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ISTANBUL GEDİK UNIVERSITY
INSTITUTE OF GRADUATE STUDIES

DEVELOPMENT OF MANAGEMENT FOR SUSTAINABLE BUILDINGS CONCEPTS IN IRAQ

MASTER'S THESIS

Mohanad Ibrahim Hameed AL TUMA

Engineering Management Master in English Program

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Thesis Advisor: Asst. Prof. Dr. Redvan GHASEMLOUNİA

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Not: Öğrencinin Tez savunmasında **Başarılı** olması halinde bu form **imzalanacaktır**. Aksi halde geçersizdir.

DEDICATION

I dedicate my research to my dear, compassionate mother, and I appreciate her for her continuous prayer, support, and encouragement.

I also dedicate my research to my father's soul and our pride.

FOREWORD

Foremost thanks to Allah, the most beneficent and merciful, who helped me to complete this study and to submit it in such a way.

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May 2021 **Mohanad Ibrahim AL TUMA**

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ABBREVIATION

BREEAM : Building Research Establishment Environmental Assessment Method
CASBEE : Comprehensive Assessment System for Built Environment Efficiency
CCA : Climate Change Act
CED : Cumulative Energy Demand
EMS : Environmental Management Systems
ERA : Environmental Risk Assessment
ERA : Environmental Risk Assessment
GBI : Green Building Index
GHEM : Green Home Evaluation Manual
GHG : Green House Gas
IEA : Iraqi Engineers Association
IOA : Input Output Analysis
ISO : International Organization for Standardization
LCA : Life Cycle Analysis
LCC : Life Cycle Cost
LEED : Leadership in Energy and Environmental Design
MFA : Material Flow Accounting
MMC : Modern construction methods
NC : New Construction
RICS : Real Institution of Chartered Surveyors
SB : Sustainable Buildings
SD : Sustainable Development
SC : Sustainable Construction
STOOL : Sustainable Building Tool
UK : United Kingdom
US : United States
WHO : World Health Organization Constitution
ZEB : Net zero-energy buildings

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DEVELOPMENT OF MANAGEMENT FOR SUSTAINABLE BUILDING CONCEPT IN IRAQ

ABSTRACT

Sustainable buildings involve applying the concepts of sustainability in the design, construction, and management of buildings to reduce the effect of buildings on the environment. Sustainable building technologies have recently been highlighted as a way for the construction industry to contribute to the decrease in greenhouse gases. Moreover, it is widely acknowledged that stakeholders interested in the built environment should collaborate to achieve that sustainable development (SD) in the future is accomplished holistically.

The environment inherent in sustainable buildings (SB) demands that services such as energy, water, and harmful outputs such as greenhouse gasses are reduced to a minimum, and user health and well-being are achieved.

Sustainable building procedures are important in Iraq as buildings essentially display negative indicators of ventilation, efficient lighting, management of electricity, water management, waste management, and other building services.

However, there is a need to address some questions if this is to be achieved: what are the ingredients of sustainable buildings in Iraq? What are the current construction experts' and specialist's roles in achieving and remove the challenges that face implementing sustainable buildings in Iraq?

The main purpose of this research is to spread the concepts of sustainable buildings among specialists of construction in Iraq, where the aim target of the research into indicating how important the referred ingredients sustainable building as per the scientific standards in achieving the concept and ensuring the implementation of sustainable buildings in Iraq, to investigate if engineers that those working in buildings construction fields are aware of the essential ingredients of achieving sustainable buildings in Iraq, and to indicate what is the challenges to achieving sustainable buildings in Iraq.

Sustainable building procedures are important in Iraq as buildings essentially display negative indicators of the ventilation, efficiency of lighting, management of electricity,

management of water, waste management, and other building services were the building occupants mostly the complain that buildings do not have the necessary facilities, such as

operating air conditioning systems, adequate water and energy control, and waste management systems.

Most construction experts and those interested in the Iraqi environment acknowledge the role they can play in sustainable construction as a way to solve the mentioned problems.

The method of search followed for this study included a mix of a comprehensive literary review, analysis of important literature and the BREEAM-NC(new construction), LEED- NC(new construction) and sustainability works buildings and civil engineering works (ISO 15392 recommendations for the implementation of the General Principles); to achieving of sustainable buildings ingredients.

After that, a questionnaire of (207) members of the Iraqi Engineers Association (IEA) was undertaken. The findings of the research reveal (26) constituents that are critical to achieving a sustainable building, and the opinion regarding the importance of these ingredients to achieving the concept and ensuring the implementation of sustainable buildings in Iraq as the first part, and then them opinion what is a real challenge to achieving sustainable buildings in Iraq as the second part.

