JOY MATHIAS ILIYA

SUSTAINABLE CONSTRUCTION PRACTICES IN MASS-PRODUCTION AND WASTE MANAGEMENT IN ABUJA NIGERIA

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NEAR EAST UNIVERSITY
INSTITUTE OF GRADUATE STUDIES
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M.Sc.THESIS

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M.Sc.THESIS

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Nicosia
February 2022

Approval

We certify that we have read the thesis submitted by Joy Mathias Iliya titled **''Sustainable Construction Practices In Mass-Production And Waste Management In Nigeria Abuja''** and that in our own combined opinion it is fully adequate, in scope and quality, as a thesis for the degree of Master of Applied Sciences,

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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, as required by these rules and conduct. I have fully cited and referenced all materials and results that are not original in this work.

Joy Mathias Iliya
07/02/2022

ÖZET

Konvansiyonel tasarım teknikleri, mevcut karmaşık projeler ve yapı endüstrilerinde atık arıtma için yeterli değildir. Çevresel faaliyetlerle ilgili en büyük sorun, yüksek üretim maliyetleri, yenilenebilir kaynak tükenmesi, üretim süreleri ve ayrıca katı atıklara büyük katkı sağlamaktır. Bu araştırma, binayı dahil etmek için modern yöntemleri, aletleri ve malzemeleri kullanmanın daha verimli bir yolunu keşfetmeyi amaçlamaktadır. Sürdürülebilir bina faaliyetlerinin uygulanması, sürdürülebilirliğin toplumsal, ekonomik ve çevresel yönünü tehlikeye atmadan inşaatın nasıl başarılacağını geliştirir.

Sürdürülebilir tasarım, atık yönetimi, inşaat atıkları ve sürdürülebilirlik hakkında kayıtlardan, tezlerden ve internetten makaleler, araştırma dergileri, yayınlar ve kütüphaneler dahil olmak üzere çok sayıda kaynaktan veri elde edilmiştir. Sürdürülebilir inşaat uygulamalarını anlamak, proje sahiplerinin karar vermelerine ve sürdürülebilirlik aramalarına, proje yöneticilerine (proje teslimi için atık, maliyet ve zaman konusunda) mimarlar (inşaat öncesi tasarım aşamasında ve yenilenebilir malzemelerin gereksinimleri sırasında atıkları tasarlamak için) ve üreticilere (geniş alanlarda uygun fiyatlı yenilenebilir malzemelerin sağlanması) yardımcı olacaktır.

Anahtar Kelimeler: Sürdürülebilirlik, yenilenebilir kalkınma, atık yönetimi, Abuja ve sürdürülebilir kalkınma.

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Joy Mathias Iliya

Abstract

Sustainable Construction Practices In Mass-Production And Waste Management In Nigeria Abuja

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Conventional design techniques are not sufficient for the complex projects at present and waste treatment in the building industries. The big issue with environmental activities is the high manufacturing costs, renewable resource depletion, production times, and also a large contributor to solid waste. This research aims to explore a more efficient way of using modern methods, instruments, and materials to incorporate building. The implementation of sustainable building activities improves how the construction can be achieved without jeopardizing sustainability's societal, economic, and environmental facets. Data has been obtained from numerous resources, including records, theses, and papers from the internet, research journals, publications, and libraries about sustainable design, waste management, construction waste, and sustainability. Understanding sustainable construction practices will help the project owners make decisions and seek sustainability, project managers (concerning waste, costs, and time for project delivery) architects (to design waste during the pre-construction design phase and requirements of renewable materials), and producers (provision of affordable renewable materials in large areas).

Keywords: Sustainability, renewable development, waste management, Abuja, and sustainable development.

Table of Contents

CHAPTER III

METHODOLOGY

CHAPTER IV

ABUJA FEDERAL CAPITAL TERRITORY OF NIGERIA

CHAPTER V

CONCLUSION AND RECOMMENDATION

List of Figures

List of Tables

CHAPTER I

INTRODUCTION

1.1 General

One of the biggest users of natural resources in the construction industry, utilizing iron, steel, minerals in the form of cement and rocks, fossil fuel, etc. As pollution and climate change have become red-hot topics of concern, the pressure on the construction industry developed in order to reduce the hazardous impact on the environment and adopt sustainable construction. However, the concept of "Sustainable Construction" is gaining familiarity within the construction industry, and it intends to replace conventional construction by incorporating sustainability principles in the current conventional construction industry. Sustainable construction is actually the construction that doesn't compromise on the environmental, social, and economic aspects. The environment is subsequently affected by the construction industry. The construction of buildings is the source of waste products that polluted the environment. In this regard, this research is going to play a vital role in exploring and demonstrating environmental degradation as well as sustainable construction practices.

Within the developed nations like New Zealand, the United Kingdom, and the United States, the concept of Sustainable Development is getting great attention from construction companies, clients, contractors, researchers, and governmental regulatory bodies. While within developing countries like Nigeria, Niger, Pakistan, India, Sri Lanka, etc., the idea of sustainable construction isn't familiar.

In the year 1994, Charles Kibert, the one who defined the concept of Sustainable Construction for the very first time during the first international conference on sustainable construction. Charles Kibert said, "Sustainable construction is the creation and responsible management of a healthy built environment based on resource efficient and ecological principles" (Plessis, 2007). In the year 2002, Plessis proposed a simple definition of sustainable construction while he was discussing the "Agenda 21 for Sustainable Construction in Developing Countries," Plessis said, "sustainable construction is a holistic process aiming to restore and maintain harmony between the natural and built environments and create settlements that affirm human dignity and encourage economic equity." This definition of sustainable construction is comparatively showing more than the reducing negative impact of construction on the environment.

Sustainable construction is supposed to be a long-term implementation by several industries to gain sustainable development within the factors of environmental, social, and economic keystones. So, the conventional construction industry that focused on the factors of quality, cost, and time, now with the implementation of sustainable construction, its focus is shifted towards social awareness, environmental responsibility, and economic profitability. The implementation of sustainability in the construction industry offers an excellent solution to socio-economic and environmental problems. The sustainable development principles applied on the construction cycle; start from the raw material extraction to the construction of infrastructure via planning and designing, the deconstruction of the infrastructure is also included in the sustainable construction (Yunus & Yang, 2011).

In this research, the practice of construction and the most suitable way of construction that cause no or less harm to the environment; by using renewable materials and the implementation of prefabricated infrastructure is under focus. Most of the developing countries are in the initial stage of the transformation of conventional construction to sustainable construction. The construction is going at a deliberate pace in developing countries and causing harm to the environment; if the developing countries don't implement the principles of sustainable construction, there will be sudden and high pollution fractions which further cause environmental, health issues.

1.2 Construction Management (CM) and Waste Control

There is a project management technique by following the professional to administer a project's planning, designing, and construction from the initial point to the final point. It is noted that a high volume of waste is generated during the construction of a building or infrastructure; so, delegate waste management has required that cause the reduction in waste production during the construction and leads to the practices of sustainable constructions.

The main objective of CM is to manage the project delivery time, cost, and quality; it is referred to as the "Triple Constraint" and "Project Management Triangle." The process of construction is divided into several stages, and for each of the cost of the stage of machinery, materials, and manpower is estimated, and the stage completion timeframe is assigned. These stages have a series of separate construction activities that perform the conversion of input into output. At each of these stages, the design or construction waste is generated in a direct or indirect way. The idea of causing the reduction in waste production via design is quite complicated because there are a huge amount of material and a number of activities in order to accomplish a single construction project (Koskela, 1992).

In addition to this, Keys et al. have shown that the case becomes further complicated when the waste generating sub-activities are added during several stages of construction (Keys et al., 2000). On the other hand, there is also a lacking of conceptual and theoretical frameworks found within the construction industry, as the focus on some activities that hide the generated waste via unpredicted delivery of resources or work release. As the international competition increased and the skilled construction labor reduced, there is an urgency to enhance the product quality and implement modern technologies into the industry (Koskela, 1992). There are many variables of design that have an impact on the production of waste, such as material choice, the complexity of the design, relations between various disciplines (Keys et al., 2000).

1.3 Problem Statement

Because of the high demand for the construction of buildings and infrastructure all over the globe, this account for the utilization of global energy about 36% and utilized the 39% of the energy produced from the upstream power generation that causes the emission of CO_2 and ultimately it leads to Climatic change. That's why the construction practices applied in today's era isn't suitable by any means for complex projects.

The boom in the construction industry is asking for environmentally friendly building constructions that obviously require new tools and techniques for project management. These project management tools and techniques should be compatible with the construction industry having a high yield of waste and also the value delivered to the client. Generally, a change in the construction and building industry is known as the delays in delivery, lacking in the final product's quality, overruns of cost, and long-awaited HSE. In order to perform such a major change, the collaboration of Sustainability, BIM, and Lean should be adopted (Koskela et al., 2010).

Nevertheless, due to Lack of governmental instability, loss of natural resources, climatic change, high waste generation and concrete documentation in regards to imapact of construction on the enirnoment especially the case study; there is an advancement in the progress of sustainable construction noted, but still, the degree of improvement is not satisfied with the progress of the building sector and the rise of energy demand. After ten years, within the global construction sector, the intensity of energy per sq. meter should improve to 30% with the comparison of 2015 in order to meet the "Global Climate Ambition" set during the Paris Agreement.

1.4 Objectives and Limitations

Global warming is increasing day by day, and the existing construction sector is the major contributor. In this regard, sustainable construction has now the most insistent practice in the developed and overpopulated cities like London and New York. And Abuja is no exception to this.

The major objective of this thesis is to find out the way by which a more sustainable construction can be performed via the implementation of new modified tools, techniques, and materials in Abuja as the case study. This thesis has the following four sections:

1. To document definition of sustainability regarding three main aspects (social, economic, and environment).
2. To investigate different variables that can lead to sustainable construction.

3. Analyze the impact of the construction sector on the environment in regards to case study (Abuja).
4. To minimize/recycling waste produced due to these constructions. that include during production and the use of these structures.

CHAPTER II

LITERATURE REVIEW

2.1 General

Several attempts have been made to decide the word sustainability; moreover, if our needs are fulfilled without undermining future generations' capacity to fulfill their own needs, the idea of sustainability is appropriate. We will require social and economic capital to sustain our definitions in addition to natural resources. Sustainability is the most traditional environmentalism of most concepts and considerations of sustainable growth and social inclusion.

A comparatively recent philosophy is the "Philosophy of Ecology," and the whole movement is rooted in social rights, conservationism, internationalism, and other deep history movements of the past. By the end of the 20th century, a significant number of these concepts had been taken together in the 1983 call for 'sustainable growth' by the United Nations, which used to assume the "World Committee for Environmental and Development" by former Norwegian Prime Minister G.H. Brundtland. There seemed to be no lasting prosperity for industrial growth at the detriment of eco-health and social justice. After four years, the 'Brundtland Group' issued its final report, The Shared Future; the earth had to find ways to harmonize biodiversity and development. It is famously described as sustainable development that responds to present needs without jeopardizing future generations' capacity to fulfill their own needs. On the sustainable growth agenda, the Commission effectively harmonized ecologism with economic and social issues. A holistic approach that addresses natural, social, and economic elements acknowledges that all must be viewed together to achieve sustainable stability. Sustainability is a holistic approach.

2.1.1 Sustainability

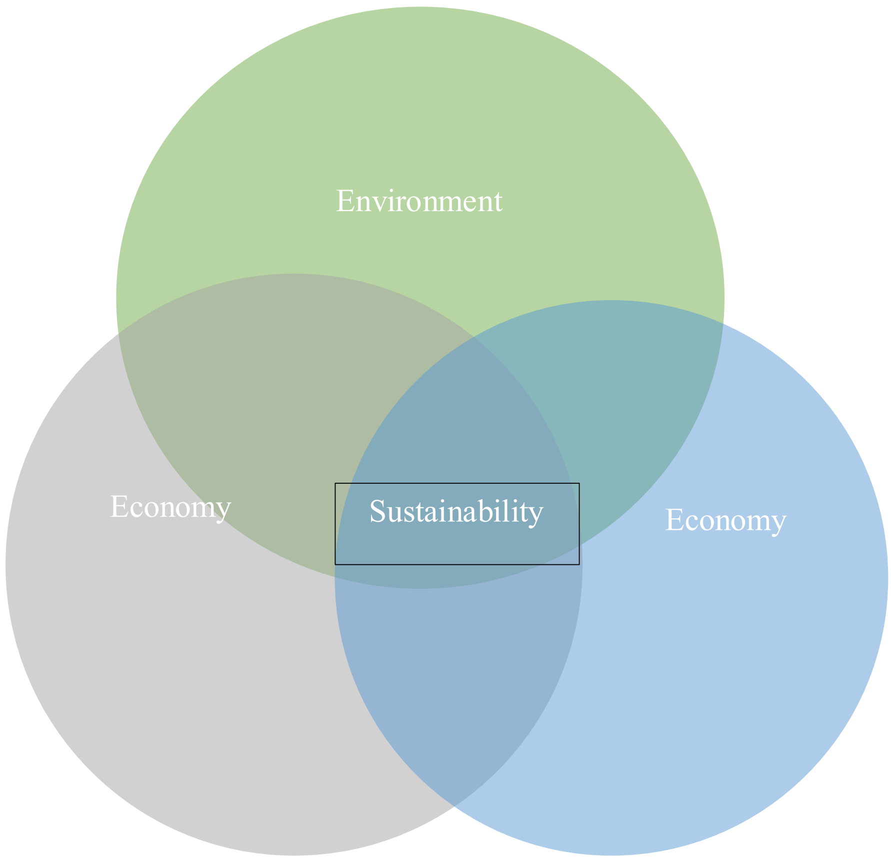
When we fulfill our own needs without infringing on future generations' capacity to meet their own needs, the idea of determining Sustainability is appropriate. What it is and how it can be done is somewhat different. At the first World Earth Summit in Rio in 1992, the notion of biodiversity was transformed into a popular language. According to the UNEP study, "Sustainability, therefore, is the key criterion directing the construction process, which means that the lifecycle (social, economic, and environmental) is the main criterion. This does not only include new, eco-sustainable projects, new operations, and maintenance practices (Du Plessis, 2002).

For sustainability to stand, there are their pillars:

- Environment
- Economy
- Society

Figure 1.

Sustainability Pillars



Environmental Sustainability. Ecological stability is retained, all biological structures on earth are kept healthy, while natural resources are used by humans at a rate that they can fill up.

Economic Sustainability. People worldwide can preserve their freedom and access the financial and other services they need to fulfill their needs. Economic structures are intact, and everyone has access to activities such as healthy livelihood sources.

Social Sustainability. Both individuals who have access to adequate services to keep their families and communities secure and clean will achieve fundamental human rights and basic necessities. Safe societies only have representatives who pledge respect for personal, labor, and cultural rights and defend every citizen from discrimination.

2.1.2 Sustainable Development

It is widely considered that the initial concept of sustainable development is the development that meets the needs of the present without compromising the ability of future generations to meet their own needs. (World Commission on Environment and Development, 1987). Unlike common opinion, sustainable development is sustainable development and the kind of development that we have to undertake to reach sustainability. The aim is not to sustain the complex equilibrium between people's demands for justice, stability, life satisfaction, and possible environmental point of view (Levin, S.A., 1996). Development is seen in its limited sense of advancement, expansion, and knowledge acquisition and as change through learning and the search for wisdom. Although the terms are also changing as disciplines and lobbying organizations are being co-opted, it is widely accepted that such calls for human interaction are central to the three structures' progress.

The three sustainable growth frameworks

- Sustainable urban growth means creating an **economic structure** that promotes egalitarian access to opportunities and possibilities and the fair allocation of scarce ecologically productive regions, enabling sustainable livelihoods and creating competitive enterprises and businesses on sound ethical principles. The goal is to establish wealth for all and not just beneficial for a handful of people and comply with ecological norms and without compromising fundamental human rights.

- The **social implications** of sustainability demand that we allow equal and egalitarian communities to evolve, promote sustainable human growth, and give individuals opportunities for self-realization and an adequate quality of life.

- In the **environmental aspects** of sustainable growth, we need to balance the conservation of and use of physical ecosystems to enable the earth to continue to support the appropriate human quality of life.

In other words, Bread Sustainable Production for the 1993 "...It wants to fulfill the essential needs of everyone and to expand economic and social growth opportunities. Finally, the concept often includes the potential for operational and financial sponsorship of construction programs. A sustainability program is recognized as viable if it is capable of carrying on operations and raising financial capital after donor funds are depleted, in addition to protecting the environment and providing opportunities." Both the ideals of sustainability implicit in these assertions are extremely unlikely to be followed on all occasions when they are subject to contradictory demands. Decision-makers are also forced to compromise and otherwise attempt and reconcile the various conditions to find the right solution for the public good. Such decisions must be adaptive and periodically updated against accepted metrics so that the three processes remain in a dynamic equilibrium. One field is not established at the cost of the other.

2.1.3 Principle of Sustainable Development

Table 1.

