, CASBEE, DNGB and many more. However, these international schemes, such as LEED and BREEAM, are used to a very limited extent in these countries.

Discussed below in details are different projects within Europe grouped under the major leasing housing certification schemes of the world.

4.2 Projects with Building Research Establishment Environmental Assessment Method (BREAM)

The Netherlands

The area of Kop van Zuid in port Sparta Rotterdam has witnessed major transformation and serves as the place where the housing project of De Landtong is located. It is made up of two separate structures. One has cubic structure and a one inner veranda, and another having a rectangle-like structure with double verandas splited by a green zone.

Figure 4.1: Side view of the De Landtong in The Netherlands

The nature of those 2 structures is entirely advanced. they will be divided into different modern pieces, characterised by completely varying branch of knowledge description, however mahomogeneous by the utilization of reddish blocks, grey windows, and courtyard with lightweight grey sealed parapets. Every single edge function associate entry

into modern-day kind of building condition. By the lines along the northern end, the the apex is disrupted through complexes with completely varying tallness, manufacturing a city-like impression. From within the garden zone, 3 of the complex area unit unconcealed as the12-floor cornerblocks of buildings. On this aspect, the structure appears a community organization of braced housing on 4 levels.

Table 4.1: Certification scheme adopted in The Netherlands

Structure	**Certification Scheme**	**Features**	**Description**
The Netherlands - De Landtong	– NL BREEAM	Two distinct buildings complex	Mix of social housing and private development
		Entire platform of 100,000 m. sq on four hectares	Street level frontages host mixed activities
		625 apartments	Jointed public areas in basements
		11 floors with commercial space	150 housing umits
		8 levels hosting social housing	Difference in tallness (4 - 11 floors, 12-33 M)

The east and city district ar blocks of severally eleven floors with business areas at the glass basement level, carrying giant flats with expanded openings directed towards the stream and also the midpoint, and eight divisions carrying cooperative buildings. The complicated, and has an entire surface covering of one hundred 000 money supply on four HA, includes 625 flats with overall one hundred fifty totally varying typo outcomes, starting with lone family homes with freelance entry, to maisonettes, penthouses, etc. the inside verandas are separated also: the central court may be a inexperienced public plaza, joining the 2 lengths of the division; the western side is elevated higher than garage space that has shrubs and greens in proximity to the vehicles; the 2 east courts, joined through a container, and a recreational avenue.

Austria

The Dieselgasse residential development, a design product of Martin Kohlbauer, is sited in Vienna's tenth province. The masterpiece, that won a contest command in 1993, was impressed by the residence location that portrays that of the early 19th century, particularly Hoffmann's 1925 "Klose-Hof" in Döbling, wherever the interior space ~~was,~~ had been characterised by the featuring of a complex. Kohlbauer's style consists by a straightened block, joined through a bridge on stilts to an oversized structure carrying 2 complexes in its inner space. The prolonged block is catered for by 3 staircases, spreading twenty-five duplex flats in each stage. The court level carries four staircases within the corners and serves the flats through exterior corridors.

Table 4.2: Certification scheme adopted in Austria

Structure	**Certification Scheme**	**Features**	**Description**
Austria - Dieselgasse Residential Development	– AT-BREEAM, OGNI	Huge structures carrrying 2 complexes in the inner veranda	Public housing development
		3 staircases, spreading across 25 duplex apartments in each division	Compact building form permeable ground floor
		4 manual elevators at the edges and joins the buildings via external balcony.	Typological variety functional mix
		360 buildings, joined to 386 basement garage spaces on 2 divisions, 3 kindergartens, greens and a lounge at the basement.	Basement Park space
			Green inner verandas

One of the edges conjointly carries the primary entrance of the structure, that is sculptured out in the least divisions and is roofed by a block characterised by an outsized round-shaped gap, making for eventful lightweight and shadow effects. The main passage has markings of a rotating court space, letting associate bulging of the inside house, carrying the passageway and tiny bridges that serves the 2-bed space residences on both sides. At the middle of the apartment, extra stairs lead to 4 cube-shaped plan residences at every level.

Figure 4.2: Side view of the Dieselgasse Residential development in Austria

The creator rigorously arrived at a city-like layout, via the planning of public areas used to enhance the values of life. The bottom architectural layout is supposed to be quite accessible on every side, with a powerful reference to the Salvatorianer Platz, via introducing variety of general pedestrian walkway. The affiliation is created additional clear by the institution of variety of internal and external "visual markers", capable of manufacturing a powerful interaction between housing and town.