Keywords: *Sustainable building, Sustainable development, Sustainable ingredients*

IRAK'TA SÜRDÜRÜLEBİLİR BİNA KAVRAMI YÖNETİMİNİN GELİŞTİRİLMESİ

ÖZET

Sürdürülebilir binalar, binaların çevre üzerindeki etkisini azaltmak için binaların tasarımında, yapımında ve yönetiminde sürdürülebilirlik kavramlarının uygulanmasını içerir. Sürdürülebilir bina teknolojileri, son zamanlarda inşaat endüstrisinin sera gazlarının azalmasına katkıda bulunmasının bir yolu olarak öne çıktı. Dahası, yapılı çevre ile ilgilenen paydaşların gelecekte bu sürdürülebilir kalkınmanın (SD) bütüncül bir şekilde başarılması için işbirliği yapması gerektiği yaygın olarak kabul edilmektedir.

Sürdürülebilir binaların (SB) doğasında bulunan çevre, enerji, su gibi hizmetlerin ve sera gazları gibi zararlı çıktıların en aza indirilmesini ve kullanıcı sağlığı ve refahının sağlanmasını talep eder.

Binalar temelde olumsuz havalandırma, verimli aydınlatma, elektrik yönetimi, su yönetimi, atık yönetimi ve diğer bina hizmetleri göstergeleri sergilediği için Irak'ta sürdürülebilir bina prosedürleri önemlidir.

Ancak, bunun başarılması için bazı soruların ele alınması gerekmektedir: Irak'taki sürdürülebilir binaların içeriği nelerdir? Mevcut inşaat uzmanlarının ve uzmanın Irak'ta sürdürülebilir binaların uygulanmasında karşılaşılan zorlukların başarılması ve ortadan kaldırılmasındaki rolü nedir?

Bu araştırmanın temel amacı, sürdürülebilir bina kavramlarını Irak'ta inşaat uzmanları arasında yaygınlaştırmaktır; burada araştırmanın amacı, belirtilen bileşenlerin bilimsel standartlara göre konseptin gerçekleştirilmesinde ve uygulamanın sağlanmasında ne kadar önemli olduğunu göstermektir. Bina inşaat alanlarında çalışan mühendislerin Irak'ta sürdürülebilir binalar elde etmenin temel bileşenlerinin farkında olup olmadıklarını araştırmak ve Irak'ta sürdürülebilir binalar elde etmenin zorluklarının ne olduğunu göstermek için Irak'ta sürdürülebilir binalar.

Binalar temelde havalandırma, aydınlatma verimliliği, elektrik yönetimi, su yönetimi, atık yönetimi ve diğer bina hizmetleri gibi olumsuz göstergeler sergilediğinden Irak'ta sürdürülebilir bina prosedürleri önemlidir.

bina sakinleri çoğunlukla binalarda klima sistemlerinin çalıştırılması, yeterli su ve enerji kontrolü ve atık yönetim sistemleri gibi gerekli tesislere sahip olmadıklarından şikayet etmektedir.

Çoğu inşaat uzmanı ve Irak çevresiyle ilgilenenler, söz konusu sorunları çözmenin bir yolu olarak sürdürülebilir inşaatta oynayabilecekleri rolü kabul ediyor.

Bu çalışma için izlenen arama yöntemi, kapsamlı bir edebi inceleme, önemli literatür analizi ve BREEAM-NC (yeni inşaat), LEED-NC (yeni inşaat) ve sürdürülebilirlik işleri binaları ve inşaat mühendisliği çalışmalarının (ISO 15392 tavsiyeleri Genel İlkelerin uygulanması için); sürdürülebilir bina bileşenlerine ulaşmak için.

Bundan sonra, Irak Mühendisler Birliği'nin (IEA) 207 üyesiyle bir anket yapıldı. Araştırmanın bulguları, sürdürülebilir bir bina elde etmek için kritik öneme sahip (26) bileşeni ve bu bileşenlerin Irak'ta konseptin gerçekleştirilmesi ve sürdürülebilir yapıların uygulanmasının sağlanması açısından önemine ilişkin görüşleri ortaya koymakta ve daha sonra bunların ne olduğuna dair görüşlerini ortaya koymaktadır. ikinci kısım olarak Irak'ta sürdürülebilir binalara ulaşmak için gerçek bir zorluk.

Anahtar Kelimeler: *Sürdürülebilir bina, Sürdürülebilir kalkınma, Sürdürülebilir bileşenler*

1.INTRODUCTION

1.1 General Introduction

The idea of sustainable building emerged in the middle of the 19th century but was only introduced in the early 20th century. Sustainable building (SB) is commonly described as being built to satisfy all existing demands of dwellers in an environmentally sustainable manner that has the least or no damaging effect on the environment.