Sustainable Development Principles

Conservation of ecosystem	The ultimate goal of sustainable growth is to conserve soil and marine habitats.
Sustainable development of society	Access to human necessities such as a decent home, a healthy diet, adequate health care, work, and quality schooling. It helps to establish their

	optimistic outlook towards nature and living beings if these components are in place
Conservation of biodiversity	All living things in the universe must be protected. People should learn to maintain their natural resources to protect their lives.
Population control	Human needs to increase if population growth is necessary to maintain a balance between resources available and populations, population regulation, and management
Conservation of Human Resource	Individuals can play a crucial role in sustainable usage and restoration. It should develop awareness and expertise in caring for the environment. Human capital can be built through training, healthcare, and schooling. The ideals of sustainable development are backed by human capital.
Increase in Peoples' Participation	Each individual's collective effort is important. Public engagement should be improved to transform the idea of sustainable growth into action. In all sustainable development projects, therefore, optimistic public perceptions should be created.
Conservation of Cultural heritage	The maintenance of social practices, rituals, worship sites, and cultural elements has been stressed through sustainable growth. The indispensable commitment of civilization is different cultural history, but superstition must be

	prevented. It is our responsibility to protect our cultural heritage. It encourages sustainable growth through conservation.
Included within Carrying Capacity of Earth	Development must be carried out within the Earth's capacity. Humans can't get the whole deal from the world right away. Earth's resources are minimal. The scarce resources in this world cannot be adequate for people's limitless means. Excessive resource extraction has detrimental environmental consequences.

2.1.4 Sustainable Human Settlement

Human settlements mean the totality of the human community – whether city, town, or village – with all the social, material, organizational, spiritual, and cultural elements that sustain it, according to the Vancouver Declaration on Human Settlements in 1976. They allow us to live in ways that promote sustainability, the values of sustainable growth, and cultural, social, and economic structures that ensure continued survival. These towns and villages, and societies have been identified in the concept of human settlement in 1976. It depends on the relationship of four distinct trends whether or not a settlement can be declared sustainable: (Chrisna du Plessis 2002)

a. The geographical layout – how the settlement is located and is therefore topographical; the spatial connection between various areas of the city; and the type of the urban environment.
b. The habits of usage – the way the settlement uses its resources and explains its facilities and services.
c. The social patterns – how people live, study, and work under, and how they cope with the settlement's social demands and possibilities.
d. The working and maintenance of settlement patterns. There are very clear and sometimes inconsistent criteria and parameters for sustainable growth to

establish these trends. These situations often vary across various economic, ecological, spatial, topographical, and social contexts. A physical design for permanent human settlements cannot, therefore, be established. The Habitat Agenda seeks to establish administrative rules that could be used anywhere to establish settlements.

2.1.5 Urban Sustainability

Urban sustainable development involves a holistic solution and is a multi-dimensional challenge. Thus, urban sustainability decision-making mechanisms can also be distinct from conventional approaches". In reality, this requires a shift toward a more integral, collaborative, and participatory approach, from bureaucratic and sectoral decision-making. Growth experts usually believe that the needs of the current can be addressed by sustainability itself without losing future generations' capacity to satisfy their needs.(Agenda 2, 2002) For instance, in a city, there is a big population, sometimes very close by. These people need a lot, such as food, electricity, clean water, and their waste must be disposed of. This will have a major negative environmental effect. Significant quantities of rural areas can be transformed into rising food; valleys can be filled to store and provide water and waste disposal sites. Urban sustainability is the notion that a community should be organized and fuel itself with green energy sources without relying too heavily on the local landscape. The goal is to have the least ecological footprint possible to create the lowest possible volume of emissions, effective land use or recycling of compost used products or waste-to-energy conversions, and reduce the community's total impact towards climate change. More than 50% of the world's population is estimated to live in urban areas, and by 2050 to be 70%. This is a huge transition that will affect the millions of people traveling and the cities they travel to. This transition creates a challenge for designers and developers. Cities, though, provide rewards as well; citizens are social beings. We flourish in urban environments that cultivate social ties.

Despite some people's opinions, urban systems can be more environmentally friendly than rural or urban livelihoods, where people can be more remote, from basic resources and from the job environment. The successful planning of facilities such as the distribution of food and public transport schemes makes it easier to conserve energy and money with people and resources too close together. Cities can support the economy by getting people together in a very small region, building, and growing ideas quickly. The larger phase of establishing sustainable human communities, particularly urban areas, is urban sustainability. This requires the construction of sustainable structures and structural, social, and economic frameworks to promote sustainable growth. The seven major urban sustainability dimensions can be defined as;

- A competitive urban economy that provides prosperity and works.
- Sustainable, economically coherent urban society and civic solidarity.
- A decent, accessible, healthy urban shelter for all.
- a safe and healthy urban environment.
- Sustainable city access through mobility conservation of resources.
- Living city and sustainable urban life
- The inspired citizenship of integrated urban society.

2.2 Construction Project Management (CPM)

CPM is a three-word incarnation and may be distinct. CPM is not, though, a novel invention. Project management in the early 1950s was originally a product of a military project (Peter 1981). "After this time, the term and methodology have been followed in several respects by various smaller organizations and companies, regardless of the form of the project's existence in question. It is known as project management, from original design to final completion and maintenance.

In design, the term frequently applies to site or construction management rather than to the holistic approach to the final completion and maintenance of the project from the strategic stage (preparation of the client report) (facilities management). Walker 1984 offers a detailed description of project management, the preparation, tracking, and organizing project management from idea to execution (including commissioning) for a customer's sake. Project management the purpose of the consumer in terms of utility, function, efficiency, time, and costs are defined, and relations between resources are created. To ensure the clients' approval of the project results, alignment, oversight, and monitoring of the project contributions and their performance and the assessment and selection of alternatives are important aspects of project management. One of the main project management projects is to resolve new ground, prevent challenges, organize a community of people and attempt efficiently and easily to accomplish very specific goals (Reiss 1995). Project management is necessary to handle a project from planning to execution and addressed at different stages of a project life cycle. A (Munns & Bjeirmi, 1996) both describe the management of projects to track project goals (which clearly encompasses the major deals of project management referenced to Reiss 1995). Yet, the project is much more complex nowadays than ever. These require a lot of investment in resources that cover many various disciplines, broadly scattered team partners, stricter deadlines, rigid levels of quality, etc.

2.3 Project Management Theory

The Project Life Cycle (PLC) is established by the "Project Management Institute" (PMI 2000). "The steady progression of a project from its beginning to its completion." The project life cycle is split into stages and phases. Nevertheless, certain stages of most programs require more or less iteration, depending on the project's form. A traditional PLC consists of two large cycles at its heart, each of two main stages (i.e., four in all). The first period consists of a business case design and validation. Then a short or charter project planning and development. The second period includes the execution, i.e., comprehensive product design and development, followed by the transfer of goods to the intended consumer. Many research initiatives for project management (de Cos 1995, Gomez-Senet 1997) include multiple descriptions for the Project Life cycle and explain various PLC stages". In different project contexts, these stages are identified by different names, but from the conventional perspective, these phases split into:

- Phase 1: Concept Creation, Vision Sense, the Big Picture.
- Phase 2: Conceiving a realistic strategy of the idea. Hearing, contemplating, aligning, preparing, involvement.
- Phase 3: Introduction to the program. Manufacturing, teamwork, collaboration, research.
- Phase 4: Completion of the plant. Material and knowledge delivery, testing, closing.

In general, each step entails very different tasks, including different management levels and skills. These standard phases can be divided into sub-phases and several phases or iterations based on the duration, scope, risk, and sensitivity, etc., depending on the project and its type. These are project-specific and focus on the overarching plan for achievement.

When we concentrate on constructing, ventures are dynamic, time-consuming enterprises. Comprehensive project planning usually involves many stages that include several professional resources. When you switch from preparation to the project's execution, this traditional job passes through multiple successive phases that include input from such varied fields as financial institutions, regulatory departments, engineers, architects, attorneys, insurance firms and securities, builders, manufacturers, etc. Even a small system requires multiple competencies, supplies, and practically hundreds of different activities during the building process itself. The assembly must be carried out in a normal order of events, reflecting a complex system of individual time requirements and restrictive sequence relations between the various segments of the system.

Basically, a proposal is planned promptly to satisfy consumer expectations or requirements. The following definition of a building project is a general idea of traditional project management analysis. In the strategic planning process, multiple alternatives can be considered before launching a project. The technical and economic effectiveness of each solution is analyzed and compared to choose the best possible project. Therefore, the funding schemes for the options suggested must be investigated, and the proposal is set for execution and cash flows. The comprehensive engineering design would include a design schedule for the building until the project's scope is well defined. The definite cost estimate will be the basis for cost management. The supply of supplies and the site's project must be prepared and managed carefully during the acquisition and construction processes. A short start-up or shake-down phase of the installed facility typically happens after the building has been finished. Finally, before the building lives its productive lives and is scheduled for closure or conversion, ownership of the facilities is handed over from the landlord to complete occupancy.

The major steps for project management in this area are:

- Business demands or perceived conditions. The aim is to identify the aims and the scale of the project. When a new facility has been selected by the owner, the specifications must be defined and budget limits defined. It includes creating large project parameters, including venue, performance standards, scale, architecture, configuration, facilities, resources, and other operator requirements required to define the project's general aspects.
- Analysis in conceptual preparation and workmanship. Conceptual preparation should not cease until the comprehensive design has been done, while substantial preliminary work will be required. The job concept is primarily the responsibility of the owner, even though a design specialist can be called upon to provide technical guidance and advice.
- Technology and architecture. Design. Construction designs and measurements are the priorities of this process. This process includes the planning and design of the whole project. The final work plans and measurements are planned for the overall building schedule. Design, procurement, and construction are frequently simultaneous in nature, with procurement and construction starting in several segments until the design is complete and drawings and standards become visible.
- Building and procurement. The procurement is concerned with purchasing, accelerating, and supplying the most critical project machinery and products, particularly those with long delivery times. This role can be done independently from the building process itself or not. Construction, of course, is the project's physical construction phase and the installation of the materials and facilities, including the provision of workers, building equipment, materials, services, oversight, and administration required for work to be carried out. • Occupancy start-up. A short start-up or shake-down phase of the installed facility typically happens after the building has been finished. The occupancy is permissible until the occupancy permit is released and the installations are authorized.
- Maintenance and service. At the last minute, the owner is tasked with the maintenance of the facility. This process concentrates on the use of machinery and the repair of the whole house. The proposed refurbishments of the building are included in this stage.

- Equipment recycling. Suppose the facility lives its useful life and is planned to be destroyed or adapted. This process includes the removal and eventual recycling of the building's installations and parts.

2.4 The Major Type of Construction

The building is a grouping of very different segments and products. The methods for procuring technical services, granting building contracts, and funding the building will vary considerably in preparing various styles of construction. The vast range of buildings can be grouped into four main categories for discussion, each of which has its own characteristics (Hendrickson & Au 2003).

Residential Housing

The housing comprises single-family residences, multi-family homes, and high-rise apartments. The promoters or supporters who know about the building industry typically serve as proxy owners in the production and construction of these projects. They are responsible for signing contractual arrangements for design and construction and arrangement to fund and sell the completed structures. Architects and Architects typically design private houses, and the buildings are carried out by builders employing contractors for the planning, plumbing, energy, and specialist works. An exception to this trend is one-family houses built by the constructors.

Institutional And Commercial Building

The institutional and industrial building involves various styles and sizes of projects such as colleges and colleges, medical centers and hospitals, entertainment centers, sporting complexes, supermarket chain stores, and large shopping malls, factories, and light-producing facilities. The building owners can not or cannot familiarize themselves with the construction industry's activities but can typically appoint specialist contractors qualified to fund the installations they designed. The architecture of a particular building style also involves specialty architects and engineers. In contrast, the designers and general contractors involved in such projects may often specialize in this type of construction alone.

Specialized Industrial Construction

Specialist industrial development generally includes large-scale projects, such as oil refineries, steel mills, chemical manufacturing facilities, and carbon-fired or nuclear power plants. The owners normally engage closely in project creation and collaborate with designers to reduce the overall project completion period. They will want to choose a builder and constructors team where the owner collaborated together over the years.

Infrastructure And Heavy Construction

Projects such as roads, rapid transportation networks, tunnels, bridges, pipelines, wastewater, and water treatment systems require utilities and heavy construction. Many of these projects are municipal and therefore are bond or tax-funded. A high degree of mechanization has steadily replaced some labor-intensive processes in the building category.

2.4.1 Challenges Facing Construction Project Management (CPM)

Building project management's core mechanism is strongly related to technical criteria such as budget and delivery but requires good coordination with all stakeholders (stakeholders, contractors, and community). The first project management challenge is accomplishing all project targets within the specified constraints (Phillips, 2003). Scope, time, efficiency, and budget are the first constraints (PMI, 2010). Building project management has historically improved over time as development projects are managed and regulated. However, there are also many possible setbacks in building a building project with the advancement of management strategies. Project managers are responsible for keeping the site smooth, stable, on track, and on budget. This can also be a very challenging activity. (McKensy & Company 2013), 98% of building projects fall under an excess budget, with 77% suffering substantial delays. And how can the project managers account for these delays and budget questions? Getting a building project, here are six common obstacles.

Inadequate Risk Management. Project managers also placed long-term risk precautions in place. However, short-term challenges are often overlooked. These things will easily escalate and really affect the end. If they are incompetent subcontractors, planning clashes, or shifting customers' preferences, there may be an otherwise minor concern that could derail a project. Consequently, contingency plans are essential. Establish a wiggle room for scheduling and invest in security preparation services to eliminate any such future problems.

Lack Of Structure. It's hard to do anything effectively without simple targets. If people may not have a definite goal to hit, a building project could potentially slip behind or over budget (or both). And it's hard to keep people responsible for their role in a project without these targets. The monitoring of results is an important feature of the management of programs. They all need specific roles to carry out to enforce this and keep everyone on duty. Divide into smaller and more daily goals for people to meet larger, project-wide milestones. It's all multiplied in the following day if anything is not done one day. Keep individuals responsible through such processes. In this way, you can avoid the whole project from crashing.

Poor Communication. Communication is a valuable tool in any exchange, but it is particularly important when work between different parties is delegated. Without efficient and consistent contact, the gaps will move through critical tasks, and the team may be unaware of a problem until it is too early to fix. Project managers must then develop consistent instructions. Communication should be given up to a clear degree, reminding the team at the end of each day of any success or challenge. Problems should be proactively addressed in this manner. If individual meetings are not a choice, it is helpful to use any tools in this regard.

Unrealistic Expectations/Bad Forecasting. There could be major issues for some customers and stakeholders. Either you want to finish a project on a speedy timeline or on a minimal budget, your goals can be challenges. While a professional project manager can do some things, some things are clearly not. Acting for impossible deadlines will potentially hamper productivity; why do you exhaust job overtime when your commitment stays short? Any of these standards are formed because of bad forecasts forecast can concentrate on the long-term rather than the short-term, just like risk management. Tap on those predictions and see whether they are feasible monthly, weekly, and regular fashion. Communicate the concerns with stakeholders if necessary. Offer an alternative strategy to see a deadline or budget, ambitious and attainable. Manage objectives from the outset, and you will build a good project.

Delayed Cash Flow. The building industry depends on fracturing, which may be an obsolete method occasionally. If payments slip down, the cash flow of a business may have a detrimental effect. This will dry up a lot of money and trigger delays for other projects. As a consequence, invoicing structures must evolve. Building firms will guarantee that cashflow does not impact other programs with better technologies and ample follow-up.

Limited Skills. The building is a reputational business in significant numbers. People want to work with people they meet and have respect. It also can be fantastic as teams that are professional about working together can be unbelievably efficient. However, there could be a pause if there is a talent difference in the squad. The response is to be mindful, before they affect the project, of these capability holes. You can fill these holes easily and effectively until you find them.

2.5 Impact of Construction Industry on The Environment

Building programs have a significant influence on the global climate. Any part of the building has a measurable impact—from extraction methods for products to waste generated in the project and its disposal. These effects influence not just the climate but also culture and the economy. According to Agenda 21, most human actions that impact the environment are connected backward or forward, and building industry practices also alleviate their impacts. The industry's environmental influence is the most important but should not be negated by its socio-economic impact. The relationship between building and human development is a subject of sustainable construction in the developed world, often marginalizing the environmental aspects. There was no simple reason for biophysical factors in the built environment except for its environmental effects. Yet, the building industry cannot afford to neglect the atmosphere regarding the extreme environmental damage faced by most developed countries.

2.5.1 Environmental Impact of Construction Industries

In terms of the climate, the building industry's presence in developing countries has a greater impact, according to the discussion conducted in Agenda 21, than in developed countries. The explanation is that developed countries are almost under development with poor industrialization. It has had a significant influence on the biophysical climate for the building industry. When evaluating the effects of energy consumption and greenhouse gas pollution on the building sector on the environment. The materials that shape the fundamental modern building are the main climate change in this aspect. They are steel and concrete. The total of other building materials, including wood, steel, plastics, and titanium, double the amount of concrete used in formal construction worldwide. Cement production entails the use of fossil fuels and adds greatly to emissions of greenhouse gases. Cement is a known source of nitrogen oxides that emit more than 25 tons annually. It still represents about 12-14% of the last concrete blend. The other approach is to remove aggregates and produce steel in the case of reinforced concrete. (Agenda 21)

Steel and iron are energy-consuming construction resources, responsible for a world energy consumption of 4.1 trillion. Water demands can be achieved by processing and final application of these materials. There are also a host of other pollution issues resulting from building practices, whether through processing construction materials or from the whole construction industry's operating operations. Noise, noise, dust, and harmful contaminants from radioactive waste are all part of this. The building sector has a major influence on agriculture as well. The planet now has 70-140 000 km^2 / year of cultivation, with soil depletion and other land loss aspects. The reduction of 20-40 000 km^2/year is due to urbanization itself. Again, the effect is dirtiest in poorly-qualified soil industrialized countries like much of Africa". Land is an expensive asset that is the basis for the sustainability of many economic activities. The construction of the property, particularly where the enforcement of environmental standards and regulations is not strict, tends in search of full economic benefits to neglect the nature of the built and natural environment.