The Greenwich Millennium Village is among the initial sets of Millennium Villages that was actualized in the United Kingdom signaling the latest of sustainability procedures

when planning, architecture and building are in discussion. The initiative set out as a stage summary prepared by English symbiosis for putting up the 14hectares Millennium Village site on the Greenwich Peninsula.

United Kingdom

As a form of competition 1997, the project was won by an international team led by Ralph Erskine. A masterful plan that borders around flexibility, mixed use and mixed tenure. The designer incorporated the concept of the British tradition of the "village" modeled with a congested modern layout which is in vogue in South Europe.

Table 4.3: Certification scheme adopted in United Kingdom

Structure	**Certification Scheme**	**Features**	**Description**
United Kingdom - Greenwich Millennium Village	BREEAM	136 habitable rooms per acre	Mixed use, mixed tenure
		4500 m2 of new commercial and trading outlets	High standard for environmental sustainability
		1770 m2 of new community structures	Redevelopment of former industrial site
		four sub phases (666 homes), with a density below 136 habitable rooms	Extensive pedestrianisation
			Master plan and implementation of design code

The building is designed through an encompassing structure spine, in the same path with the entire park intersected by halving channels going all the way through directly in the modern collection from perimeter roads and by the general public parks settled at the divisions of the paths. The plan of the urban mass is U-shaped, gap to the stream and to the

eco design unit park that may be a core a part of the village. the entire settlement incorporates a sturdy modern feature and is fastidiously improved.

Figure 4.3: The Greenwich Millennium Village in United Kingdom

The concluding layout was endorsed in the 5th month of 1999, 4 levels of divisions that has 666 homes was signed in till now, with carrying capacity not up to 136 inhabitable rooms/acre on the average, 4500 money supply of latest industrial and trading outlets to ensure a diluted use. The inter related period was made possible by precise needs that reacjes twenty of the allocated apartments will to be allotted for social housing. Designing situation enclosed a variety of property goal throughout the time of existence of the project. eightieth cut down in the major usage of energy, half-hour reduced water usage, five hundredth reduced overall energy, five hundredth reduced water generated from building and construction activities and twenty fifth limitation of automotive usage among ten years from execution.

Spain

The project consists in fifty-one apartments for children. The initiative is a highly welcomed one and one that is well requested for as obviously stated in the "Pla d'Habitatge 2004-2010" and it's settled within the Eixample District, in AN atypical block ("manzana") of the urban layout of the Eixample, supported the 1859 Pla Cerdà. quite 1/2 the block is occupied by an association football field, that lies below the road level. This manzana between Sardenya and dock streets has a particularly reduced size when compared with the normal ones, due to the fact that dock street is one the largest within the example.

Table 4.4: Certification scheme adopted in Spain

Structure	Certification Scheme	Features	Description
Spain - Fort Pienc Housing	ES-BREEAM	51 housing units	Characterization through color
		2 blocks based on a L-shape	Finished modern units
		Collective corridors	Adoption of techs that reduces energy usage
			Public residence development
			Basement garage
			Basement garage

The building style by Conxita Balcells Associates is made by 2 units supported a L-shaped one in every one and goes along the road of Ali Bei Street, whereas the opposite is sited at ninety degrees angle, making the edge of the manzana to be a splited gap, gap a sq. ahead of the doorway into the structure, whereas the design on the football game field, with respect to the distinction in stages, bares a basement ground for parking. The 2 units are placed in a way that ensures adequate cross-ventilation and that enough daylight is experienced inside. gap at the turn of the manzana, due to the L-shape of the building units, the façades of the building, sometimes thought of "internal", become "external" and exactly opposite the public sq. and therefore the streets.

Figure 4.4: Side view of the Fort Pienc Housing in Spain

The entrance to every forty M2 flat has a general balcony, splited to 2 ducks baring a core set of facilities that may be simply gained access through the general balcony. The flats opposite the football arena additionally outline a special treatment of the façade, via the utilization of slippery covers. The general balcony additionally utilises completely varying colours (green, orange) to differentiate the 2 units. 1 in all the targets of construction work has been sustainable, carrying along conscious energy usage reduction means and ways of managing them are enclosed within the initiative to enhance the level of pleasure derived from the units in climate, sounds, and lighting terms. Every flat has its own way to provide predicament and self-supply of heat, due to the star panels placed on the upper side.