Taking into account the advantages of the term for the environment, health, competitiveness, and costs, etc., the concept of sustainable development is supported in a very active way by developed countries such as America and other European countries.

This style is also known as the green building or future-oriented construction. Sustainable development (SD) is primarily intended to address existing housing needs as well as to protect the environment and the resources of the future, and not only to recognize future needs.

This is a difficult challenge since people are increasingly and more dependent on the environment and the resources for their everyday needs as a result of the growth in population and subsequent development activities. As a result, natural resources are dilapidated every day, i.e. forests are reduced, ice peaks are lower, the sea level is higher, the air is polluted and the ecological chain is disrupted.

Some animals are at risk, some have become historical and are fixed only in pictures and documentaries. This is not just the reason for building green but the ultimate purpose is to satisfy people by providing a good shelter and healthy environment and also to encourage others to share the environment and protect the Earth.

This study discusses the key issues related to managing any building project along with the idea of green technology or sustainable development (SD)that would reduce risks. This means that the definition eliminates the effects of building on the

environment effectively. People have spoken with little concern about green cities, green buildings, and green technologies.

In summary, construction management by new technologies, strategies, materials, instruments,processes,manufacturing, and efficiency is the long-standing achievement

of effectiveness, cost reduction, reliability, and other issues relating to sustainable construction.

1.2 The Historical of Study

Like several others, Iraq concentrates on building a sustainable ecosystem. To achieve a large level of protection and comfortable gratification and to meet the SD specifications, this is the key priority of building developers and practitioners.

Companies understand that the environmental, economic, and social components of SD have developed measures such as the selection of non-deleterious and renewable building materials that could be respectively beneficial and preferable to the community.

The environmental component involves protecting sustainable resources preserving ecologies and controlling the effect of economic growth on the environment. The economic component involves economic development, resource support, preventing sustainable resources from being exhausted, and decreasing the use of non-renewable resources.

The social component includes poverty alleviation, efficiency increases at an adequate population level, and social facilities such as health and individual quality of life are provided.

People depend on an environment for the protection and for their basic life, where the environment must be held in a condition which will help future generations to advantage from it. Human beings have never taken sufficient steps to preserve it, however.

The need for SD seemed apparent as it was evident that human actions were degrading the environmental condition of the planet. This includes construction and technical growth programs.

The impact of construction in the destruction of the natural environment has been shown by construction industry activities, where buildings are accountable for the use of enormous amounts of fuel, water, and ground and are therefore accountable for most of the world's environmental problems (Mumovic, and Santamouris, 2009).

Almost 40percent of environmental assets and 40percent of waste and greenhouse emissions producing electricity for air conditioning and heating are used in the developed environment, and buildings also account for (1/6) of the world's clean water usage, (1/4) of the wood harvested, and (1/5) of all materials and resources (Reed et al.,2011).

Despite the negative environmental effect of the building industry, it contributes decisively to achieving SD and identifies essential community requirements for accommodations and services (Sinha et al., 2013).

The industry addresses major obstacles not only in meeting the demand for equitable accommodation and growing urbanization as well as in socially and environmentally sustainable ways (Du Plessis ,2007).

Therefore, the goal of achieving economic productivity, safeguarding and restoring ecosystems, and enhancing human well-being is becoming the main consideration for building professionals in the sector (Sinha et al., 2013).

The community is more conscious than ever of the health and well-being effect of buildings, as people spend their most time there. Indeed, people continue to aim to live and work with energy efficiency initiatives in convenient, safe buildings (Roaf et al., 2004).

Attempts to improve the SD also, therefore, prompted building practitioners to make efforts to refute ecologically damaging activities. It has prompted sustainable development (SC), which is the creation of specific parts of a sustainable building design focused on productive and environmentally friendly resources as stated in the report (Kibert, 2016).

SC could be employed as an ensures to design structures in whom the concepts of SD are implemented to the construction procedure and sustainable buildings were always built.

It is also important to deduce from the design of sustainable buildings the achievement of a more sustainable urban environment.

Sustainable buildings could be characterized as buildings that decrease the consumption of energy and water supplies, reduce undesirable outputs such as carbon gases, and improve the health and health of consumers (Eley, 2011).

Sustainable buildings include the creation, design, operation, and demolition of sustainable structures.

Only if the building is designed with conservation steps taken before construction processes and if environmental impacts exist during construction phases, will the building be effectively sustainable.

However, since this is the highest of a construction life cycle, the operating process does have the greatest environmental impact (Zhang et al., 2006).