Figure 2.

Gravel and Soil Extraction

2.5.2 Social Impact of Construction Industries

The building is the world's biggest business employer (in its limited definition) with millions of workers worldwide. For these, 74% are in countries with low wages. Because low-income countries generate just 23 percent of global construction, it is apparent that the "employment intensity" is much higher in low-income countries than in high-income countries. Therefore, the building industry and its working conditions will play a significant role in people's welfare and improve their quality of life. The construction industry is nevertheless notorious for arrogance, racism, unequal labor conditions, and environmental degradation. The business was deemed much more crooked than the weapons and the oil industries in a new multinational Gallup survey. Construction corruption, which led to sub-standardized building materials, was also due to Turkey and India's high deaths during recent earthquakes. In a report undertaken by the International Labour Organisation (ILO), construction jobs in nearly all parts of the world have been disregarded. In many countries, wealthy and poor people are forced to work and seldom want to work in construction. Few would want to enter the industry for their offspring.

The ILO study also indicates very poor safety records in the building industry. Still, accurate statistics are sparse, especially in developed countries where workers' insurance is rare, indicating that injuries are frequently unreported. This high number of injuries is attributable to a shortage of professional schooling and subcontracting the uncontrolled informal market. The fluctuating nature of the sector combined with low benefit and high turnover of casual staff also leads to the apprenticeship's failure and, after that, to a lower national skills base.

2.5.3 The Economic Impact of Construction Industries

The building sector can improve its organization, behavior, and efficiency in terms of economic sustainability. Built environments typically account for over half the overall national investment in capital in nearly all world countries, and building represents up to 10% of GNP. 19 In the development of small, medium-sized, and micro businesses, the industry also has a significant role (SMMEs). In micro-companies of less than ten employees, 90% of construction workers are employed. There is no reason to underestimate the impact that small and informal contractors make on the economy. Cement and paint are often sold to smaller customers. A substantial majority of the construction material made by small businesses is also responsible. About 11,000 small businesses are making ceramic bricks and tiles in Brazil alone. They encourage local economic growth in a manner that is not practical for big national and international corporations. The economic viability of the industry and its environmental effects are both closely related. An economic building industry improves environmental efficiency by offering low-cost construction approaches that promote optimum resource utilization and prevent waste. Moreover, buildings' economic viability includes the internalization of social and environmental impacts and the mirrored values of finished goods.

2.6 Sustainable Construction (SC)

Sustainable construction is an expanding philosophy aimed at integrating the general principles of sustainability into actual building industry practice. However, I consider sustainable building to be the act by which building construction is regulated without compromising social, economic, and environmental aspects. They involve existing structures but are not limited to modern, environmentally friendly projects, new operations, and maintenance. It is axiomatic that the building industry has a significant environmental effect. The Pearce study (Pearce, 2003) concluded that "a more holistic concept for sustainable building should be implemented before the construction industry would contribute to sustainable growth." UK Green Building Council (2009) also states that "an applicable and widely recognizable concept is required to achieve cross-sector buy-in, which is important to promote real improvements to SC in the industry." However, efforts have failed to establish a widely agreed description for SC (Plessis, 2007)(Cooper, 2006; Hill and Bowen, 1997; Ofori, 1998; Ofori et al., 2000). Several meanings contained in SC literature are shown in Table 2. Although there is no universal interpretation, SC could define some main features by revising the various definitions in the following manner:

- Considering the whole building life cycle,
- incorporating the three components of the climate, social and economic aspects.
- Taking non-technical and technological options into account,
- We are dealing with existing and potential stakeholders' wishes.

Table 2.

*Different Definitions of Sustainable Constructions (*Sachie Gunatilake 2013*)*

Reference	**Definition**
Hendriks (2001)	A way to design and build buildings which promote health and are in harmony with nature, both physically and psychologically.
Kibert (1994 cited Hill and Bowen,	Creating a safe urban atmosphere focused on environmentally sustainable energy.
Huovila and Richter (1997)	SC aims at reducing electricity and pollution that are hazardous for the atmosphere and well-being during its own operations and goods during its lifespan, and offers

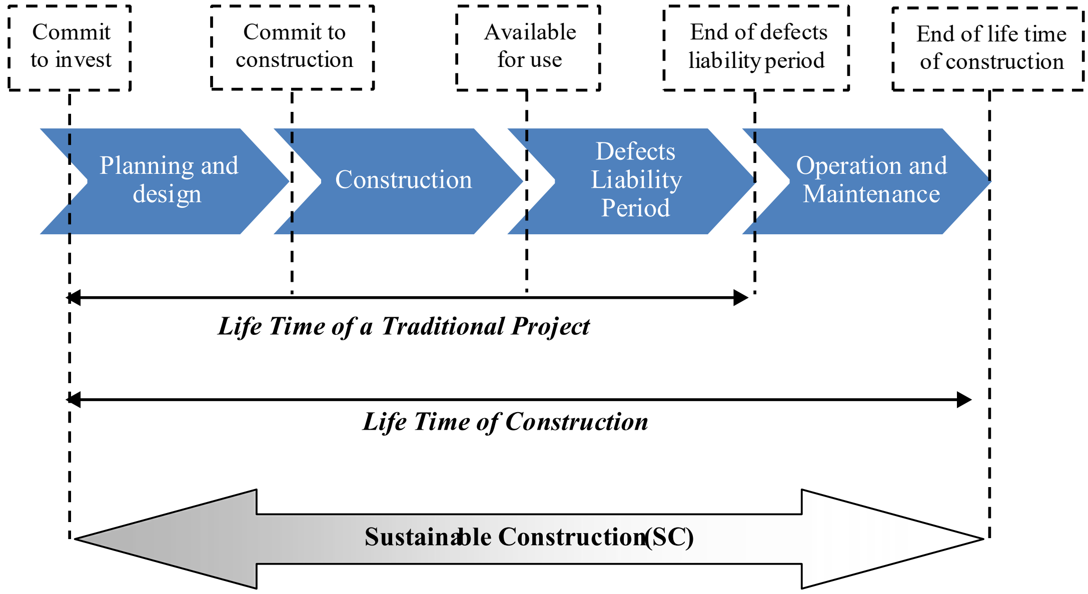
	important knowledge for the decision-making of its customers.
(Un-Habitat, 2011) (1996 cited Ofori, 1998)	Within ecological capability, the SC shall make use of resources and take into account the concept of caution and provide the people with. Equal opportunity for good, sustainable, and prosperous living in harmony with nature and their natural and cultural heritage, and to ensure economic and social growth and conservation of the environment.
Kibert (2008)	SC best explains how the building industry and its built-in commodity will contribute to the survival of the world, including its humans and non-human residents, in many fields of economic and human life.
van Bueren and Priemus (2002)	Designing, planning, installing and managing the real estate to reduce as much as possible the detrimental impact of buildings on the climate, restructuring, and management.
UNEP (2003)	Using and/or promoting a) ecological fabrics, (b) energy conservation in buildings and c) residential waste control.

2.6.1 Consider the Whole Lifecycle of Construction

Brandon and Lombardi (2011) emphasize that considerations of the decision-making period be noted with all SD-related discussions. It refers to SC talks as well. When discussing SC, some authors, such as Hendriks (2001), referred only to the design and development phases in their descriptions. However, according to Pearce (2003), property and its administration must be included in the SC's holistic report. The importance of understanding that SC is interested not in the project's lifespan but rather in the life cycle of the 'house' was stressed in this sense (see Figure 3 below) (Parkin, 2000). In other words, it is necessary to remember, as Hill and Bowen (1997) observed, that while SC contains the word "construction," it describes a process that begins long before the physical phase of construction and continues after it.

Figure 3.

Project Lifetime vs. Construction Lifetime (Adapted from Parkin, 2000)



Edum-Fotwe and Price (2009) note that 'lifecycle' describes the Lifetime of a chosen individual. The Pearce study emphasizes the importance of considering the whole building life cycle from planning to deconstruction if sustainable construction is to be done correctly (Myers, 2005). The lifecycle of a building involves planning, architecture, construction, service, renovation, and de-building. Some scholars extended this further, noting that the process starts with the processing of the raw material (Du Plessis, 2002) and emphasizes the importance of keeping the supply chains of material and components into account (Wyatt et al., 2000). Cooper (2006) also puts spatial planning under the umbrella of sustainable growth. It acknowledges the need to collaborate with planners to ensure that a holistic approach to sustainable development ultimately contributes to sustainable neighborhoods. This perspective is also expressed in the public advisory report to the Department of Business and Regulatory Reform (BERR, 2008) on the Sustainable Building Draft Strategy. The respondents proposed incorporating urban planning in this strategy.

Many scientists, including Hill and Bowen (1997), NAO (2007), Ofori (1998), Parkin (2000), Shi and Gong (2008), Wyatt and others (2000) believe that the principle of sustainable building requires a 'back to down,' from architecture and preparation to the stage of deconstruction. A more conceptual change in the cradle-to-cradle system has taken place in the cradle-to-grave approach to sustainable construction in the last ten years. The cradle-to-cradle Frame looks at flows in the "safe, regenerative, closed-loop cycles" instead of the one-way products (McDonough et al., 2003). Therefore, sustainable builds have evolved from a simple reduction of negative impacts (i.e., cradle-to-grave approach) to maximization of beneficial natural, social and economic gains (i.e., cradle-to-cradle framework) (see, for example, Huovila & Richter, 1997; Lanting, 1998, van Bueren and Primus, 2002) (Du Plessis, 2005; McDonough and Braungart, 2003).

2.7 Elements of Sustainable Construction

The second question, which calls attention to the various aspects of sustainable construction that the authors concentrate on, are the concepts available for sustainable construction. These sustainable building features have also been named sustainable building measurements. In their concepts, several researchers, including van Bueren and Priemus (2002), Huovila and Richter (1997), and UNEP (2003), have viewed sustainable buildings as environmental problems. It has prompted many scholars to consider biodiversity as synonymous with "good environmental management." However, our definition of sustainable building as an environmental problem has experienced major shifts over the years. Initially, the attention was on limited capital (particularly energy) and ecological impacts mitigation.

The solutions were mainly found by technological advances in construction materials, components, and design principles relating to energy (Sjostrom and Bakens, 1999). However, it is still widely acknowledged that it is difficult clearly from an environmental viewpoint to achieve sustainable building. As sustainable building represents the adaptation of sustainability concepts (SD) to the construction industry, it is commonly agreed that the three natural, social, and economic components are identical to SD, sustainable construction. However, an analysis of sustainable development and generic SD literature shows various additional considerations that various scholars interpret in different contexts.

In addition to the above, Liu (2006), in its place of the more typical three components, uses two other components: socio-economic (that describes the project's partners' behavior in built-in assets) and socio-environmental. Instead of the environmental part, Hill and Bowen (1997) used the term bio-physical and incorporated and the three main components a fourth technological aspect. The functional aspect adopted by the building defines the standards relating to 'building efficiency and quality.'

Table 3.

Editional Elements of Sustainable Development (Sachie Gunatilake,2013)

Element /dimension of SC	**Environmental Ecological Biophysical**	**Social**	**Economic**	**Institutional**	**Legal**	**Political**
Sjostrom and Gavle (2000)	●	●	●		●	●
Pawlowski (2008)	●	●	●		●	●
Ofori (1998)	●	●	●			
Liu (2006)			●		●	
Ashley et al (2003)	●	●	●			
Hill and Bowen (1997)	●	●	●			
Du Plessis (2002)	●	●	●			
Langford et al. (2000)						
HSD(1997)	●	●	●	●		
Nelms et al. (2005)	●	●	●			
Persson and Olander (2004)	●	●	●			

Although traditionally, this can be seen as part of the social aspect, the additional element was justified because it calls for technical implementation (Hill and Bowen, 1997). Valentin and Spangenberg (2000) also used the fourth factor to separate structural dimensions from environmental, economic, and social concerns. The institutional aspect is defined here as referring to human beings' relationship and the rules by which they are directed, that is, as 'institutions of society. The social aspect, therefore, is the sum of human abilities, according to Valentin and Spangenberg. The number of measurements or components considered, according to Gibson (2001), is merely a matter of stressing them. For example, in SD discussions, the ecologists typically prefer a two-pillar approach as this site's climate and human production are equally significant. On the other hand, the three or five pillar versions tend to highlight the significance of the other components for the international Development Programme's long-term growth. However, the lack of logic in choosing a specific category of elements and disregarding the others is a big problem with these multiple elements suggested by separate authors. Hill & Bowen (1997), for example, have not given explanations for preferring these specific measurements since they see sustainable development based on all four social, economic, biophysical, and technological components.

The choice of which elements will depend on the nature of the analysis and the priority (Ofori, 1998). Any of the considerations which may lead to deciding the importance of various elements of sustainable constructions in a particular sense are the nature and size of problems facing them. Development goals, local production, public capacity, building stocks, economic development, the level of skills, and cultural values (Sjostrom, 2001; Sourani, 2005). Ofori (1998) reports, for instance, that management and group components are particularly applicable to developed countries. It is because, under these circumstances, the sustainability of the management will ensure the efficiency and efficiency of the products used in construction, especially large and complex products undertaken by foreign companies. In cases where important projects are underway without due consideration for the community interests, thus destroying local livelihoods and social ties, community survival is also important. Pawlowski (2008) pretends that the various elements of SD are connected hierarchically. He sees moral concerns in the hierarchy as having the top position. The second stage is concerned with ecological (or environmental, social, and economic problems, while legal, technical, and political elements will become final. He assumes that all three layers must be completely incorporated, but they are incredibly difficult to do in practice. There is, however, universal support for the incorporation of at least three natural, social, and economic components of sustainable building. They tend to be the most widely spoken about and used in literature. The legal, fiscal, ecological, environmental, bio-physical, scientific, administrative, and societal concerns can usually also be categorized into three key components. It may thus be concluded that achieving sustainable construction involves a state of equilibrium over the lifespan of construction with these three fundamental elements. It tends to accomplish long-term SD targets. In each of the three key elements, the following sections address the significance and priorities.

2.7.1 The Environmental Element Of Sustainable Construction

Building and end goods industry operations have substantial environmental effects. Construction has significant environmental impacts: energy consumption, emissions of air (e.g., dust or gas), waste generation, noise pollution, land use, current site loss, habitat depletion, the use of natural resources, and water discharges (Tam et al., 2006). The environmental costs of construction are not confined to physical construction but escalate over the whole building life cycle (Circo, 2008). More than one-third of global energy demand and resulting greenhouse gas emissions are accounted for by the building industry worldwide (Cheng et al., 2008). The UNEP has estimated that 30 - 40 percent of the world's primary energy is in houses. The demand for accommodation and office spaces in developed countries is projected to rise this value further over the years. The IPCC estimates that building-based carbon emissions, including energy usage, could rise from 8.6 billion tons in 2004 to 11.4 billion tons in 2030 under a low-cost scenario. This amount is forecast at 15.6 billion by 2030 in a high-growth scenario. It is also responsible for a high volume of carbon dioxide (CO_2) pollution, comprising about 47% of overall UK CO_2 emissions (BIS, 2010). The quantity of building materials used annually is equal to 6 tons per capita in the UK (Shelbourn et al., 2006). About 90% of non-energy minerals mined in Great Britain are used for producing these building materials. In 2010, 20 million tons of construction, demolition, and excavation were shipped to landfills by the environmental agency (2012). Indeed, the most significant source of illicit waste at the end of 2011 was the construction, renovation, and excavation waste (Environmental Agency, 2012). 20% of the manufacturing and commercial noise complaints are also the building industry's faults (BRE, 2002).

According to Adetunji et al. (2003), environmental sustainability discusses the environmental effect of building operation and encourages the avoidance of impacts to the environment, which are detrimental and ultimately irreversible. However, few have made this further advancement and found environmental protection not only to address 'preventing' adverse environmental impacts by the careful utilization of natural resources and the minimization of pollution, but also to 'restore or improve' ecosystem where possible (BRE, 2002). Any environmental building sustainability values that can be practiced in literature include.

- Minimize resource consumption — includes fuel, water, materials, and soil (especially carbon-based).
- Re-use/recycling capital, maximization.
- The preferred use of renewable energy for non-renewable resources.
- Extract and produce permanent natural substances at rates no faster than their low deposit in the Earth's crust Fossil fuels and minerals are removed
- The protection and enhancement of the life and habitats of the earth.
- The development by reducing emissions of a safe and nonpolluted environment.
- Efficiency pursuit in the design of the surroundings.
- Minimize fragile landscape impact.