4.3 The German property Building Council (DGNB)

Denmark

All places around Europe previously carries arenas are being remodelled to become sound residential environment, wonderful views, waterfronts, closeness to the middle and a creative character create majority of those quick success stories recorded.

Figure 4.5: Side view of the Gemini Residence in Denmark

The most needed residences in these comes area unit typically the born-again warehouses that mix a contemporary fashion with slightly of character. The transformation of the Frøsilos in Copenhagen goes well with this image, however may also be thought-about as

a lot of desperate progressive moves. A storage facility on the other hand is viewed as a a lot of or unfinished built places, that ought to be with modesty treated to still carry its allure, the storage area unit incomplete, a clean built environment during this integrity is still the major obstacle encountered during the execution of the project.

Table 4.5: Certification scheme adopted in Denmark

Structure	**Certification Scheme**	**Features**	**Challenges**
Denmark - Gemini Residence	– DK-DGNB	Apartments are inwardly directed.	Naturally lit common covered space Private development Reconversion of factory buildings Dock spaces requalification Reservation of primary charm

Making huge openings within the concrete holdings in the silo is tough and restricted. Creating a feasible inlet and outlet as lengthy as the door however difficult and may solely be created in restricted amounts. If there have been residences to be placed within the silos this may mean that in a region wherever views count, the residences area unit inside directed. In a typical storage facility, this could be a welcome development, as a result of its gigantic status, however during this case it's a uncomprehensible chance. each core is often lined with a glazed roof, making an artistic movement lobby wherever folks go back and forth. during this manner the silo can type a brand-new foundation for the inuriative and every one the useful house, every room, rewards via the site of the project.

Germany

As a locality of a wider initiative to reclaim the previous industrial sites at intervals Berlin and its geographical area, exist this swift intervention named Wasserstadt (Water City). This project was fell upon by a developer known as Klaus Theo Brenner, World Health Organization was conjointly actively concerned within the hands-on building planning.

Figure 4.6: The Berlin Wasserstadt in Germany

This master piece of style categorical its full mixture of buildings with the set up that was supposed by the developer. A capping impact was entirely mirrored within the relationship between the public housing and also the landscape of the realm as painted by the Spree watercourse. The physical look of the atmosphere preaches a well. paid out street front whereas making associate degree avenue for a superb travel to with natural components. Considering the depth of location, all housing units possess a gap along the watercourse. The construction plan relies on the reconversion of Berlin's modern units, with associate degree interwoven spaces, and a range of fine arts incorporation within the inner veranda.

Table 4.6: Certification scheme adopted in Germany

Structure	**Certification Scheme**	**Features**	**Description**
Germany - Berlin Wasserstadt	PassivHaus, DGNB system, DE-BREEAM	Residential units possess straight access to the water body	Master planned development
		Several of architectural articulations in the inner verandas	plans showing strong interaction with nature

	544 apartments	Renovation of the modern architectural structure in Berlin Taking personality as priority Semi-private inner corridors Utilizatiom of native subjects

The frontal a part of the building is of disjointed fragment that permits the flat units to possess an improved gap along the inside and also the read on the stream. The balconies area unit appearing as inexperienced areas planned on numerous stages, with terraces down along the water line, recreational areas, etc. Every structure at intervals the programme area unit characterised by a consistent treatment, reddish block brick protection for the outside facades, a style selection once more showing the continued trend with Berlin's building tradition. The Wasserstadt development hosts just about 1300 people dwelling in 544 building apartments.

4.4 Popular Projects with other Certification Schemes in Europe

Belgium

This sizable structure of note was erected in a site initially stated as a prison ground when the need for high-density and typologically diverse projects were raised and thrown to befitting and desiring competitors which was eventually won by the young Antwerp office Haverhals Heylen. The location of the buildings is at the centre of city of Bruges and mediates between the scope of the area which stands for tourist attraction and the base residential environment. The initiative was established on a land area totaling up to approx. 8 610 m2.