Sustainable buildings are structures that mitigate the environmental consequences of these practices and simultaneously create a favorable internal environment. These are buildings that allow building consumers to increase their health, comfort, and maximize their economic benefits (Billie, 2012).

The spread of SB's concepts and ingredients among experts and construction engineers will contribute effectively to the design process and has the greatest influence in the operational phase by minimizing the passive effect of implemented buildings in the current environment.

The need for the construction industry to satisfy the need of SD for a sustainable environment also, therefore, contributed to the creation of sustainable buildings that can be accomplished by construction experts and engineers, providing the theoretical backdrop to this research.

The management of sustainable building refers to an activity that integrates the concepts of corporate governance, design, behavioral sciences, and technology with the employee's physical organization and the manufacturer's work.

Iraq buildings normally exhibit signs of mismanagement, where the buildings are badly built for ventilation, natural lighting, water, waste management, and other construction facilities.

Building residents also complain that buildings do not have requisite facilities such as working air ventilation required and reliable waste management instruction.

Therefore, research focuses on developing the management of sustainable building practices and concepts, through the description of the ingredients for the sustainable building to specialists and engineers in buildings construction, that ensure the design of buildings that given the building user a sustainable environment and comfort.

Where the specialist's experts and engineers in building construction (such as civil engineers, architect engineers, mechanical engineers, electrical engineers, construction

inspectors, quantitative inspectors, etc.), spend a small amount of time in the lifecycle by beginning their role in the design process and completing it in construction.

In Iraq, expertise in building construction can make a significant contribution to the achievement of sustainable buildings by involving specialist specialists and engineers in building construction.

The study reveals how it is possible to achieve sustainable buildings by highlighting the particular ingredients and requirements needed to achieve these kinds of structures in Iraq.

Therefore, the study involves the following topics to be answered:

1. What determines sustainable construction in terms of Iraq?

2. What are the existing challenges to achieving sustainable buildings in Iraq?

Therefore, the study objectives and some targets were set to help address the above-mentioned questions.

1.3 Study's Objectives

The objects of the study are to highlight the basic ingredients of how sustainable buildings can be achieved and the requirements needed to obtain these kinds of structures in Iraq, were to achieve these objects, it's required to;

1. Identify SC ingredients concerning literature and worldwide agreed-on criteria.

2. Assess the function of the specialist experts and engineers at the planning, design, and implementation process and operational stages for sustainable building.

3.Investigate the barriers which preclude achieving sustainable buildings.

1.4 Program for Research

The program of research method in this study can be shown utilizing a three stages research framework as shown in Figure (1.1).

Stage one consists of the literature review and study of sustainable building documents and their ingredients.

Literature review of sustainable buildings was involved in the literature review and document study, stage one also included the highlight on the challenge to implement the sustainable buildings in Iraq.

Stage two consists of a study of questionnaires to further assess the results of the review of the content. Stage three consists of validating and analyzing the research results in depth.