Construction environmental protection is very well-investigated and is commonly seen as more advanced than the social and economic aspects. The availability of well-established environmental management schemes may be partially due to this. In comparison, concerning the social and economic values (UK Green Building Council 2009), it is better to establish quantifiable SC environmental principles. Moreover, in the sector, the general trend is that the bulk of those responsible for adopting SC is environmentally conscious (Adetunji et al., 2003). It has led to a substantial degree of focus on environmental issues.

2.7.2 The Social Element of Sustainable Construction

Pawlowski (2008) treats the social aspect as a decaying environment, analogous to the natural environment. This "environment" has a wide variety of influences, including rituals and practices, history, faith, relationships between people, and living conditions, Pawlowski says. SC's social dimension may also be viewed as meeting people's needs engaged in building work at various phases of their life cycles (related to the factors mentioned above). Stakeholders, such as customers, manufacturers, workers, and local communities, may be included. It is tough to resolve social issues about the construction period as-built facilities (primarily buildings) have longer life cycles than other manufactured goods. The building sector generally has a low media image. Dirty, upsetting, risky, old-fashioned, and often not honest in the industry was seen (Construction Industry Research and Information Association - CIRIA, 2001; Myers, 2005). Lastly, outlaw merchants, known as 'cowboy builders,' is primarily due to the industry's credibility (DETR, 2000).

Construction is a critical industry that builds a physical stock of infrastructure and facilities that decides our lifestyle for up to 100 or more years (Pollington, 1999). The built environment determines our cities and countryside existence, work, and appearance (DETR, 2000). The building industry, therefore, plays an essential part in deciding the quality of life of individuals. People spend about 90% of their time in buildings (BRE, 2002), and 70% of the world's population is projected to live in urban areas by 2050 (Population Reference Bureau, 2012). The buildings are also capable of impacting dramatically on their inhabitants' welfare. Indoor air was determined to be 2 to 5 times more pollutant than outdoor air (occasionally, this value is more significant than 100 times even). This low air quality will lead to several health threats, including cancers, asthma, and legionary diseases (Baum, 2007; Kibert, 2008). The construction of the UK, in general, has proven less safe, less effective, more pollution and contaminants produced, and more expensive than that in most other countries in Europe (Halliday, 2008).

Thus, the social aspect of SC concerns the legal, moral, and ethical responsibilities to its customers such as workers, vendors, and the society in which it runs the construction industry (Adetunji et al., 2003). Any of the ideals of socially sustainable development found in the literature (Dair & Williams, 2006; DETR, 2000; Hill & Bowen, 1997; Sjostrom, 2001) have been presented below;

- Improve human life standard, including alleviation of poverty.
- Provision of development planning for social self-determination and cultural diversity.
- Community upliftment.
- A healthy and safe working climate preserves and encourages well-being.
- Ethical norm conformity (ethical trading standards and fairness-at-work policies).
- Human Capital Growth
- Training and skill-building for vulnerable groups
- Fair and fair sharing of housing social expenses.
- Equitable allocation of housing social benefits.
- Look for equity between generations.
- Sufficient municipal services and construction infrastructure
- Integration of local growth.
- High-quality assurance
- The inventions that can be lived.
- Preservation of local history and history
- It provides systems that satisfy consumer and user expectations (e.g., give greater satisfaction, well-being, and value).
- Stakeholder confidence and equal treatment

2.7.3 The Economic Element 0f Sustainable Construction

According to Adetunji et al. (2003), "the industry's contribution to sustaining high and stable levels of economic growth and jobs through increased productivity and improved delivery of projects is the economic sustainability of construction." It ensures that tools such as jobs, supplies, water, and electricity are used effectively to maximize profitability. However, it is not detrimental to the atmosphere or public necessities to seek profitability (BRE, 2002). SC is also seeing to boost consumers' satisfaction, reduce environmental effects, and meet all stakeholders' needs more effectively in the economic or market context. The building is essential for the economy of a country. The sector is not only seen as a vital factor in achieving many of its policy goals by governments (Bosher et al., 2007). Also, in many countries, the construction industry is the primary economic sector. In the UK, the building industry accounts for about 7.6% of the total Gross Domestic Product (GDP) (Office for National Statistics, 2012). In 2010 the sector contributed £71 billion to the national economy's gross added product and played a crucial part in economic recovery (GVA, 2011). The building industry is a significant source of work for people, being mostly labor-intensive. It also has close ties with many other sectors back and forth.

For example, construction goods make up 20% of UK manufacturing output, which accounts for 4% of UK GDP (Construction Products Association, 2007). Also, the state of housing and other construction facilities will directly affect other industries' competitiveness. Taking sustainable problems into account will also lead to minimizing the main building risks for consumers. It may include cutting green tax exposure, reduced expensive planning production delays, prevented credibility loss and tension community opposition, and made buildings more available. Various researchers have also shown a positive correlation in the building industry between market success and sustainability (Adetunji et al., 2003).

The literature contains concepts of the economic viability of the building. (Sjostrom, 2006; DETR, 2000; Hill and Bowen, 1997; 2001);

- Ensure financial affordability for beneficiaries by reducing technological sustainability overemphasis,
- Encouraging job growth and labor-intensive development to sustain local financial commitment,
- Utilizing full cost accounting and actual cost price setting for products and services rates that represent total social and biological-physical costs,
- Implementation of policies and activities to support sustainable growth by improving productivity and competitiveness

- Selection of vendors and contractors accountable for the environment,
- Investment in social and intellectual capital through the use of non-renewable energy (this is to ensure that the needs of the future generations could be met),
- Benefits/profits from capital gains
- Enhance small business/economic diversity.

2.8 Barriers in Sustainable Construction

There are many potential barriers to implementing sustainable construction; the main one is seen as an expense. Green structures appear to have a widespread belief that they cost more than regular ones. In the short term, individual buildings can recover overall construction costs. Initial costs are increased by an average of 2 to 7 percent above expected construction costs; decision-making never quantifies reduced running costs using the entire life cycle (Castillo and Chung, 2005). The change can overcome these challenges from cost-benefit considerations and short to long-term expectations. In most developed countries worldwide, sustainable building has been identified as impaired. The studies indicate that there is a low degree of sustainability in building projects in these developed countries (Alabi, 2012; Aje, 2016; Baron and Donath, 2016; James and Matipa, 2004). In the developing nations of the world, amid the achievements of sustainable construction and the green building campaign, other developed nations fall far behind. However, certain obstacles to broader adoption are still met in defiance of these reported successes in sustainable building technology in developing countries. Sustainable building production in any country must recognize the bottlenecks stopping such activities. These obstacles include buyer resistance, lack of the right knowledge, inadequate capacity to execute sustainable building projects, horrible experience in sustainable architecture, cost implications, and barriers.

Many reasons for this low-sustainable building have been kept responsible in those countries. Only by acknowledging can successful steps be introduced to address them and achieve sustainable construction in the built environment. These aspects are known as barriers to the achievement of sustainable development.

Vandierendonck et al. (2010) have identified obstacles as features and circumstances that can obstruct behavior or impede progress towards some goals (in this case, achieving SC). However, Ayarkwa et al. (2017) suggested that barriers have a negative effect and can be internal or external in adopting sustainable development. As one of the obstacles to implementing a sustainable building, Kibert (2008) initially described the perceived higher cost. Ametepey et al. (2015), (Häkkinen & Belloni, 2011), in agreement, pointed out that renewable construction is more costly and can be more expensive than conventional construction, which means higher investment costs.

Because of higher risks, lack of prior expertise, innovative procedures, need for further testing and inspection, and lack of funding from manufacturers and vendors, consumers, are discouraged from accepting sustainable construction. Shi et al. (2013) recommended that the cost of life cycles be used to calculate the different costs and their consequences to encourage sustainable building. Hydes and Creech (2000) concluded that the higher cost associated with the sustainable building is attributed to higher consultancy fees, overestimated costs related to steps to be energy efficient, and future cost benefits being overlooked. The lack of promotion of financial services and creative budgetary tools to mitigate higher costs, which can be offset by increasing leases, are other factors correlated with prices (Serpell et al., 2013; Sodagar and Fieldson, 2007).

The government is the gateway to implementing the law, updating laws and regulations, creating building codes, benefits, and other fiscal instruments, according to (Powmya & Abidin, 2014). The government's inability to make renewable constructions impossible to enforce. Accordingly, amongst other mechanics appointed for sustainability, (Häkkinen & Belloni, 2011), have established building codes and regulations. It was also claimed that without them, the implementation of the sustainable building would be hampered. (Djokoto et al., 2014) cemented other researchers' findings by arguing that policy formulation guides the migration of sustainable buildings by clarifying the current policy structure and acts as a predictor of the government's potential guidance on sustainable growth. These policies will help get the fractured development together with its separate stakeholders. The lack of expertise, knowledge, and evidence was described as significant obstacles to adopting sustainable systems by William and Dair (2012). Whang and Kim (2015) have indicated that sustainability knowledge and efficiency are crucial to the effective adoption of sustainable building.

Similarly, some scholars Opoku and Ahmed (2015), recognized that public awareness is a matter of priority for fostering sustainable building activity in different construction companies and that adequate information and understanding about sustainability are necessary for sufficient growth. (Alsanad, 2015) in Kuwait discovered that the adoption of sustainable buildings is low, resulting from a lack of knowledge of the country's philosophy of sustainable architecture. Baron and Donath (2016) nevertheless found that the key obstacle to sustainable architecture is improperly applied while there is a significant understanding of Ethiopia's sustainable building principle. Sustainable construction in the country has been found in most cases either due to budget limitations, lack of alternative building materials, or awareness, or reduced to the problem of sustainable resource management in general.

Therefore Aghimien et al. (2018) argue that an inadequate understanding of holistic, sustainable architecture may be a significant obstacle to sustainable building. It inevitably contributes to a rise in production, according to economic standards where demand is present. In this sense, Pitt et al. (2009) and (Powmya & Abidin, 2014)indicated that the number of buildings completed through sustainable building activities would increase as the demand for sustainable construction is raised by consumers, buyers users. (Häkkinen & Belloni, 2011) agreed that consumer demand and preparation are necessary to create sustainable construction due to the relation between the market and other relevant segments, such as supply, value, and cost. The lack of involvement by construction customers and other stakeholders in environmental concerns is another consideration decided by (Du Plessis, 2002). It is exacerbated by the misunderstanding of architects' and contractors' advantages from sustainable construction as a comparative advantage. Pitt et al. (2009) concluded that the customer's and other building players' curriculum would help raise awareness and desire for safe building activities.

The building industry must lead to leading and informing construction customers and other stakeholders on sustainability issues. (Du Plessis, 2002) further states that developing countries need knowledge and technologies compared to those they receive from developed nations suitable for their natural resources. Gomes and Silva (2007) also discovered in their Latin America report that, owing to a lack of integration of research efforts at local levels, the local research group wasn't helping to accelerate sustainable development. (Du Plessis, 2002)and Opoku and Ahmed (2015) found that sustainable building skills are missing. Many projects are carried out in developed countries by small companies that, if necessary, outsource staff. It adds to inadequate recruitment and promotion of professional staff. It can be seen in the use of old administration and building methods transmitted from colonial days. In addition to skills deficiency, Shi et al. (2013) found that green materials are essential for achieving sustainable building. The instability of their success has hindered their use. Furthermore, there are other issues with the green content supply chain. First, materials are often costly, and conflict of interest between stakeholders will lead to confusion and a lack of confidence. Secondly, no database with a supplier list is open. Davis and Davis (2017) also argued that most SC ventures had had difficulties locally sourcing green goods, such as sophisticated vitrification systems. Mousa (2015) has found that there is little to no space for renewable product usage due to the market's customer-based nature. In most situations, consumers with an inadequate understanding of SC do not consider the notion of solutions that are not widely used. As a result of market interest and a lack of fair competition, less sustainable options are sold at high costs.

Table 4.

Practical Implication of Sustainable Construction with Barrier(Daniel, Oshineye and Oshodi,2018)

Author	**Country**	**Significant barriers**
Wilson and Tagaza (2006)	Australia	High initial cost.
Willuams and Dair (2007)	United Kingdom	High prices, low investment gain, reluctance to reform existing procedures, and lack of expertise and know-how for the subcontractor.

(Alsanad, 2015)Hakkinen and Belloni (2011)	Finland	Customer knowledge lacks credible cost-saving information associated with sustainable development and lack of sustainable construction practices.
Hwang and Tan (2012)	Singapore	Sustainable building and the absence of sustainable construction practices.
Zhang et al. (2012)	Hong Kong	Lack of consumer needs, lack of benefits, and high costs of government.
Abidin et al. (2013)	Malaysia	Failure of the economy, high cost, and consumer demand.
Shi et al. (2013)	China	Sustainable construction, overrunning the timeline associated with sustainable construction, and lack of green providers are added costs.
Szdlik (2014)	USA	Low expectations because of bad experience, loss of expertise, and aversion to changes in contemporary society.
(Alsanad, 2015)	Kuwait	Lack of awareness.
Ametepey et al. (2015)	Ghana	Resistance to reform, lack of interest from policymakers, and high costs perceived.

2.9 Sustainable Architecture and Housing Design

2.9.1 Sustainable Architecture

The design of sustainable development aims to mitigate the detrimental effect of buildings on the environment through sustainability and restraint of resource usage, resources and development space, and the ecosystem in general. In the construction of an urban environment, sustainable architecture employs a conscientious energy approach and ecological restoration. The idea of sustainability or environmental architecture is to ensure that our use of the resources accessible does not harm our mutual well-being or prohibits the availability of resources for other purposes in the long term. While the sustainable term has been used more abstractly, it has gained popularity in the last 30 years due to immense risks to nature. This idea is a modern 'paradigm shift' impacting both life and architecture. Provided that almost half of the energy they produce in the developed world is absorbed by buildings and operations within them. They contribute half of their carbon dioxide emissions, and the architectural approaches of civilization have become unavoidable. Consequently, after the sustainability paradigm was first established, sustainable architecture was developed in the architectural field. Architects would then play an essential part in contesting this equation.

Concerning the concept of sustainable architecture in the Brundtland report, sustainable architecture can be defined as "the architecture that meets the needs of the present without affecting the ability of future generations to fulfill their own needs." It is "a revision in architectural conceptualization to address a variety of contemporary concerns regarding the effects of human activities." According to Williamson, as we see the adverse impact of human beings on nature, 'the idea of good design has evolved into an environmentally conscious framework, which will protect the ecosystem sufficiently from the possible contamination and disruption caused by human habitation the constructed environment in many respects. By building more sustainable architecture, we are not just protecting biodiversity; we are doing a "wonderful thing." Sustainable structures are buildings of good quality, which last longer, are either less costly to build or no more than traditional designs. The environmental, economic, and social impacts of sustainable design are observable. The economic advantages are motivated by lower operating costs and better occupant efficiency. Increased well-being and comfort of the inhabitants have social benefits. The environmental gains arise from the decreased effects on climate, water, sites, and green energy supplies of the building's design and operations.

Figure 4.

Structures Developed Pa rtially Underground (Bercy Chen Studio, 2012).

(a) Entrance

(b) Rare view with good lighting

(c) From distance looks like a hill

Figure 5.

Another example of sustainable construction

Architecture is planned to enhance the quality of life as well as the climate. The purpose of architecture, according to Kremers (1995) not only to conserve money but also to reorganize them to serve people better. The articulate architect rationally talks of various problems such as sustainability, sustainability, durability, materials, and a sense of place. Sustainable vocabulary in architecture is quite comprehensive. To discourage confusion, it is essential to find out that sustainable architecture requires environmentally friendly construction as a whole. It is ecological, but it is also environmental, cultural, social, esthetic, and useful. The definitions for nature-friendly practices in architecture, terminologically, vary in time. Currently, there is an inadequate comprehensive history of sustainable architecture. Depending on the moment, there are common keywords. In 1970 the keyword to talk about natural-friendly buildings was "environmental design." In the 1980s, the term became 'ecological' or 'green.' Sustainable architecture appeared simultaneously since the 1990s, particularly following the 1992 Rio Summit. (Madge, 1997) says that in architecture disciplines, sustainability was already discussed in early 1980, which became a turning point of environmental, architectural debate in the early 1990s. "The words are, in effect, very transposable, while such substitution is a sign of changing behaviors. After discussions on the subject, 'Sustainable Architecture' is not only "used to describe the moving of 'environmentally aware design' but also to describe movement in the architectural field of cultural and economic consciousness. These are just keywords that examine different aspects of the last thirty years." The topic continues this trend.