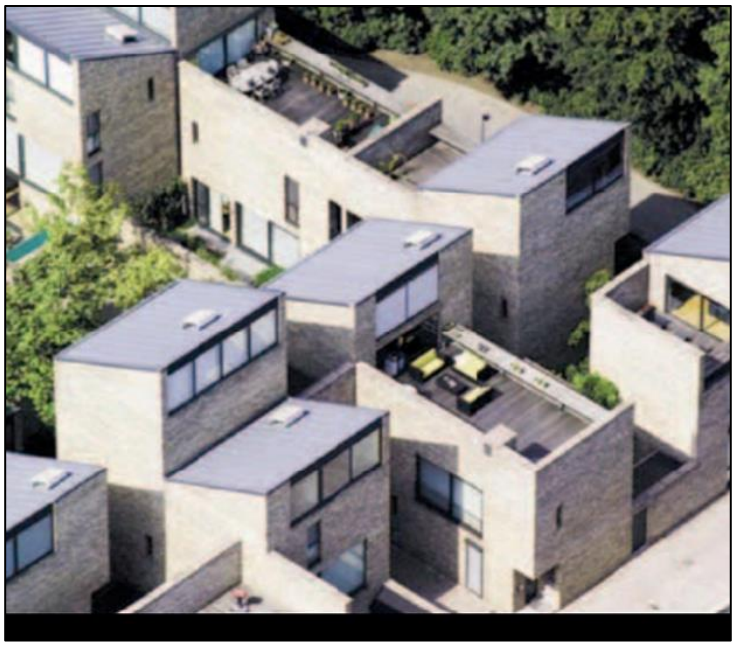

Figure 4.7: Overhead view of the Pandreitje housing in Belgium

The Pandreitje housing consist of complex and dynamic structures that takes up to about 80 residential apartments, a spacious underground parking garage, and commercial areas.

Table 4.7: Certification scheme adopted in Belgium

Structure	**Certification Scheme**	**Features**	**Description**
Belgium - Pandreitje housing	Valideo	Approx. 8 610 m2 A total of 80 dwellings Parking garage and commercial spaces. Open public space Private exterior space at the ground floor	Public housing Open urban fabric Pedestrian accessibility Homogeneous image Varying typology Underground parking spaces

The street design in the Pandretje is unlike the usual medieval urban form which considers probable eventual growth in the region and not in a predefined layout. The entire layout is of a square geometrical grid of 10x10 m with resident apartments within these grids and a

clear spaced area to arrive at a uniformly balanced arrangement and alignment between public areas and houses. This is of a similar design to the Beguinage which also consist of little apartments circling a wide public space. It is however important to note that design of the apartments in in the two housing forms are varied with each dwelling carrying a private external opening at the basement, created to function as prolonged version to the centre room.

Finland

Kannelniitty is found within the western district of capital of Finland, close to the most transportation network and amenities that, ranging from the town center, joining every residential district|community} neighborhoods happiness to the settlements.

Kannelniitty in Finland is a component of the trendy wood city initiative, air worldwide program starting in 1997 and backed by the Finnish government to push and enhance the utilization of wood in residential design and building construction, following the standards of cultural property.

Table 4.8: Certification scheme adopted in Finland

Structures	**Certification Scheme**	**Features**	**Description**
Finland - Kannelniitty	PromisE assessment tool	6 open clusters enclosed by residential buildings	Relationship to natural site features
		Verandas and green sites joined through a slim system of pedestrian tracks	Typological variation
		4-storey buildings along the western border and 2-storey buildings towards the green area.	Common courtyards
		114 flats of different typologies (unit of	Use of renewable materials: cultural and

	flats, row houses, linked semi-detached houses)	environmental sustainability Good network and safe pedestrians' pathways Well linked public and private growth

In the late 1990s, a repaired city set up was endorsed for the world changing where it is headed from college web site to apartment unit construction. Architects Pekka Heikkinen and Markku Erholtz with the team of national capital urban planning Department styleed the overall design layout of the place. In 2000 the ATT (Housing Production Department of town of Helsinki) initiated a bailiwick competition for every design layout of buildings.

Figure 4.8: The Kannelniitty in Finland

The space|residential district|community|district|territory|territorial dominion|dominion is at the sting lying within growth in apartment units from the Seventies on the side and a large sporting arena on the side close to the location of the Mätäjoki watercourse.

The overall design layout is constructed in 6 openings clustered and boxed in by apartment units, making balconies and inexperienced areas joined by a slim channel of walkable lanes. The residential web site is preponderantly flat, nevertheless a a lot of jointed profile is made via a sloppiness in the height of a structure from 4-storey buildings on the west side boundary (near to the opposite residential {area|community} areas) to 2 storey buildings along the inexperienced area.

Portugal

The built structure by Portuguese master Álvaro Siza goes in line with a revived form of communicatory artistic movement together with his world-renowned creativity.