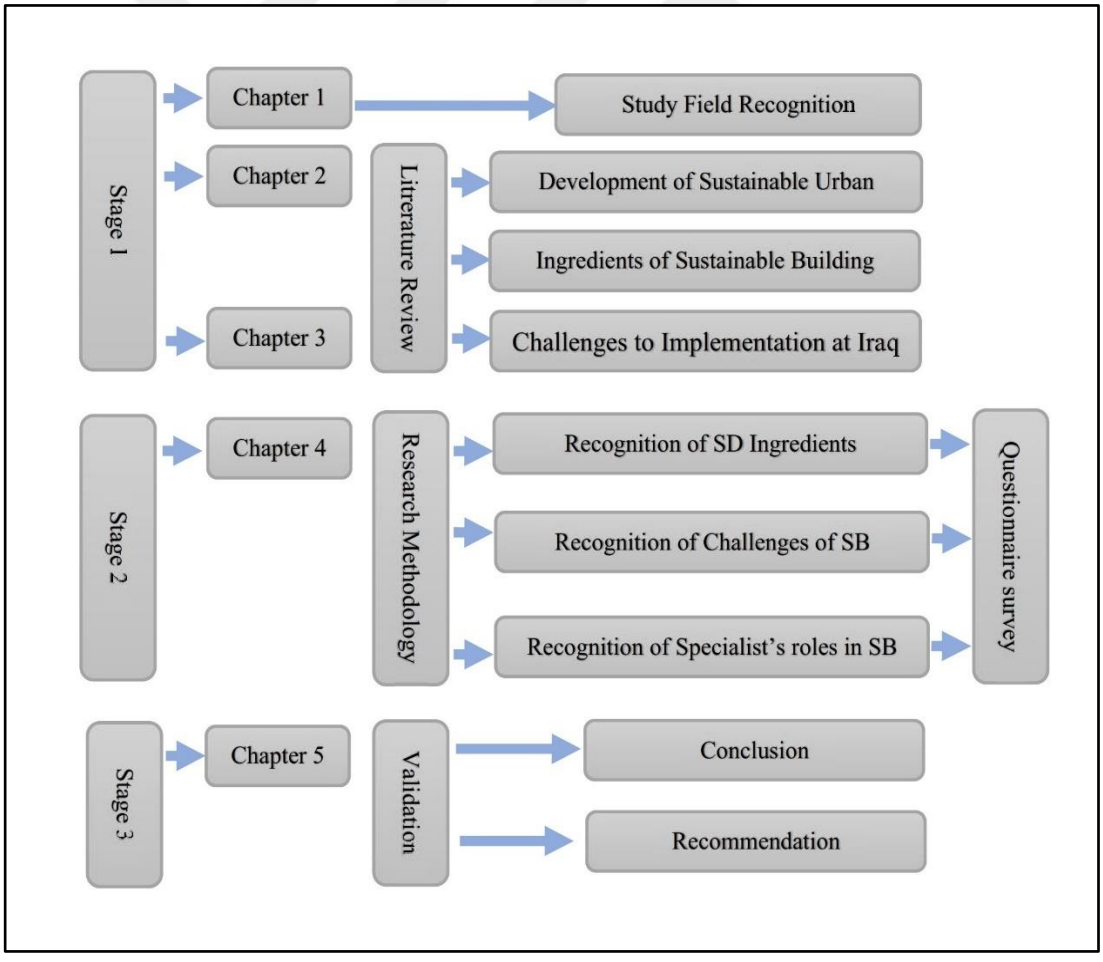

Figure 1.1: Framework for Research Stages

Source:Author

1.6 The Methodology of the Study and Involvement in Understanding

There are very few studies, in regards to what qualifies sustainable construction in Iraq. Limited experimentation is also being done on obtaining sustainable buildings, the few recent relevant studies have not centered on Iraq.

This study presented written verification of what establishes sustainable construction in Iraq as well as the accomplishment of sustainable construction. This study corresponds to the current understanding of sustainable buildings in Iraq, a field where few studies have been done before.

The specified sustainable building ingredients are required to assist the specialist experts and engineers in building construction in Iraq to have sufficient understanding about how a sustainable building becomes.

The study offers new knowledge regarding the environmental, social, economic, and management parts of SC. This, in impact, will assist supply end-users with a sustainable environment.

2. DEVELOPMENT OF SUSTAINABLE URBAN

2.1 Background of Sustainable Development

One of the most important challenges of our world is sustainable development (SD). These have developed from limited environmental conservation concerns to larger social or economic growth issues.

The claim on the sustainable building also has developed. This claim is sufficient to imitate the increase of natural resource exhaustion rising energy expenses and greenhouse gas pollution and a greater understanding of the condition of indoor air.

This chapter provides a summary of SD and its background, the chapter discusses the first purpose of this research study with the theoretical background, focused on the principle of sustainable construction. The first aim of this research study with the theoretical history of the sustainable building definition is covered in this Chapter.

In recent thirty years, SD has played a significant role in the main field of social issues. Where is a continuous mission to assess and how to make development, the main challenge is to evaluate achievements in sustainable development, where no more action decision could be made in addition to assigning a clear vision of the present situation (Kardos, 2012).

There is indeed a general awareness that sustainable development is beneficial, refers to inter-temporal justice, and also serves multiple elements to achieve useful life after several cycles of lives (Ricardo-Nieva and Pereira 2010).

Malthus (1766–1834) and William Stanley Jevons (1835–82) and other theorists from the 18th and 19th centuries who were interested in the lack of resources especially in growing numbers of population upwards (Malthus) and energy shortages are among the key concerns concerning SD (Jevons). Between Fairfield Osborn (1953) and Samuel Ordway, the issue was posed in the 1950s (1953).

It wasn't before the sixties so the seventies, but there was some discomfort in a large segment regarding community feeling. The intensity of worries in relation to the environment, especially the wellness hazards due to practical pollution, has marked

such decades. This led to traditional, production economic development's environmental views in effect (Baker, 2006).

As an outcome of these growing worries, over the past 40 years, the UN, an international organization shaped by the USA, has been helping to improve international peace and safety.

In specific Europe, the European Union (EU), which consists of a political and economic coherence between 28 countries, also developed its support for SD through the launch of economic development and healthy environment programs (Jacobus A.,2006).

Table 2.1 displays the efforts undertaken in attempts to achieve SD by the United States, the European Union, and other foreign organizations.