Some debates found that ecological and green architecture was separated. According to Cole (1999), green buildings are set up to boost efficiency in contrast to standard practice, while sustainable buildings achieve a more radical, 'total' performance, based on the 'Biosphere' global health and the 'Capacity requirements.' The sustainable architecture consists of green and other architecture: sustainable design, organic architecture, environmentally friendly architecture, energy-efficient architecture, architecture that saves on energy, energy-efficient architecture, energy-conscious architecture, low-energy construction designs, bio-climate architecture. In philosophy and reality, the spectrum of language is increasingly expanding. In the architectural realm, the color levels are also impressive: A deep green structure would have a circular metabolism, whereas a light green design would have a linear but diminished metabolism. While the term 'sustainable architecture' has always been the general emblem of the modern environmental revolution in architecture, hundreds of pessimistic questions still exist against sustainable architecture as exactly it is. "The approach to sustainability can, according to Faucheux, offer a holistic, comprehensive, and variable response to an environmental crisis; and this is why sustainability is not regarded as a single path or approach, but the concept of sustainability often comes as a black box." It results in the expansion of sustainable development. "Green's designation is extremely broad, covering many points of view and is open to broader interpretation," Cook and Golton point out; it is an "essentially contestable conception." The scheme is recently assessed as an example of a sustainable housing project where some sustainable architecture idea is used for a housing project. For instance, whether a building uses low energy, water, or material use technologies may be considered sustainable. Likewise, a building can be sustainable using natural energy, environmentally friendly green technology, healthy and recycled materials, or only with the use of passive architecture concepts. The response to the question, what is sustainable? Both of these meanings make it harder to find the answer.

Adequate architecture may be appreciated as any form of architectonic, cultural, and economic-friendly approaches. None of these criteria should be overlooked to create a fully sustainable construction. Architects are unable to address all environmental issues, as Foster mentioned above. Yet, they may be an unavoidable part of this trend. Anyway, embracing the values of this theory and seeking to improve our way of living is beneficial. It is vital for the health of the environment in the new millennium. Building a simple sustainability project must respond to unique ecological, physical, spiritual, esthetic, and economical design problems related to the case study. A regional approach to design, for example, is also essential in addition to ecological design. The atmosphere and topographic aspects of the site are not ignored during the construction period. On the other hand, it is also essential to uphold the country's social and national character. Architecture should also provide the needs of the people who live in the area of faith and aesthetics. In other terms, a holistic solution to healthy houses, climate, towns, and neighborhoods is indispensable. (Foster, 2008) It is possible to construct viable construction forms for the future only by seeking new solutions to the current problems. One of the critical mistakes in the architecture profession regarding sustainability is that the building's energy efficiency against global warming is the same. Indeed, as Foster notes, "The optimal design approach involves social, technical, esthetic, economic and environmental aspects, sustainable architecture does not only include energy-efficient architecture."

2.9.2 Different Facets of Sustainable Architecture

Academics and architects seek to frame the emerging idea of sustainable architecture; moreover, Guy and Farmer make sustainable architecture the most compelling mix. We define the various approaches to environmental design as "six alternative logics." The foundations of logic vary from the world in terms of 'how each logic foreshadows technological methods and alternate visions for sustainable sites.' These logics include eco-technical, eco-centered, eco-esthetic, eco-cultural, eco-medicinal, and eco-social logics.

The Eco-Technic Logic. The geotechnical rationale is based on a scientific, political dialogue that believes in radical technological reform and that science and technology will bring environmental problems. The emphasis here is on energy conservation. In terms of global action and local reactions, the role and context of sustainable buildings are highlighted. This logic encourages ecological modernization that "indicates the possibility of overcoming the environmental crisis without abandoning the path of modernization." Further industrialization is the only way out of the ecological crisis. It can be said that a high-tech approach is being built to sustainable buildings with this issue. It is a predominantly quantitative approach. Progress is reflected in the numerical decrease of making energy usage, material embodiment energy, pollution, resource use, and the flexibility of the life cycle and cost-benefit study. Air, sun, noise levels, resource use, and similarly observable economics face measurable environmental facts in the technological picture. Decreased power usage, decreased materials energy, internal temperatures, and illumination levels can also be calculated by reduced initial and operational costs. The biggest issue in planning, resource use, and processes is logic and efficiency.

2.10 Sustainable Housing

Sustainability can be described as addressing today's needs without undermining future generations' needs. However, sustainable construction will deliver quality housing at an affordable price both in the short and long term. Sustainable housing thus needs to be built to achieve fiscal, social, and environmental sustainability from the planning stage to delivery and, at the same time, contribute to sustainable, accessible, and less destructive housing. The housing industry is not only the world's most developed project type. It is also the most touching on human life. "This idea of sustainable development encompasses a compact between society today, environmentally sound resources, and the future needs of society," says Edwards at the middle of the sustainable design triangle. In other words, the interdependence framework at a strategic or global level is triangular with housing in the middle." A sustainable building bears an increased cost of capital. It varies by configuration and specification but typically is 5-15% higher than the standard. An additional 8 percent of the building costs would retain the potential for a payout term of six to ten years. The sustainable home. The renewable house. The advantages for consumers have reduced electricity costs and lower national CO_2 pollution levels are the economy's gain.

The five conditions for sustainable housing are in line with Edwards;

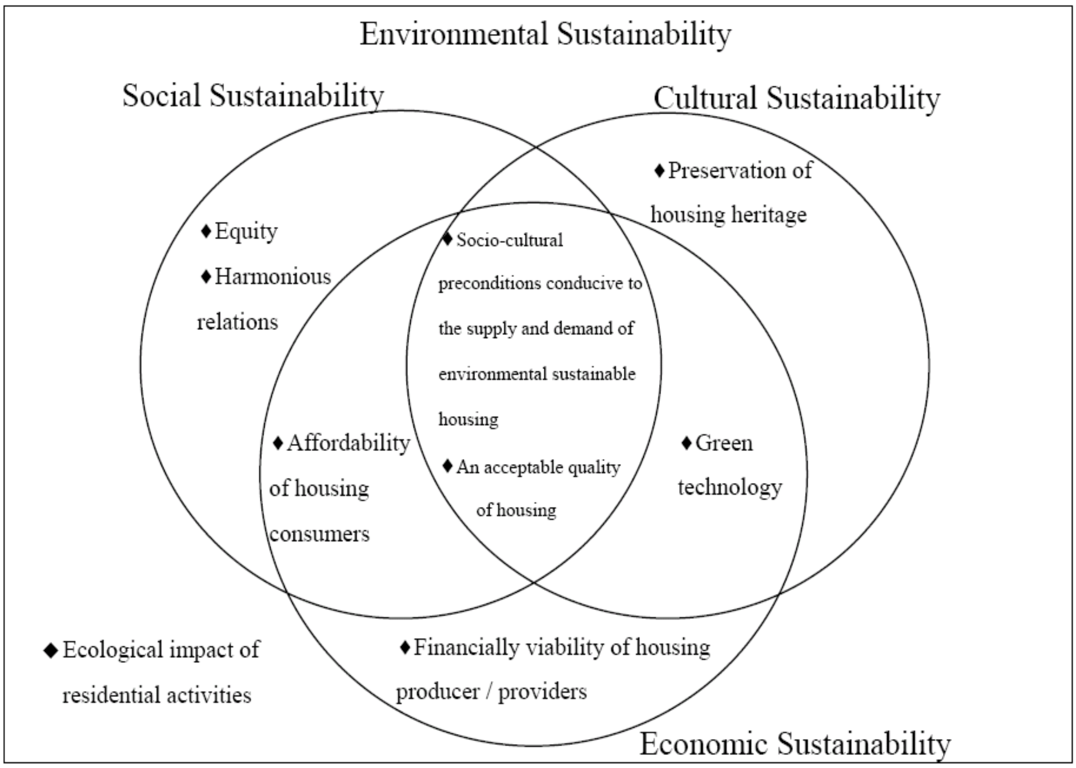
- Low resource utilization: electricity, water and other (land, minerals, etc.),
- Safe: plan protection,
- Healthy: Health emotionally, psychologically (stress),
- Productive: Physical, social,
- Gorgeous: metaphysical, aesthetic, ecological.

Homes are multi-faceted by default. It consumes natural resources and affects nature. It is a significant economic practice that has an influence on the economy as a whole. It is an essential aspect of society and quality of life. The state is also used for political and economic reasons. It is also a cultural aspect, manifesting in its own specific setting the esthetic meaning and way of life of man. Therefore, if we are to prepare for the future of housing growth, we need a systemic viewpoint. The paradigm of sustainable development provides this possibility. Sustainable housing Chui clearly explains particular facets. She notes that housing challenges can be taken into account systematically and long-term when applying the structure. In addition to "ecological sustainability" in the past, principles of "economic sustainability," "social sustainability," and "cultural sustainability," as core aspects of sustainable housing, have now been introduced. Chiu added: "Linkages should be fully taken into consideration between these different dimensions of sustainability and should not be isolated from one another."

In addition to meeting basic requirements, affordable construction can also enhance working standards. Better conditions mean more expansive areas and more services; secure, affordable, and convenient society living with piping, sanitation, irrigation, transportation, health, schooling, and child development. Furthermore, an environmentally friendly, chemical-free residence. It is equally necessary to address people's needs, including their houses and neighbors, who respect them and who meet their social and cultural interests.

Figure 5

Sustainable Housing's Facets (Forrest & Lee, 2003)



2.11 Sustainable Construction Implementation

(Haselbach, 2008) described sustainable building as any construction that meets the present's needs and desires and does not sacrifice future generations' potential. The building industry is customer-led; the degree of understanding and the adoption of sustainable building by its customers play an essential role. The key players in upgrading sustainable facilities are design workers (Häkkinen & Belloni, 2011). Most building businesses have been oblivious of the business appeal and future losing customers in sustainable construction because most customers ignored the benefits. The construction sector's reluctance to relinquish conventional building practices is hampering sustainable construction in underdeveloped and developed countries.

Abidin and Pasquire view sustainability as a framework for equalizing natural, social and economic priorities that require the creation of healthy and sustainable housing (Abimbola and James 2012). To achieve high-performance and low-environmental impact buildings, sustainability standards must be implemented from each project's outset. Venegas has identified five main environmental protection building elements: citizens, manufacturing base, capital base, natural environment, and the environment. However, in September 2009, it was developed that sustainable building can be classified on a three-dimensional basis for environmental, social, and economic growth, which is based on three principles: management of resources, design of life cycles, and the design of human housing. Sustainable characteristics are challenged to balance ecological security, culture, and the environment. Information on sustainable values remains very weak because the best practices in the home construction sector are inactive.

2.12 Possible Solutions to Sustainable Construction

2.12.1 Proper Awareness of Sustainable Construction

Sustainable design is, without a doubt, an integral aspect of today's design education. Third-party universities in Nigeria must develop environmental architecture in their semester program at both undergraduate and postgraduate levels. Sustainable production, sustainable design processes, values, legislation, and construction laws may be used. The younger designers' mindset will be designed to be more mindful of sustainable growth and development. The lack of sensitivity in the Tertiary Institution to environmental design needs this education. Practitioners could use consultancy firms or neighborhood resource centers to fill the educational void. Primary evidence indicates that, unlike architects, other designers are not familiar with construction laws encouraging energy efficiency and recycling.

2.12.2 Products Suppliers and Manufacturers

The production and extension of their product lines are critical for product and material suppliers and producers. Designers and consumers are more likely to prefer the alternative with expanded variety. Also, designers must actively inquire about their raw materials, methods, and the sources of goods as they are questioned. It will show good outcomes with persistence (Haselbach, 2008; Opoku & Fortune, 2013).

2.12.3 *Client Education*

Barriers that discourage consumers from following a sustainable design solution already amount to excess costs, limited use of materials, and education on the urgent need for sustainable growth. It results in consumers ignorant of environmental liabilities and designers' lack of passion for sustainable building (Opoku & Fortune, 2013). The higher education level would allow consumers to be more educated on the benefits of alternative strategies for sustainable growth and architecture. In this way, consumer understanding is strengthened, and acceptance is enhanced. In the end, demand for sustainable building will increase, and the price of sustainable materials and technologies will be reduced (Yudelson, 2007).

Use Of Tool Rating. Many scientists have recommended a Green Star classification system. It is essential to establish and manage a Green Building Council international standard. The use of ranking tools would have a positive effect on the sustainability status of projects. It included cooperation in a project aiming at environmental sustainability with other professional organizations, including developers, architects, contractors, the environmental industry, and all other stakeholders. Therefore, a majority of participants were suspicious of the method (Häkkinen & Belloni, 2011; Larson, 2001).

Introduction Of Sustainable Construction In The Educational Institutions. It is essential to incorporate sustainable and green building education into the curriculum. Many people graduate from various schools in architecture and construction fields every year, and these areas also include several green energy and services for construction sciences, technology, and architecture. It will help experts and educators learn practical knowledge of the working world in schools.

Accessibility Of Information And Intricacy Of Analysis. They underlined substantial accessibility of knowledge and detailed research on sustainable development by (Azapagic & Perdan, 2000), (Phogat & Singh, 2013), and (Yudelson, 2007). It represents an indicator of qualitative, quantitative, and sustainable task development for the whole scheme. It offers a structure and a structured method for assessing building sustainability. Knowledge and sophistication of research lead decision-makers to evaluate the construction equipment procurement process in triple terms of sustainability.

Waste Management *i*n Sustainable Construction

Waste is defined as something more significant than the minimal quantity of tools, supplies, parts and work time needed for building manufacture. Waste comprises material losses, and needless work carried out, which lead to additional costs without adding value to the finished product (Koskela, 1992). Briefly, waste is something for which the client is not happy to pay (Tommelein, 2015).

2.13 Waste in Construction

Building waste consists of unwanted material, manufactured by construction or manufacturing, expressly or by accident. It involves construction supplies such as "insulation, nails, al-conveying electrics, roofing shingles and waste shaping the ground, such as dredging, tree stumps and debris. Constructing waste can include plumage, asbestos, or other environmentally dangerous substances.Waste in the construction industry may be deconstructed or destroyed and produce substantial waste during the development process and at the end of a building's lifespan.

Typical construction waste products include;

- Asbestos and Insulation materials.
- Ceramics, tiles, bricks and concrete.
- Plastic, wood and glass .
- Tar, Bituminous mixtures and coal tar.
- Metallic waste (including cables and pipes).
- Soil, contaminated soil, stones and dredging spoil.
- Gypsum.
- Cement.
- Paints and varnishes.
- Adhesives and sealants

Many studies have been carried out into waste in construction, but the bulk of those studies concentrate on waste materials that constitute only one building process resource. It is seen in terms of the vast quantities of waste, lack of value and adding value to existing building methods (Formoso et al., 1999).

Agopyan et al. (1998), organizing a two-year analysis on material waste assessment, involving 15 universities and more than 100 building sites, undertaken at the Brazilian Institute of Technology and Standard of Construction (ITQC). The main findings summarized by (Formoso et al., 1999) were:

- The real surplus values of construction supplies are above the average values of the company's cost calculation.
- As they do not adopt reasonably clear procedures for avoiding waste at the facility, most organizations do not appear to be concerned with substance waste. These businesses tend not to have a well-defined material control framework or co-ordinated substance use legislation.
- The site is different when dealing with waste. Unique concentrations for the same substance may have been shown from close locations, meaning that a large amount of the trash will be eliminated.
- Many construction contractors are not fully aware of the waste they have and how they can avoid it.

- The majority of waste's critical factor issues in the pre-production stages include insufficient preparation, insufficient architecture and lack of material availability, etc.
- (Formoso et al., 1999) state that this type of study has been somewhat limited in its approach to founding waste management schemes, and for the following reasons:
- The majority of the studies concentrate on material waste, which represents a single resource of garbage in the building industry. Several of these experiments have been done on the premise that waste is considered associated with faeces.
- In addition to the need for a broad group of analysts and people to track work at the facility, the massive data collection costs are also involved. In real-time production management systems, the waste control techniques used in research studies are not readily adapted.
- This experiments had only a few impacts in terms of disciplinary measures since these studies typically require a long time to produce outcomes.
- For businesses like most waste management procedures, the restriction of the learning processes arising from these studies is external because most individuals engaged in data collection and processing do not belong.

2.14 Waste Management

Waste management applies to the practices necessary to handle waste from start to finish. It covers waste generation, storage, treatment and disposal, and waste control inspection and enforcement.Waste management is an essential component of the construction (Shen et al., 2004) to reduce and recycle the quantity of waste generated. Sustainable building practices must be accomplished using social, environmental and economic principles which lead to sustainable development. The significant waste management phases include production, transportation, collection, delivery, refining and disposal (Rodgers, M 2011). Where several methods to ensure productive management can be implemented at each level. Although waste generation can be possible, it can be minimized and accomplished general building practices, from architecture to deconstruction. For instance, some researchers, including Ajayi, Greenwood, R. And Ekanayake, emphasized that one of the most appropriate waste control techniques is architecture to mitigate it. If less waste is first produced, the other stages in the management process may have less burden.

The emphasis of this research on the success and efficiency of the whole management process is on the final stage, disposal because poor and non-discriminatory waste disposal would entail environmental degradation. Therefore the choice and implementation of waste disposal procedures for building materials is essential because their desirable characteristics may be useful as tools for other sectors, which are environmentally sustainable (Geng et al., 2012; Greenwood, 2003).

How to manage waste in construction

Waste disposal has been a big challenge for developing and developed countries alike. Owing to population development, habits, usage, and technical change, the waste generation trend has continued to increase, which has increased the need for this environmental problem to be tackled.

But, in three significant steps, waste may be treated, or decreased;

- Designing out wastes,
- Waste minimization through procurement,
- Site waste management plan.