This particular structure still represents as associate degree scaled status of the architect's capability of constructing differences in an existence analysis topic. it's settled close to the Chiado environs, redesigned by him once the large fireplace in 1988. The world encompasses a huge cultural price and is found on a sharp sloping within the cultural avenue of the town of Lisbon. The existence of some archaeologic findings created it as troublesome as attention-grabbing to style.

Table 4.9: Certification scheme adopted in Portugal

Structure	**Certification Scheme**	**Features**	**Description**
Portugal - Housing in Chiado	Lider A	A building made of two parallel blocks	Public housing Background and links to historicalplacwa and cultural artifacts Subjects from native elements Secluded interior space Connected to joined modern scope Basement garage

The designer designed a building fabricated from 2 unmatched units, separated via an indoor ilha that carries and captures the real imagery, remodeling them in finer images of the platform in topography. the upper layer is suspended by culturally fabricated pillars that, beside the outcome, forms the indoor spaces. The façade is created of Portuguese azulejos with colours and components that portrays the exhibition ninety-eight tent and therefore the restoration of the Bouça neighborhood.

Figure 4.9: Side view of the Chiado Housing in The Portugal

This resolution makes the façades and also all of the advanced iridescent. It offers a way of respite to the set of people viewing the structure when returning from the underground of the town centre. The apartment units are separated, or split off, to make vistas and urgent town see through, frames and poetic photos of port. The pure mathematics of the veranda and sloppiness is against the desperate 2-unit plan.

France

The realization of this social development was created potential by a action established in between the design experts and also the administrative rooms of the town of Montreuil, manufacturing a motivating resolution. The multiple divided targets include the corresponding with a style to an exact source for low-priced social housing, whereas sampling with a specific plan, which is meant to champion the repossession of the whole POS. the world is found in an exceedingly features for the part of Montreuil referred to as Murs à Pêches, an outsized tract still these days with respect to its real agricultural background, and encircled by a residential area landscape underlined by tiny buildings, outlined by a typical land fragmentation. From the result and findings of this pre-existing condition, joined with the choice to confirm a decent relationship between buildings and inexperienced areas, derived the site's totally original organization, characterised by the permeableness of semi-private areas.

Table 4.10: Certification scheme adopted in France

Structure	Certification Scheme	Features	Description
France - Montreuil Social Housing	HQE	Tight relationship between buildings and green spaces	Public apartment bebefits Interwoven network of urbanization Linking and joining of pedestrian routes Redesigning native features in agriculture Physical varied appearance givea peculiar pictures

The overall plan proffers the likelihood for the compression of structural heaps via the transformation of the individual structures. This potential is supposed to focus on the prevailing urban kind, with specific relation to the diminutive size of the individual land parcels and therefore the antecedent street network. the look creates a mesh of external areas delimited by some forty medium-sized dwellings.

Figure 4.10: The Montreuil Social Housing in France

The meaning of service with respect to its component areas plainly limks. the new buildings with the present modern materials, manufacturing a brand new volumetrical balance, decipherable at numerous totally varying guage. Every housing is increased by a particular localization, so they'll all calculate east and west facades, with living rooms gap towards the non-public patios, and every one higher floors square measure outfitted with exterior areas like passages or verandas.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

This chapter captures an extensive run through over the housing systems that are in use for the evaluation of the environmental performance of residential and industrial structures. These certification schemes are important calculation tools which are designed to have pinpoint usefulness for carrying out evaluation exercises on buildings. These past few years, the attention paid to sustainability and sustainable development as it concerns buildings and the greenhouse gases that are contributed to the environment has spiraled a great deal. This is bared out of the need to ensure that a reduced level of these gases is generated so as to put the earth in a safe position against the numerous catastrophic and resounding effects of the greenhouse gases. This development has had a huge effect on the guidelines that are followed when putting a building in place as construction industries are wary of these concerns and therefore incorporate certification schemes at the forefront of their designs and layout strategies.

This research study bodies much on the four major and well engaged certification schemes which have been well referred to in building and construction journals and publications. This research work is majorly driven by the need to establish a working template for the use, adoption and general coverage of these schemes. After carrying out a pilot study and extensive underground research schemes for carrying out assessments on its impact in building technology. There was a total of four (4) schemes were routinely evaluated for the successful impact of the work. They include; LEED, BREEAM, DGNB and CASBEE.

Information was gathered on these schemes form published and unpublished literatures and official websites with some others obtained from the engagement of some site agents, building contractors and designers or veterans/longtime professionals in the building and construction industries.