1972 the UN arranged a meeting on the humanitarian environment in Stockholm and brought together developed and developing countries in compliance with the concept of people's rights in a safe and innovative way. This was the UN's forward-looking main global environmental convention. The creation of the United Nations environmental program became also one of the consequences of the Convention (UNEP, 1972).

In 1980 the World Conservation Strategy (WCS) was established by the International Union to support the philosophy of SD due to various Conservation of Natural Resources (IUCN). The WCS declared that environmental conservation cannot be carried out without a lacking alleviation and stressed the developmental interdependence. It also suggested that sustainable development would taking into consideration all social, ecological, and economic agents (IUCN).

The World Environment and Development Commission (WCED) in 1987 enhanced the idea of countries around the world that are mutually dependent and that of economics and environment. The study connected global approaches to social-cultural, economic, and ecological problems, acknowledging that the world does not function as a different entity from humans (WCED, 1987).

In 1992, United Nations Conference on Environment and Development (UNCED), Summit in Rio de Janeiro revised the Brundtland Report results of several documents, including Agenda 21, which recognized the relationship between

environmental and social challenges and the three elements of sustainable development in the context of economic development (UNCED,1992).

A specific conference named Agenda 21 (Rio +5) was convened by the UN General Assembly in 1997 to determine Agenda 21 progress, the congress appreciated the initiatives undertaken with regard to Agenda 21.

The conference reported Agenda 21 is still unfulfilled and they have been identified the reasons for the failure to implement: increased globalization, increased wealth inequality, and a continual environmental decline.

Table 2.1: Global Background of Sustainable Development

Year	Milestone to Achieve SD	Summary
1972	UN conference at Stockholm	The connection of the implementation of environmental issues to the political development debate.
1980	The International Union for Natural Resources Conservation (IUCN) has authored the World Conservation Strategy (WCS), which announces the SD concept.	Statement on development for poverty reduction and conservation and development connectedness.
1987	UN Environment and Development Committee Report.	Defining sustainable development in connection with environmental issues and social and economic development.
1992	UN Conference on Environment and Development (UNCED), at Rio de Janeiro.	Adoption of five major publications by more than 178 Governments: • Environment and Development Agreement from Rio presenting 27 Environment and development concepts for all developing and developed countries. • Sustainable development Agenda 21, composed of 3 elements – environmental, economic, and social. Not a compulsory text, but a working strategy or action agenda with a specific engagement to an environment and development priorities. The UNCED's biggest commodity. • Climate Change Convention (UNFCCC's low), signed by 53 countries members. Formal international debate in this regard the convention started with the establishment in 1988 International Panel Climate

Table 2.1: Continue

1992		Change Panel (IPCC). Incorporated in 1994. • The UN ecological diversity convention. • Principles declaration for sustainable forestry management •
1997	A special meeting was called by the UN General Assembly Action 21 (Rio +5).	Agenda 21 status determination. On Agenda 21 the Assembly recognized progress as remarkable and described triggers like rising globalization, widespread income inequality, and a continuing global deterioration. The meeting concluded with an agreement on additional steps.
2000	Millennium Development Goals (MDGs).	A strategic action plan to fulfill the 8 poverty alleviation targets by its 2015 objective.
2001	EU turned the SD vision into an operational plan through the European Commission.	Environment change restriction and increased use of renewable energy in enforcing SDs, resolving public health risks, more efficiently managing natural resources enhancing the transport system and land management, poverty reduction and social deprivation, and solving social and economic consequences of the population.
2002	The EU applied to the 2001 organizational plan through the European Council.	Enhanced organization's policy by leveraging trade globalization to SD, reducing poverty, fostering social security and sustainable management, and the Monterrey agreement.
2002	World Summit on Sustainable Development (WSSD), at Johannesburg (Rio+10).	Deployment of the Johannesburg agreement and the action plan, furthering the agenda of Johannesburg, with more focus on poverty reduction in the context of the Sustainable Development Strategy, furthering Agenda 21 and Rio tasks.
2005	EU released an article by the European Commission Essential assessment of development after 200l.	This guidelines document summarizes the evidence on the present situation on SD, describes the means to tackle this problem through a thorough consideration of the key themes of SD in previous years (an overview of the main SD themes that could generate certain challenges and recommendations are given in this document).
2005	The Kyoto Protocol is in effect (Kyoto).	On 11 December 1997, the Kyoto Protocol was adopted in Kyoto, Japan (UNFCCC-COP3) In force on 16 February 2005. In effect. The detailed details COP7 in adopted rules for the application of the Protocol in 2001, Marrakesh h is named Marrakesh Agreement.
2007	The fourth Climate Change Evaluation Report of the International Commission	The report says it is best to recognize climate change policies by integrating them into the broader SD Strategy framework.