2.14.1 Designing Out Wastes

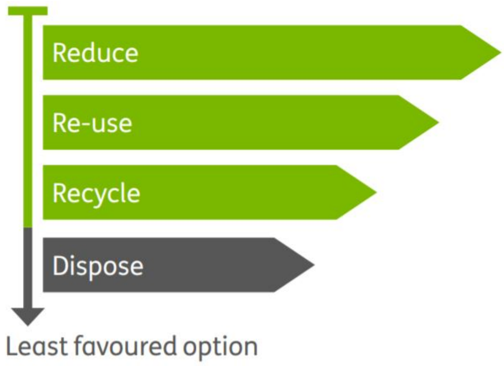
The design stage is an essential factor in deciding whether the waste is generated in building projects. It is necessary not only to avoid debris being created first of all but also to ensure that the recycled material and potential recyclability of the project are improved positively.

The five main concepts used in the design of waste;

- Plan for effective waste procurement;
- Plan for optimization of materials;
- Plan for building outside the premises;
- Reuse and recovery design; and and
- Discovery and versatility architecture

Figure 6.

Hierarchy of Waste



Construction plans should always be prepared and built to prevent waste being generated at the site. Still, it is necessary to follow the waste hierarchy where it is not feasible (Figure 7) by exploring the following levels:

- Reduce waste by using waste management initiatives.
- To prevent waste from being produced, reuse materials.
- Cycle materials from places where it is not feasible to recover materials.

2.14.2 Waste Minimisation Through Procurement

The project's procurement of services explains the best way to work with consumers or building ventures owners of small and medium-sized enterprises (SMEs). Some initiatives can be carried out during contractors' procurement to assist with waste ownership and to minimize building waste within the supply chain. Contractual relationships between consumers, manufacturers, principal contractors and project subcontractors may affect waste management. Maximizing the reuse of the materials also offers contractor ways to work smartly to enhance waste control, reuse waste disposal techniques, and make the project more cost-effective. By following these methods, contractors are more likely to vary and, theoretically, raise their tendering ratings.

In their invitations to tender, prospective contractors may be invited to suggest the project's possible recovery goals at the design stage. There are two explanations for this. First of all, the capacity for waste generation on-site, if the plan includes acceptable practice levels for waste minimization, would be minimized.

Thus, a lower target rate can be taken into consideration. Second, as a solution for the workplace, the contractor is a better fit than the customer.

2.14.3 Site Waste Management Plans

The best practice illustrated in this chapter is to complete the SWMP for this site, which does not replace the SWMP need. An SWMP in a building project is sound practices and gives you an efficient waste management process.

Three primary goals of an SWMP exist:

- Enhancing the productivity of your projects' capital and profitability;
- increase your workers' knowledge of waste and materials (both site and management);
- Helping to satisfy the duty to offer treatment.

Preparing a preliminary plan SWMP Overview facilitates the study of existing waste reduction and recovery principles and highlights areas of acceptable and best practices in waste reduction and management. The Outline SWMP also allows waste avoidance to be identified and applied in detail during building, reuse and recycling opportunities, while reducing restoration, renovation and excavation waste transmitted to the site.

2.14.4 Classification of waste

The benefit benefits from waste decomposition are less than the expenditure needed to minimize it and avoidable waste, where the waste costs are considerably higher than the price of avoidance, can be categorized into inevitable (natural destruction), according to (Formoso et al., 1999). Depending on the place, environment and organization, the volume of eventual waste depends (as it depends on the technology implemented). Their source may also identify wasted goods, that is to say, by the root cause of the waste stage in the process. However, waste can produce strategies before the production level, for example, preparation, design, procurement of products, and supply and training for personnel. Debris can usually be detected in the development stages. Shingo states (1989) that waste can be divided according to its composition into seven categories. Bodek (2007) added the eighth waste, under-used workers' expertise, which is how Lean approaches define and handle it.

Waiting Time. That is the idle period triggered by the inability to lift and synchronize the flows and work speed between various groups or machinery (Formoso et al., 1999). The cycles of inactivity occur when entities, machinery or systems delay until primary operations are finished and the loop time is extended due to an unvalued activity. This delay is typically attributed to lack of contact between ground activities, supporters and service providers. Equipment used to carry out the previous operation often breaks down or is not ideal for the job. Usually, a team at a building site awaits supplies, sketches or guidance for a process to begin.

Movement or Motion. Inefficient or excessive workers' gestures during their jobs. Poor disposal, weak machinery or inadequate working procedures may explain the waste (Formoso et al., 1999). Not only consume time for all additional phases and gestures but does not also add value to the finished product or service.

Transportation. The unwanted transfer of materials on-site, which does not help the operation. It may be manufactured due to insufficient machinery, excessive handling or unsafe road conditions. Highlights are also misalignment and lack of preparation for material flows. Consequently, time, energy, space on the site and material may be lost (Formoso et al., 1999). The more resources travel, the more loss and pollution would be possible (Banawi & Bilec, 2014).

Processing and Over Processing. The essence of the processing task and the processing system used are closely connected to it. E.g., if a ceiling is plastered, the waste morter (Formoso et al., 1999).

Inventories. Unnecessary or unsustainable supplies that meet the industrial criteria contribute to material loss, such as insufficient product requirements, material degradation, theft or vandalism. The money attached because of the discarded materials is often called a cash loss. The key factors behind the waste are confusion in measuring amounts and not preparing tools (Formoso et al., 1999).

Over Production. It happens as production starts when it is halted. Therefore, output results in excess inventory, materials, and workforce use more quickly than or before it is required (Banawi & Bilec, 2014).

Correction or Defects. The final or intermediate output does not adhere to the consistency criteria (Formoso et al., 1999). It will lead to more work making prioritization more difficult.

Underutilized People. Do not take advantage of talent, mental and physical capacity (Garrett & Lee, 2010).

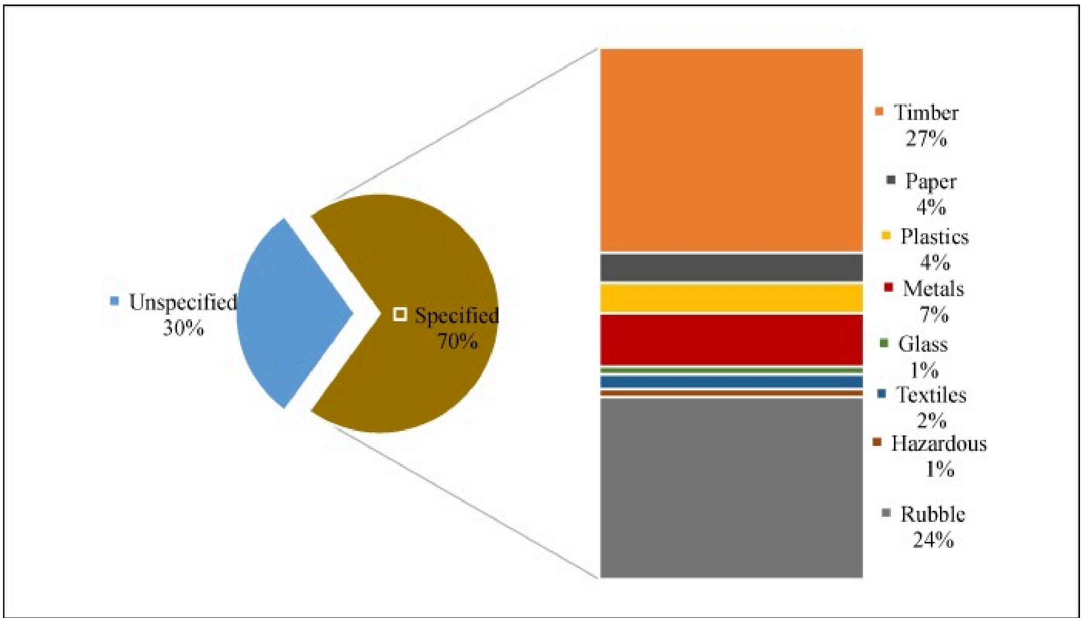
2.14.5 Construction Waste Statistics

Building waste is produced and then discontinued, irrespective of whether it was treated or deposited. Building, water, electricity and materials are the foundation of all our demand, but they also produce waste. This waste is called C&D waste, created in the construction, maintenance and disposal phases of a house. In addition to destroyed buildings, real estate renovations and the development and reconstruction of parks, overflowing and bridges, the construction waste industries contain waste. In 2012, worldwide cities produced 1.3 billion tons of solid waste per year, according to a 2012 World Bank survey. It is projected that this amount will rise by 2025 to 2,2 billion tons annually. Per year, building materials account for half of the world's solid waste. The preparation and isolation, collection and transfer, recycling and reuse and waste disposal are measures for building waste management.

Approximately 170 million tonnes, of which 48 %were estimated to be recovered, were produced in the US by 2003. Chun Li et al., (2013) have compared building waste generation to the plant's floor areas by suggesting that most buildings produce between 20 and 30 kg of m2 in the United States. In the EU, the largest waste stream is created annually by over 450 million tons of built and demolition waste, excluding waste from mining and farming. 75% of EU building and demolition waste is landfilled, even as in countries like Germany and the Netherlands over 80% recycling rates have been exceptionally hit. Disposal of building debris in the UK accounts for more than 50% of the gross deposit volumes. Also, Guthrie et al. suggested that, due to injury, failure and over-ordering, at least 10 % of all the materials supplied to UK sites was wasted. However, Fishbein claimed that the average weight of construction materials shipped to a building site is as much as 30 per cent. Similarly, 38% of solid waste in Hong Kong is from the building sector, and about 40% of the available waste management capacities were used in 2006 to handle building waste. A majority of the construction waste in the Asia Pacific region is expected to be produced in the coming year, followed by North America. Europe has built the best waste-management technology for building according to the study.

Figure 7.

Composition of Construction Waste



Poon et al. (2004) state in Hong Kong that the waste from seven products is being tracked in 5 house building projects and prevention of building waste. The volume of direct waste by weight was between 1% and 10% by weight of the number of products purchased after processing and weighting all material wastes. In comparison, the overall bought building materials were waste on-site on average, 9 % (by weight). A similar study by Begum et al. (2006) in Malaysia showed the following composition and percentage of material wastes: Soil 27%, wood 5%, brick and blocks 1.16%, metal product 1%, roofing material 0.20%, plastic and packaging materials 0.05%, concrete and aggregate 65.80%. Jones and Greenwood (2003) obtained percentage of waste in ten materials as plasterboard 36%, packaging 23%, cardboard 20%, insulation 10%, timber 4%, chipboard 2%, plastic 1%,electric cable 1%, and rubber 1% (Osmani, 2008). Another study carried out by Kulatunga, Amaratunga, Haigh and Rameezden (2006) in Sri Lanka identified the wastages of the main material as sand (25%), lime (20%), cement (14%), bricks (14%), ceramic tiles (10%), timber (10%), rubble (7%), steel (7%), cement blocks (6%), paint (5%) and asbestos sheets (3%). Formoso et al. (2002) were one of the first material waste research in Brazil to have involved a single case study based on results from an 18-storey building project, which were picked because the construction firm held all material source and usage records properly. It was determined that ten products were both overt and indirect waste. Direct and indirect waste figures used. All products bought contributed to 18% of the overall waste, reflecting an extra expense of 6%. One of the big achievements of this research was that it emphasized the value of direct waste. E.g., the amount of indirect morter waste amounted to 85% of the plaster volume. That represents a major unwanted additional burden on the building structure and a loss of materials.

2.14.6 Waste Handling System in Construction

The waste disposal system is a system for storing, sorting, recycling, or depositing human society's waste materials. Waste by source and composition shall be graded. In general terms, the waste products are liquid or solid and can have a harmful or inert effect on health and the atmosphere as their parts. Usually, the word waste is used for industrial waste, drainage, hazardous waste, and electronic waste. Municipal water discharge is funneled into drainage systems in developing countries, where it is exposed to treatment for wastewater or sewage. This method eliminates any or more wastewater or sewage impurities until it enters aquifers and surface water such as rivers, streams, estuary, and oceans.

Figure 8.

Treatement Plants For Waste Water

Figure 9.

Ladfill for Sanitary

Refuse (MSW) is the non-hazardous solid waste from a recycling or transportation community to a waste management or storage facility. MSW refuses are waste from the district. Trash and waste are used in denial. Waste is primarily food waste that can be decomposed, and waste is mainly dry material such as bottles, paper, fabric, or wood. Waste, although scrapping is not, is exceptionally decomposable. Small debris containing large objects such as old refrigerators, sofas, or wide stumps for trees, or waste from building and renovation (for example, timber, drywall, bricks, cement, and rebar), often in need of unique collection and treatment. [A steel rod with reinforced concrete frames] A rejection is usually deposited in health sites, i.e., in pits or other locations with impervious plastic liners, where waste from the rest of the world is segregated.

Any type of solid and liquid waste has been listed as toxic because it affects the atmosphere and human health. Hazardous waste contains hazardous, volatile, ignitable, corrosive, contagious, or radioactive materials. Toxic waste is agricultural, chemical, or biological waste that can lead to damage or death when swallowed or absorbed into the skin. Reactive waste is chemically reactive and reacts with air or water violently or explosively. Infectious wastes (for example, discarded bandages, hypodermic needles, etc.) are products containing pathogens. Radioactive waste (such as cobalt and iodines used for cancer therapy and other medical uses in spent fuel rods containing fissionable materials used in the manufacture of nuclear power) emit ionizing radiation that could damage living organisms. Dangerous waste faces unique obstacles to handling, transportation, and recycling, which differ in nature.

2.15 Waste Management Recycle and Reuse

According to the report, 'reduction, reuse and recycling' strategies are required to regulate the amount of building waste, but scarce services are hindered from occurring, lack of standardization, slow profit margin, political apathy, and lack of knowledge. A majority of the construction waste in the Asia Pacific region is expected to be produced in the coming year, followed by North America. Europe has built the best waste-management technology for building, according to the study. The aim is to minimize waste production to a certain degree below the industry level. However, Poon et al., 2004 stressed potential factors that could influence recycling;

- Contamination,
- Collection and transport,
- Sorting, transforming and disposing,

- Standards,
- Size of market and
- Requirement for information.

For a further project, the destroyed buildings must be reclaimed and reused. Recycling and reusing materials can, on the other hand, be favored for building instead of new materials. It's an environmentally friendly change. The following should be mentioned in the building materials, according to Edwards and Turrent:

- An integrated energy audit may provide valuable advice for the design process,
- The use of recycled substances such as wood, bricks, roofing tiles should be considered,
- Recycled newsprint cellulose separation can be easily used in the building of timber frame,
- New elements such as masonite beams have a high weight to strength ratio, using reclaimed wood,
- Prefabricated or assembled parts eliminate waste and mitigate on-site dust exposure,
- In contrast to polymer-based goods, natural materials such as wood, stone, and linoleum should be used.

2.16 Renewable Energy

Renewable energy is defined as renewable, continuously loaded energy from natural sources or processes. Sunlight and wind, for starters. And if the availability depends on time and time, they keep sparkling and blowing. Renewable energy is mostly viewed as a modern invention, and natural life is used for travel, electricity, ventilation, and much more for a long time. The architecture has recognized the detrimental impact of non-renewable energy sources on renewable energy sources. This issue affects electricity generation in the LEED rating system in particular. It can now be sustained with the assistance of photovoltaic cells, and the remaining energy can be sold on the board.

Although renewables are mostly considered a modern concept, the use of the force of nature for heating, transportation, illumination, and more have long been used. The wind has pushed vessels to grind grain to sail seas and windmills. The sun was warm throughout the day, helping to spark the fires until the evening. But in the last five hundred years or so. People have become cheaper and cheaper dirtier energy sources, including coal and fracked gas. Now that we have more and more creative and cheaper wind and solar energy collects and keeps, renewables are becoming a more significant energy source, accounting for more than one-eighth of the US. Renewable energy expansion happens on both small and large scales—solar panels in the house on rooftops that will supply electricity to enormous wind turbines on the network. Even whole rural areas rely on heating and illumination electricity from renewable sources.

2.17 Materials and Resources

2.17.1 Materials-Efficient Framing

The aim is to maximize the use of framing materials. Under this title were assessed waste factor cap and off-site processing. Often the building materials are extra organized. It is obvious. It adds to higher costs and degradation of the environment, such that pre-manufactured products are the safest ones to work with.

2.17.2 Environmentally Profitable Products

In his study The Green Building Handbook, he explained a few headings, including the environmental effects due to development, oil use, loss of water, global warming, acid weather, pollutants, and health risk choosing materials for a construction project. (Woolley et al., 1997) briefly illustrated some of the following headings, which need to be addressed. The environmentally sustainable substance has high levels of emissions that arise naturally. There is zero-emission for any of these goods. The construction materials' environmental friendliness tends to be measured by a new term called incarnate energy. A substance's energy is equal to the materials needed to collect, transport, or assemble it before use in the factory. Usually, incarnate energy accounts for about 10-20 percent of over 50 years of overall energy. The incorporated energies of construction materials generate the complete incarnated energy of the house. The presence of the goods is ignored, on the other hand, in this dilemma. The following is critical of Foster:

The longer the system lasts, the more investments will be made in its incarnated resources. The case of high-quality, robust goods is, therefore, tend to be reinforced. But here, the statistical equations of embodied energy get more complicated. The refinement of aluminum, for example, requires such a considerable energy input that it is regarded as an unsustainable content. Yet aluminum of high quality will stay maintenance-free for decades. Sustainable lower quality products can need to be restored or replaced in the same period, contributing to increased energy usage. Sustainability should also be balanced with longevity and the delight of quality; sustainability does not entail the loss of luxury or amenity (Foster, 2008).