There exist varying forms of certification of certification schemes within Europe and in other parts of the world. The popular ones include, The Building Research Establishments Environmental Assessment Methodology (BREEAM), The Leadership in Energy and Environment Design (LEED), The Comprehensive Assessment Systems for Building Environment Efficiency (CASBEE) and The DGNB which are in use in countries around Europe. Some other schemes also exist which are not as widely accepted but localized within the countries which they are either created for use. Thses include Valideo (Belgium), PromisE assessment tool (Finland), HQE (France), Lider A (Portugal), GREENSHIP (Indonesia) and LOTUS in Vietnam. While these other certification schemes may be of slightly different scope and content or rating, the end goal of all is to achieve a sustainable certification housing status. Several criteria were used in which the evaluation was based on and the following points listed below were discovered;

• The certification schemes examined in this study which serve the purpose of assessment of the environmental impacts on buildings which is suited for use for already developed buildings which can also include it's the renovation of built structures

• BREEAM, CASBEE & DGNB can be used to assess all types of buildings, while LEED does not cover industrial buildings

• BREEAM, CASBEE & DGNB cover all period of existence of a building.

5.2 Recommendations

The following recommendations can be made from the findings of this research;

• The implementation of housing certification schemes in Asia is not as prominent as in Europe. There is a need for more to be done on the part of the government of nations, by architect, designers and building contractors and also the individuals when it comes to the erection of structures with respect to adopting suitable schemes and rating standards.

• Considering the levels evaluated within the scopes of the reference standard in consideration, energy peak performance and utilization, waste management and it's

disposal, water tend to be the features that are and should be mostly focused upon quantitatively;

• The division levels that are of minimal consideration should serve as the threshold against natural disasters, safety against earthquakes and nostril tract disturbances;

Conclusively, it is imperative to underline that the selected schemes are with high acceptance above others and their usage is wide and beyond within the building and construction industry and as a result, nations should do more to key into their usage or rather take cues from their implementation which can be aid the standard of their adopted system as well.

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APPENDICES

Appendix 1

YAKIN DOĞU ÜNİVERSİTESİ

ETHICAL APROVAL DOCUMENT

Date: 15/02/2021

To the **Institute of Graduate Studies of Near East University**

The thesis titled "*Evaluation of Building Environmental Assessment Methods: A Theoretical Framework*" has been evaluated. Since the researcher will not collect primary data from humans, animals, plants or earth, this project does not need to go through the ethics committee.

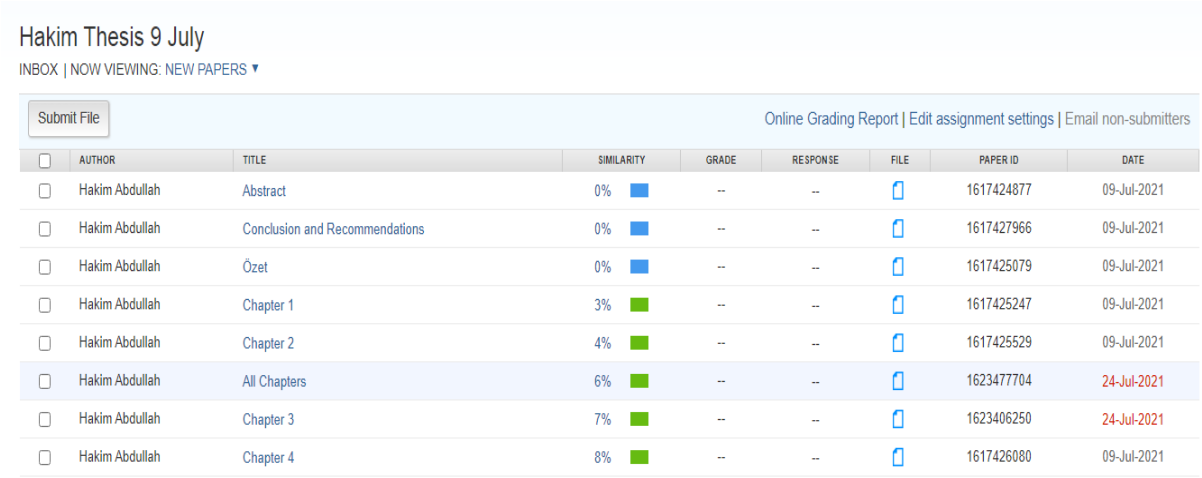
Title: Assoc. Prof. Dr.

Name Surname: Buket Asilsoy

Signature:

Role in the Thesis: Supervisor

Appendix 2



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