Table 2.1: Continue

2009	The 2009 EU Strategy was introduced by the European Commission.	The plan for 2009 outlined a wide range of SD policies, such as climate change, promoting a low-carbon economy, defense of core values, and upholding democratic principles.
2010	The 16th meeting of the Conference of the Stakeholders Cancún was the site of a Single National Framework Convention on Environmental Change.	A Green Environment Fund and a Climate Technology Center and network were requested during the Meeting.
2012	The United Nations foundation conference on Environment and Development (Rio+20).	Rio+20 (2012) was a high-profile follow-up to the seminal United Nations Conference on Environment and Development (UNCED) submitted in Rio de Janeiro, Brazil in 1992. At that Convention, member states reaffirmed their commitment to Agenda 21 and developed an SD model confirming that educating and encouraging society to be more resourceful on energy efficiency, restricting consumption, reducing CO2 emissions, and using renewable resources was a long-term course of action for the sustainable development of their nations.
2014	World Conference for Education for Healthy Living. Production was carried out in Japan.	The conference welcomed and marked the end of the United Nations Decade Sustainable Development Education (DESD ,2005–2014). The Global Education for Sustainable Development Action Program was also initiated and the Aichi-Nagoya Declaration was passed. DESD was formed by an agreement between the Member States to enhance the role of education in achieving SD at the 2002 World Summit on SD.
2015	Sustainable Development United Nations Summit concluded in New York.	Transforming our world: The Sustainable Development Agenda 2030 was the theme of the summit. It was decided at the summit that poverty and hunger would be ended, inequality in and within countries would be addressed, that human rights would have to be safeguarded and gender equality promoted and women and girls empowered, and that the earth and its natural resources would have to be sustainably protected between 2015 and 2030.

Source: Author

Pledge pursuant to SD was reaffirmed at the UN General Assembly (UNGA) in 2000 after UN Millennium Development Goals were authorized (UNCED, 1997).

In 2001, the European Commission decided from an organizational perspective on its role in Gothenburg in the direction of SD.

The government policies are designed to protect against climate change, increase and facilitate the use of pure energy, promote policies that enable greater responsibility of public health and of natural resources, improve regulation of behavior and management of the land, addressing poverty and inequalities in culture (Hategan and Ivan-Ungureanu, 2014).

The organizational strategy for Barcelona was extended in 2002 by the European Council in line with three key targets: increasing global exposure to the SD system; reducing shortcomings and fostering related development, and managing the environmental resources in a sustainable manner.

The European Council which was formed by the heads of states of the Union has taken obligations in favor of the Monterrey consensus in supporting the accomplishments of the UN objectives in 2000 (Hategan and Ivan-Ungureanu, 2014).

Moreover, after 10 years of the Rio de Jane roe declaration, a follow-up resolution was convened at the 2002 World Summit on SD Rio 10 (WSSD), in order to reactivate international cooperation to fulfill SD.

The United Nations has reiterated its contribution to Agenda 21, a collection of global sustainable development goals (UNCED, 2002).

Sustainable Development Strategy, the European Commission (EC) started by publishing the main evaluation on the development achieved since 2001 in February 2005, and established action guidelines for future years on environmental issues, threats to public health, lack and social inclusion, the absence, and exclusion of citizens.

On this basis, a statement on sustainable development recommendations, including a revised Lisbon Agenda on Growth and Jobs was adopted in 2005 (Hategan and Ivan, 2014).

They are also seeking to find some kind of consensus at the UN on being interested in the UN Convention on Environmental Change (UNFCCC).In 1992, the Rio Convention was adopted in international society and executed in Japan in 1994, after which the Kyoto Protocol was introduced in international society (UN, 1998).

This was primarily made according to practice in developed countries as it has the ideals to reduce GHG pollution.

Until 2005, the necessary industrialized countries had agreed to sign its implementation, the Kyoto Protocol was not implemented. Consequently, the first effort and commitment period for GHG emissions are in 2008 and 2012.

The World SD conference on the sustainable development platform, kept in Aichi-Nagoya Japan in 2014, is also organized in certain programs, teaching the public about the existence of SD.

The convention was defined and implemented in the later years of the United Nations Development Instruction, and until 2005–2014, the Convention dedicated intensive efforts to eradicate poverty and hunger.

The convention saved earthly sources and provided an extra environment for the livelihood of human beings, as announced at the UN sustainable development summit in New York, in 2015.

These varied initiatives, as described above, contributed to activities to reach SD and also helped decrease GHG emission levels at the series of UN meetings in Copenhagen and Denmark.