Table 5.

Building Material's Embodied Energy (Sue et al., 2001)

Materials	**Density**	**Low value**		**High value**	
	(kd m^{-3})	**GJ tonne^{-1}**	**GJ m^{-3}**	**GJ tonne^{-1}**	**GJ m^{-3}**
Natural aggregates	1500	0.030	0.05	0.12	0.93
Cement	1500	4.3	6.5	7.8	11.7
Bricks	1700	1.0	1.7	9.4	16.0
Timber (prepared softwood)	500	0.52	0.26	7.1	3.6
Glass	2600	13.0	34.0	31.0	81.0
Steel (steel sections)	7800	24.0	190.0	59.0	460.0
Plaster	1200	1.1	1.3	6.7	8.0

GJ= giga Joule, a unit of energy, 1 GJ= 278 KWH

Even though the house's embodied energy is of high importance, it is often seen to provide higher quality management through manufacturing and improved building speed. Half of the new stainless steel in the UK is recycled steel. Green reasons in support of this substance, says Edwards. It is imperative for sustainability to be a recyclable and long-lasting material. Foster also supports this strategy. According to Viljoen, though, their original production is quite likely to use all stainless steel and aluminum. However, they have quite serious environmental consequences. It is not considered ecological for their widespread use in structures. However, it seems more sustainable as compared with reinforced concrete, stainless steel. The following are Yeang's comparisons:

- Structured concrete frames have about the same amount of incarnated energy as steel, but they are less recyclable than steel at the end of their usable life. Structural steel can usually be recycled and essentially reused in the original application, while concrete can be recycled for structural purposes only in a limited form and with restriction.
- The plastics have very high incarnated forces. They have both benefits and inconveniences, just like steel, and are chemical waste materials. It may also be argued that we reduce waste accumulation through the use of plastics. However, 'the use of plastics has also helped to benefit the industry itself that is responsible for a huge volume of CO_2 pollution as well as over half of all toxic emissions to the environment.' Furthermore, plastics tend to emit gases into the atmosphere, known as volatile organic compounds (VOCs).
- It is clear that local construction materials should preferably be selected for highly processed materials and those from far-off areas and those requiring minimum processing. Non-toxic goods should instead be compared to materials containing chemical pollutants. The materials' toughness is also very critical. It impacts a building's lifetime. As long as a host with low energy lasts, its materials will have a less relative impact.

CHAPTER III

METHODOLOGY

3.1 Research Design

The techniques of conventional CM are unable to be compatible with the modern complex construction project with respect to sustainability. In this section, the research approach has been discussed that is adopted for this research. A broad literature review has been performed critically in order to understand different approaches used by different researchers regarding sustainable construction and waste management, followed by the importance of sustainable development and its implementation within the construction industry. By performing the critical review of the literature, the theories and practices of sustainable construction to the corporate sector have been studied. Further, the drivers of sustainability construction, barriers of sustainability construction, locate the Nigeria related research, and problem identification is also found by performing the critical review. The research is to find out the sustainability implementation barriers, drivers, and modes within Nigeria. The objectives are found from the literature review having the themes related to the sustainability implementation and adoption in different firms and nations over time. On the basis of these themes, the data collection and initialization of thematic analysis have been performed.

3.2 Participants / Population & The Sample / Study Group

The sampling of numerous survey results was the primary way to gather data. In six municipalities in Abuja, namely: AMAC, Bwari, Gwagwalada, Kuje, Kwali, and Abaji, a descriptive survey was carried out with a questionnaire. Random dispersal included sample sizes of about 20-30 respondents. The key respondents were building practitioners who had sustainable activities such as architect, contraactors civil engierie . Primary sources such as newspapers, reports, newsletters, workshop papers, and internet references were also used in the study. The analysis of these literature categories was necessary if sustainable building developments were to be established.

3.3 Data Collection Tools/Materials

Due to distance from case study, sampling of numerous survey and online interviews was the primary way to gather data. Resources such as research articles, thesis, newspapers, workshop papers, and internet references were also used in the study.

3.4 Data Collection Procedures

A random survey has been carried out to understand how much people know about sustainability and sustainable construction in regards to the case study. Major respondent what are into construction, architecture, and background on building has been consider in this research. Survey and interviews questions are sampled below.

Questions from the survey were the following:

- Should the business use sustainable methods of delivery for green architecture practices?
- Do Abuja processing organizations follow waste management practices in project delivery?
- Can you agree that the environmental consequences of construction operations are negative?
- How the house impacts Abuja's natural ecosystem
- Do you know the green building and content selection criteria for architecture?
- What are the key problems in Abuja that impede the use of sustainable practices?
- What are some of the advantages of the discipline of sustainable construction?

CHAPTER IV

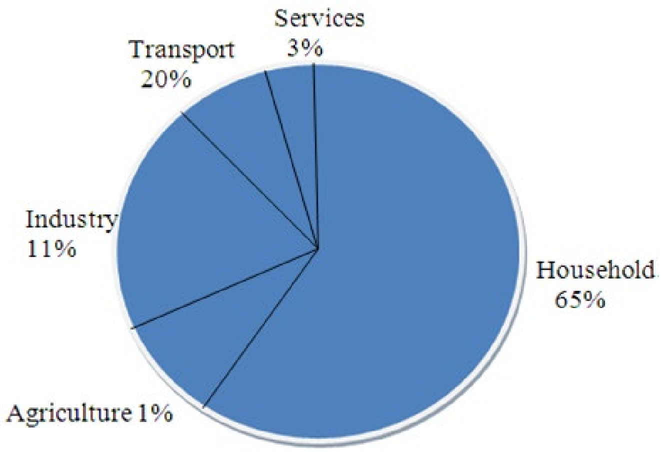
ABUJA FEDERAL CAPITAL TERRITORY OF NIGERIA

4.1 Introduction

In the past decade, Nigeria's economy has been underlined by the dramatic shift in growth, including the construction industry. The business has outstripped numerous other sectors with double-digit growth rates, with stronger GDP and worker protection consequences. Despite that, the industry faces various difficulties, not limited to insufficient professional jobs, the scarcity of materials, and wasteful activities in power and farm. The following case study has been designed to examine emerging sustainable building activities in the construction industry. New construction has eradicated conventional approaches for constructing the project, with the bulk of them employing ecological and sustainable architecture techniques. The industry is also at the forefront of improving the quality of life through environmental provision and infrastructure and environmental balance. The research assesses the environmental impact of building schemes focused on environmental efficiency and the industry's increasing potential. The chapter presents an in-depth overview of the country's buildings, ecological problems, sustainability restrictions, potential solutions, and sustainable activities that differ in terms of local contexts and stakeholder skills in a specific field. That can help you explain why company-wide sustainability can only be accomplished if sustainability, nature, and business consequences are well understood.

Figure 10

Nigerian Economy Distributors

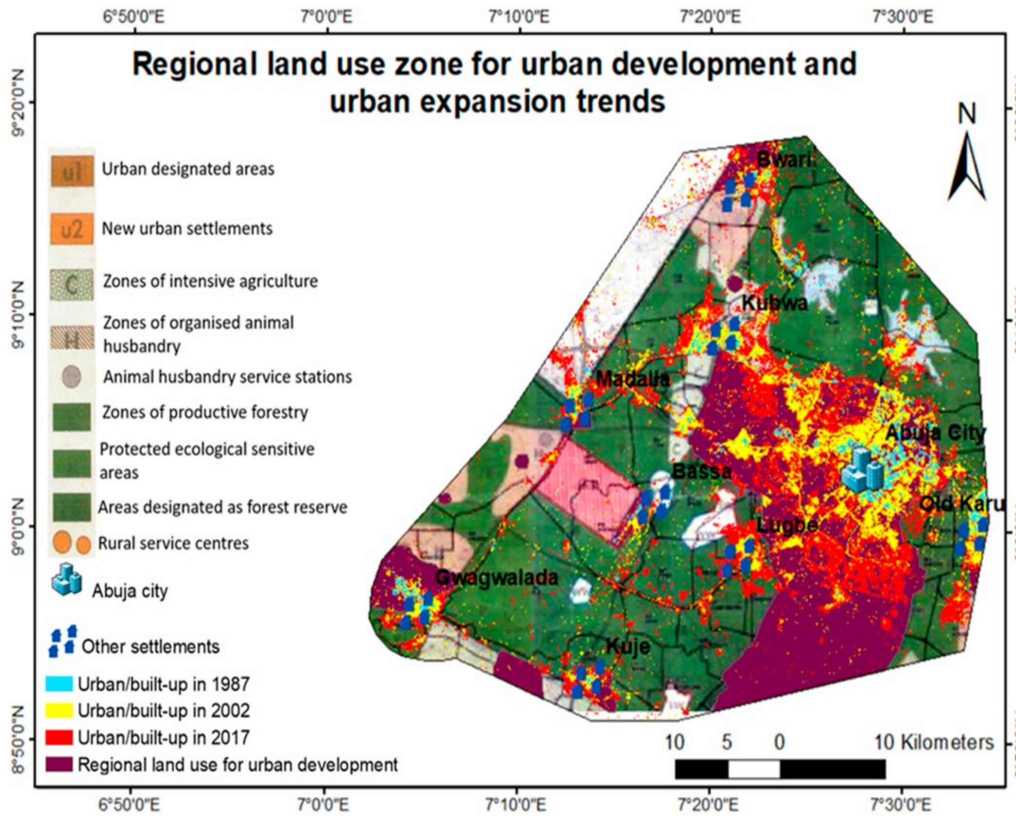


4.2 Construction in Nigeria

According to the National Bureau of Statistics (NBS), the building sector has improved over the last three years at an 8% GDP record growth rate (Ola, 2019..). The industry has fostered more substantial investment and growth prospects by large ventures concerning the construction and maintenance of structural engineering and infrastructure facilities such as highways. The Nigerian GDP is one of the leading industries that play an essential role in economic development, contributing to an average of between 17 and 25 percent. According to UN-HABITAT estimates, the state's 17 million units hosing deficit will require a profitable growth from 172000 to 200000 companies annually over twenty years to fill the lacuna. These will have a significant financial effect and worry about environmental knowledge. Moreover, estimates in the Integrated Master Plan for Infrastructure show that the nation will invest about $3.05 billion in the next 30 years for infrastructure growth.

Figure 11

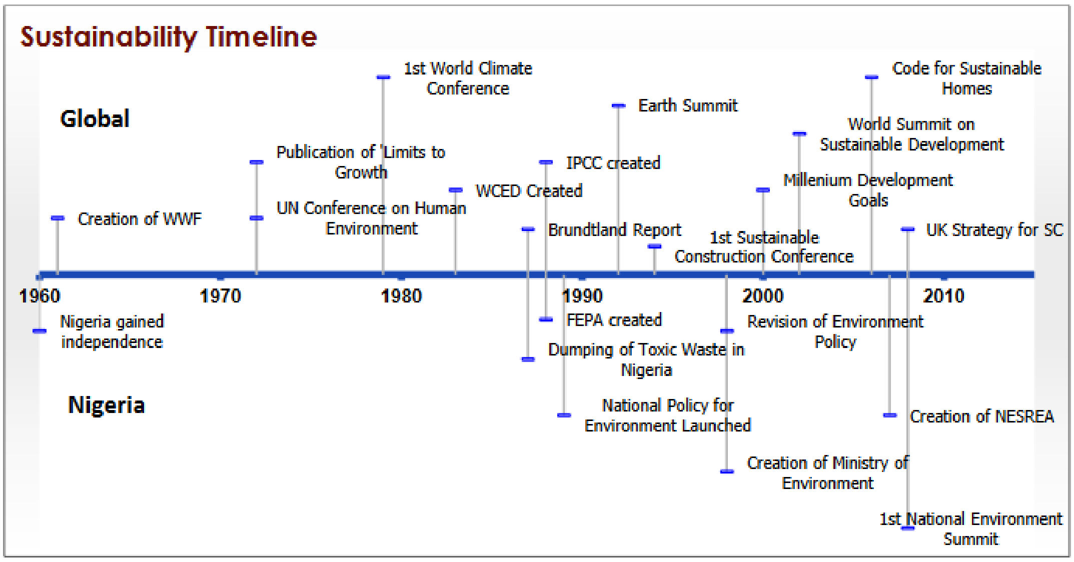
Nigerian Region Land



The construction sector is one of the critical factors for socio-economic growth, according to estimates by the Nigerian Construction Industry (NCI) (SARKI, 2019). It is also a leading producer of natural commodities, some non-renewable, including petroleum and calcareous. Rising demographic demand for utilities and homes in urban areas increases, ensuring more buildings and structures need to be built. More building materials and resources will be in the market as the construction needs rose. The mechanisms ought to resolve the need for environmental protection, social responsibility, and economic support to achieve prosperity through housing and infrastructure. For continuing progress, a sustainable development policy is essential in developed countries.

Figure 12

Timeline of Sustainability in Nigeria



4.3 Waste management in Nigeria

Waste control has been a global concern in the past decade, without the exception of African cities. Nigeria is one of the countries with more than 210 million people plagued by waste-related environmental issues. The estimated annual waste in the world is 32 million tons. Most waste results from irresponsible disposal, with just 20 percent gathered and well disposed of. As a result, blockage of water supplies with high water contamination degrees is allegedly increased in sewers and drainage systems. African populations are reportedly growing, creating increasing pollution in cities that lead to slum residents. With population growth up to 5.5%, Nigerians are rising at a rate of 2.9% annually. For this cause, the inadequate handling of waste is associated with severe health and environmental consequences.

Table 6.

Waste Composition of Different Nigerian Regions (CO Ugwu · 2020)

Reference	Plastics %	Paper %	Metal %	Glass/Ceramic%	Others %	State
Abur et al (2014)	7.04	9.58	2.54	7.32	20.28	Abuja
okey et al., (2013)	7.72	3.13	6.07	-	5.33	Akwa Ibom
Ahmed (2012)	15.80	8.81	-	-	64.23	Illorin
Nabegu, (2010; 2014)	21.50	23.00	14.00	-	-	Kano
Igbinomwanhia,(2012)	5.95	7.01	12.17	14.29	8.06	Jigawa
Musa et al., (2016)	35.32	10.17	6.84	2.57	11.92	Enugu

4.4 Background

Abuja, the federal capital of Nigeria, came to be a national unity based in the 1970s. Moreover, the government felt the need to improve the country's central part, following the increasing population at Lagos and the growth of its economy. It led Nigeria's administrative office to Abuja (Obiadi et al., 2018). It is a big city in Africa between 8o25'N and 9o25'N latitudes and 6o45'E and 7o45'E longitude. Nassarawa on the east, Niger on the west, Kogi on the southern border, the Kaduna state on the north. The area has been excellently designed based on a master plan aimed at removing all planned bottlenecks. With a projected growth rate of approximately 30 percent and an economy of roughly 778,561 or 1092 people per kilometer, the city is in an excellent position. After the growing settlement rate and population rise, Abuja became a city of squatters and suburban squatters. The Region is based on fossil fuels, far from modern-day sustainability steps, after significant innovations and growing architectural and civil systems.

Figure 13

Nigerian Map

4.5 Waste management in Abuja

Abuja, which functions as Nigeria's administrative capital, has a waste management strategy but many adverse political and organizational limitations concerning it. At first, Abuja was initialized with a Master Plan to foster development and monitor unplanned growth. With the increase in Nigeria's population, however, the inhabitants were beyond their original ability, and population growth in Nigeria was rapid by 2001. It resulted in inadequate city planning oversight, including waste collection infrastructure. This research aims to evaluate Abuja's city both in construction and other fields as regards waste management.

During the last decade, waste collected in the city has risen in terms of quantities and variety. Control and disposal have been questioned. After testing, food residues, paper, glass bottles, metals, and plastics are the waste's critical components. Due to building practices in which non-biodegradable materials are used, a large amount of waste was taken from our research. Each of the five councils in Abuja has made a considerable contribution to the region's waste, which is why better management is required. In pursuit of waste management and environmental restoration, the Environmental Protection Board at Abuja is a parastatal. The board is responsible for the removal, transport, and storage of agricultural and commercial waste. Also, during the approval of waste management systems in the area, the team established a master plan for waste generation and disposal. The team is responsible for advising the public through programs and public engagement on appropriate disposing of harmful and hazardous waste.

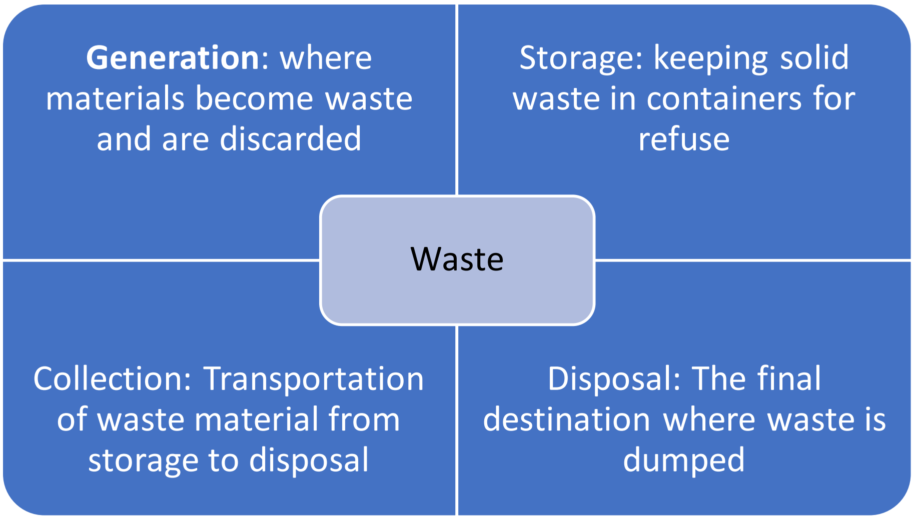
Table 7.

Composition of Municipal "Federal Capital City" (AEPB, 2012)

Composition	**Quantity (tons)**	**%**
Paper	16112.944	25.3
Textile	1930.3099	3.03
Plastics	5357.6878	3.40
Water sachets	9257.8228	14.5
Organic material	28420.7616	42.60
E-waste	1786.329865	2.80
Metals	2642.8035	5.29
Glass	2250.3883	3.00
Total	63707.107465	100

4.5.1 Stages in Waste Management

Figure 15 Stages in Waste Management



4.5.2 Methods of Waste Management

There are some different methods of managing waste

- Recycling: reuse of products materials after use Recycling:
- Composting: agricultural waste degradation process
- Waste disposal: requires raw water treatment to create a non-toxic waste discharged to water and sludge water supplies
- Incineration: Combustion for oil recycling and disposal reduction
- Depositary waste in a specially built environment with a waterproof coating that reduces pollution

4.5.3 Recommendations on Effective Waste Management

- Conducted intensive AEPB and NGO campaigns to increase public awareness of the need for a safe atmosphere.
- Support for successful clean-up and waste control agencies by the federal government
- Encourage private sector support, particularly in building projects, to ensure that waste management systems are implemented.
- Sensitizing contractors and stakeholders on the design of green architecture projects that ensure the use of environmentally sustainable materials.

- Laws and policies on waste management that are purely required for enforcement by inducing strong sanctions.
- Technical studies on the application of alternative building approaches.

4.5.4 Design Considerations to Help Reduce Waste

- Usage of fewer materials in smaller initiatives that save money
- Assembly style that fits the standard content dimensions
- Usage of clips and stops to support wood deposition
- Using disassembly design for improved content recycle and reuse
- Using fabrics that are more deconstruct able with removable fasteners
- Build should advocate versatility and space transition

4.6 Sustainable Construction

4.6.1 Nature of **Construction** *in Abuja*

The building industry in Abuja is structurally tricky, with a wide variety of modern development patterns. However, the sector is a driving force for growth and a pioneer in fostering job stability (Aliyu, 2016). To satisfy the needs of the modern century, the building world has undergone massive changes. However, the Nigerian sector has not improved considerably, as there is a lack of appropriate sustainable activities. Furthermore, businesses need ample funding to achieve effective sector structures (Oyedele, n.d.). It illustrates the need for the partners to sensitize sustainability activities fully.

4.6.2 Challenges Hindering Sustainable Construction in Abuja

Lack Of A Supportive Environment. External reasons that do not help the tradition of sustainable construction are surrounding business activities. These incentives are implemented by authorities mechanisms that discourage Green Building practice from economic, political, legal, and social factors (Daniel, 2018).

Uncertainty In The Economy. Nigeria's private sector is faced with a small business base that creates undue government reliance on subsidies for programs.

Also, the facilities which were traditionally provided by the government were privatized, and low productivity was achieved.

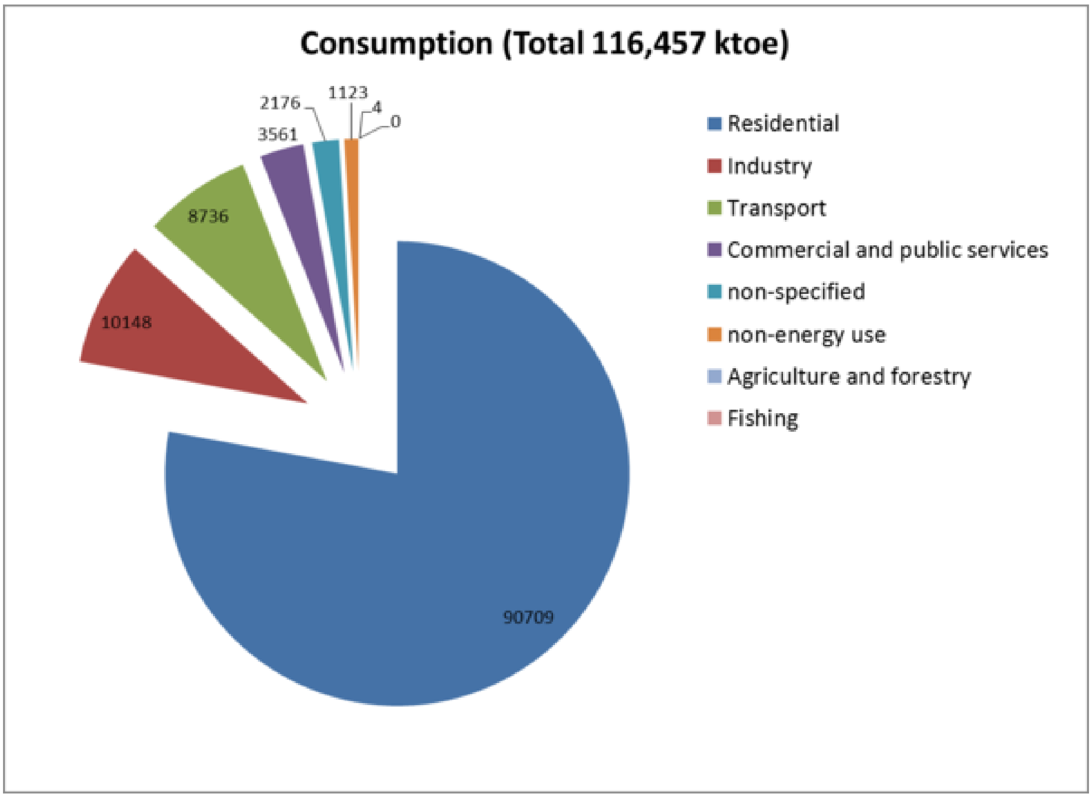
Technological Hindrance. Technological addiction has also hindered the growth and advancement of natural resources such as wood and earth use and is an obstacle to indigenous development.

Lack Of Integrated Research, The bulk of building technology research tackles individual problems and, therefore, lacks a sound solution (Obia, 2016).

Lack Of Interest. Generally speaking, the primary building stakeholders fail to prioritize the core environmental and best functional problems. In Abuja, local authorities have low respect for the ecosystem with the approval of crucial schemes and control of land acquisitions. There are no adoptions of the Statement of Environmental Impact.

Figure 14

Energy Consumption



4.6.3 Strategies for Achieving Sustainability

Sustainable Site Design. Sustainable architecture should ensure that land and natural resources are reduced and unnecessarily destroyed. The architecture should encourage sustainable growth and regeneration of higher density that retains green spaces. Protective utilization of resources should be made by diligent site assessment. There are various methods to do this. Next, the use of land in existing buildings and facilities should be increased. The City should encourage green spaces like parking lots and playgrounds that lead to ozone pollution mitigation (Devarajan, 2020). Secondly, to conserve green space and reduce growth, the City'sCity's municipal government could provide urban high-density construction. To maximize the use of green electricity through solar and natural lighting, it is therefore essential to properly evaluate the locations and the arrangement of buildings. Landscape architecture can be used for environmental protection and regeneration with a focus on indigenous plants. To reduce the urban heat effect, the use of light-colored rooftops and perverse surfaces is necessary.

Figure 15

Eps Panels

Sustainable Water Consumption. The construction of sites and the rehabilitation of buildings rely mainly on water availability and is therefore based on the various hydrological systems. Designers should rely on rainwater preservation and on-site runoff, thus minimizing inefficient and wasteful drinking water use. There are, therefore, numerous methods to achieve sustainable use of water. Next, adequate preparation for the treatment of floodwater and natural flows concerning the site. It helps stop time-consuming, cost-effective earthworks (Ding, 2019). Secondly, a comprehensive site assessment should be carried out to maintain current hydrology and vegetation characteristics. Furthermore, sites' location can maximize the production of low-impact stormwater such as bioretention and concrete paving that facilitates soil recovery. The plan should protect the water on-site and the consistency of the groundwater employing indigenous plants.

Figure 16

Walls Developed By The Recycling Of Plastic

Figure 18. Recycling of plastic has been used in this construction which is being filled with fine aggregate that is abundantly found on earth and in the place of an iron bar, bamboo sticks were used as the frame of the structure. The binding agent is used to fuse and carefully arrange the recycling plastic together to act as walls of the structure.

Energy and Environment. Minimizing energy needs, optimized site, construction design, material selection, and conservative steps are essential. To minimize undesirable sunshine, passive solar orientation, exterior shading systems, and structural massing are necessary. In comparison, the use of high perfume glazing by a low-E organization saves electricity in lighting.

Indoor Environmental Quality. For workers and their health welfare, a stable, relaxed atmosphere is essential. The building requires indoor air quality, ventilation, thermal comfort, and lighting. Several techniques in the service installation of a building are essential to the achievement of those requirements. Firstly, it is essential to use building sealants and furniture which contain no pollutants such as sulfur and other organic volatile compounds. Daylighting of an optimal solar angle should be used to guarantee sufficient illumination indoors. The use of operating windows also offers natural ventilation and eliminates dependency on mechanical systems. Also, it is necessary to enforce the envelope and environmental policies providing appropriate ventilation.

4.6.4 Recommendations

Based on the study's results, multiple causes are recommended; various steps for supporting sustainable methods are recommended.

Enlightenment of the public. Knowledge of the importance of sustainable building should be responded through numerous governmental and non-governmental professional bodies. To mobilize sustainable practices and techniques, the State has implemented the Continuing Professional Advancement initiative, as stated above.

Adoption of Local Agenda 21. Nigeria's government is responsible for formulating business policy and the incentives required for their execution (Olaopa et al., 2017). It should ensure that they have a sustainable administrative structure.

Design of affordable houses. The lead designers have a part to play in ensuring that consumers are over-relying on non-renewable commodities, including fossil fuels and that the products use minimum energy. There are some specific approaches to ensure sustainable growth.

Sustainable architecture. Sustainable architecture values through organizations and polytechnics must be sensitized to the general population.

4.7 Objectives

The case study on building activities was focused on multiple goals in Abuja, Nigeria.

- Check out what Green building activities are in Nigeria.
- To express the sustainable development philosophy and values in Nigeria.
- We are identifying the environmental effects and potential mitigations of the building in Abuja.
- In Abuja, to figure out the citation for waste management
- Identify waste management issues resulting from building operations.
- To ensure that sustainable waste management mitigations are accomplished.

4.8 Findings

The data collected were analyzed by the respondents and tabulated.

4.8.1 Distribution

The response percentage was roughly 80 percent of the survey questionnaires submitted and analyzed, of which 60 percent were realistic consultants. About 90% of all respondents said the building is a significant cause of deterioration of the environment. Most of the professionals concluded that standards for green design activities in several Abuja sites are not considered.

Table 8.

Questionnaire's Distribution

Distributed (per state)	30
Well completed and submitted on average	25
Percentage response	83%

Table 9.

Details of Participants

Professional	Distributed	Responses	% response

Construction managers	42	39	93%
Architects	21	16	76%
Engineers	34	19	56%
Lecturers	49	45	92%
Quantity surveyors	29	21	72%
Contractors	37	33	89%

Table 10.

Plan for Waste Management

Response	No of responses	% response
Yes	36	27%
No	98	73%
Total	134	100%

Table 11.

Main Reason For Environmental Degradation is Construction

Response	No of responses	% response
Yes	92	72%
No	35	28%
Total	127	100%

Table 12.

Awareness of Green Architecture

Response	No of responses	% response
Yes	37	36%
No	67	64%
Total	104	100%

Figure: 19

A Building Developed following the Criteria of Sustainable Construction (interstate Architets 2017)

Figure 19. This is a proposed concept designed by interstate architects with a view to becoming the first LEED Platinum building in Arfrica. It is a product of a careful analysis and synthesis of the four main requirements of the client; compliance with planning regulations, provision of a fully secured facility, provision of a high-quality office, sustainable building that employs both passive and active measures in reducing energy requirements.

Figure 20

Plastic building bricks from plastics (Gjenge 2021)

Figure 20. A company in kenya narobie has specialize in turning plastic waste into briks which is said to be five-senven times stronger to than concete. This process was produced by Nzambi Matee. Demand for plastic is not going away with market valued at 700billion that project to grow in 2030. This helps in managing the plastic from littering the sea and environmentl pollution.

CHAPTER V

CONCLUSION AND RECOMMENDATION

Sustainable building remains a most respected agenda as the climate appears to be fundamental. Regardless of age and other relative considerations, the environmental security of all people continues to be a significant obligation. Therefore, the building must aim for economic viability with minimum environmental impact. Numerous references within the study illustrated the industry's importance to today's environmental issues and the need for sustainability. Projects can meet their efficiency targets at a low cost and with reduced material loss. With most countries at basic levels to meet sustainable building targets, and organizations need to increase the schedule's visibility. One of the most important ways to encourage progress in sustainable development is by managing houses. The framework should be applied to satisfy the needs of sustainability as project management's key objectives are cost, time, and efficiency. If the basic purpose is to meet the specifications of a project and have a limited environmental impact, it is possible to incorporate sustainable building by adopting the approach suggested.

Considering the strides achieved towards a sustainable restriction, the market strengthens but does not meet the growing energy demand. Therefore, in all programs, including the preservation of infrastructure due to the environment's essential nature, sustainability tends to be an important priority. The study identifies sustainability in the societal, economic, and environmental contexts of three key dimensions. The study further stresses the industry's effect on natural environments and the future assessment of waste minimization, and the research essentially demonstrates various sustainability degrees and defines sustainable building within sustainable development based on the literature review. The work shows that primary sustainable development concepts include habitat management, sustainable societal development, biodiversity conservation, and population control. I define these elements as necessary to achieve sustainable growth in every sector. To accomplish those aims, the study explains how the administration and preparation of building projects are crucial from inception to completion in the planning and scheduling project work. Project management requires various phases from perceived criteria, strategic preparation, architecture, development, service, and disposal. The contractor is responsible for the execution and other activities at the site over the entire lifecycle.

The style of building that impacts sustainable growth is another significant aspect. The study analyzes the major development forms as residential buildings, commercial, advanced industrial buildings, and facilities. Different building styles require different sizes and control of the capital. In all buildings at various stages, the need to prioritize sustainable construction practices is applicable, as defined. Despite the organizational efforts engaged in projects, numerous obstacles, such as insufficient structure, poor coordination, and delayed cash flow, are prevalent, prohibiting successful, sustainable building activities. The study highlights the implementation of the whole lifecycle strategy in the construction industry to accomplish sustainable goals because of these challenges. Item parts and supply chains form an essential aspect of project implementation following a project's lifecycle, which is why the sector wants to include the designer in guaranteeing a systematic approach to sustainable building. For example, concerning the environment, the influence of projects, including energy use, waste emissions, noise pollution, and land recession, would be bound to vary.

The study indicates that more than a third of the global energy demand and related greenhouse emissions is expended in the construction industry, with an estimate of 35% of primary energy in buildings consumed. The environmental sustainability standards should then include numerous initiatives, including reducing water use, utilizing natural energy, goods recycle, habitat conservation, and quality production for the built environment. Also, the principles of environmental sustainability should extend across projects. The social climate, in which sustainability can be reinforced by enhancing human life quality and allowing social self-determination and safeguard or health arrangements, is also stressed. Also, increased productivity and performance can preserve the economic climate by implementing practices that support the sustainability agenda. Certain challenges to sustainable economic, environmental, and social growth, including high start-up costs, a lack of consumer knowledge, and a lack of public commitment, have been highlighted in the study.

The various aspects of sustainable architecture are also central to sustainable planning during the design process to accomplish sustainable growth. Eco-technical reasoning, affordable housing, and sustainable implementation are also included. Knowledge of sustainable practices by training in industry is one of the recommended strategies for sustainable building. Furthermore, theoretical knowledge's usability and depth can be expanded so that sustainable construction is framed and consistently addressed. Waste is another significant element in need of efficient waste management activities and is a big environmental deterioration source. The study suggests waste management in three phases, including waste design, procurement, and waste planning. The industry needs to implement and advocate for quality waste management practices, with the amount of waste generated in urban areas projected at 2.2 billion tonnes. Because of the Abuja case study, waste management is a major problem that negatively impacts the environment. To foster a healthy working atmosphere for the sector, the report proposes different sustainable approaches. The financing of clean-up efforts and sponsorship from the private sector for waste control systems are among the main recommended strategies. While this is not restricted to the building industry, it is necessary to enforce the proposed steps. Also, for achieving sustainable building design, factors such as the use of fewer materials in smaller projects and disassembly design are recommended". Finally, any company should be concerned with sustainable building activity, so the recommended practices such as prefabrication and material recycling should be so.

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