In the event that we look at the gist of it all, the enhancements that we are achieving are a consequence of the numerous changes in the present government that have agreed to strengthen the social and economic climate.

The implementation of SD is rendered significantly advantageous in different sectors, including agriculture, mining, manufacturing, construction, and other industries. Sustainability is often misunderstood considering the long history of SD.

2.2 Definition of Sustainable Development

The development offers tremendous potential for change, where the communities are looking for nearly new planning approaches and to increase their investment. Dispersed by development forcing individuals to cut long distances into employment

and residences, many neighborhoods have daunting regulations which are so unassailable that jobs, homes, and applications can be brought closer together.

Several communities are exploring the fiscal purpose of disregarding existing facilities while improving existing sewage systems, highways, and utilities along the periphery.

In addition, Urban Development has become a license for this success in many communities where everyday life, the economy, and the climate have changed.

Sustainability isn't about the assessment of risks but about the analysis of processes. In particular, it is necessary to decide if environmental, economic, and social processes benefit from their common abilities and limitations in a number of areas.

While sustainability (SD) is typically a compromise between environmental, economic, and social sustainability elements, the means and related social elements priorities continue to be vague (Dempsey, et al., 2011).

In fact, the almost conceptually obscure cornerstone of the SD speech has actually been identified. Moreover, the social aspects of sustainable development were not given equal consideration with those of the other two pillars (Dixon and Colantonio, 2008).

SD works to ensure the long-term health of human beings, including resolving the problems of limited environmental supplies and global poverty, and safe life, access to education, shared social and political group lives, and well-paid employment that gives people the possibility of achieving their dreams, expectations, and ambitions (Pérez, et al., 2014).

Sometimes, social acts are chosen as a rule alternative than policy coherence in the sense of sustainable development metrics as prominent groups give the greater opportunities to resolve their concern, and such ambiguities suggest that there is

desirable a broader view of the social pillar on SD.

Since the composition suggests that it is important to un-brick from the establishment of a greater partnership between the social and environmental elements, the government must pass this legislation (Littig and Griessler,2005).

Sustainability encourages the protection of the natural ecosystem by encouraging the challenge in a way people live as a way to remove the pollution and the scarcity of resources (Robinson, J.,2004).

Sharachchandra, M.L. (1991) view sustainability as an evolving mechanism involving the voluntary engagement of human beings in the environmental restrictions for a sustainable planet.

Baker (2006) says that sustainable development at the beginning is ecological and the main problem of ecosystem survival with time.

But Baker (2006) claims that if sustainability is created, its emphasis is shifted from environmental to social.

Society is essential to sustainability and is directed primarily at the functioning of the economic system, to consist of environmental issues and social change.

In the years following the success of the report, this talk was recycled, misquoted, and revised in numerous ways and carried forth a multitude of critics, demands, and policies.

One of the criticisms listed here is the simplistic and vague argument above. Where, after the definition specified in the report, the paragraphs covered clearly indicate the complexity and completeness of the Commission's SD description (Dresner, 2008).

Another commonly used SD concept technique is economic terms accordingly.

In which case sustainable capital is regarded as "non-declining capital," while the word "capital" describes "natural," "economic" also "human" capital.

It has also been extended so that the term applies to a broad spectrum of sustainability, the more severe of which vary from 'very sustainable to 'very bad sustainability' (Dresner, 2008).

Strong sustainability emphasizes the same concept as all the previous environmentally sustainable policies. The main idea is that the environment cannot be used as a resource. It is because the environment is priced so high.

Moderate strong sustainability nevertheless allows natural resources to be exhausted because this is offset by some forms of human-made capital, such as investing oil prosperity earnings by developing sustainable types of energy.

Meanwhile, true weak sustainability implies that natural resources will infinitely be replaced by capital-making citizens.

Medium-low sustainability retains essential natural capital which recognizes that natural resources cannot be replaced without problems (Dresner, 2008).

However, according to the sociology-economic implications, it is the key drawback of this technique that its locations stress the environmental problems paying little or no interest.

In addition to that, in line with the implementation of its policy, its usage at the national level of evaluating sustainably the general industry performance was challenged at the country-wide level and indeed successfully used there (Hopwood et al, 2005).

In 1987, based on the SD models, Ed Barbier suggested that SD consists of three developmental spheres.

This perspective, which is based on the WCED definition of SD, suggests that the social, environmental, and economic variables also known as individuals, planet, and benefit, and 3Ps are stable within reaching SD, as shown in figure (2.1).

The three key pillars that define the sustainable development approach are the value components the social, economic, social, and environmental, that are broadly known as the Triple Bottom Line approach (Du Plessis, 2007).

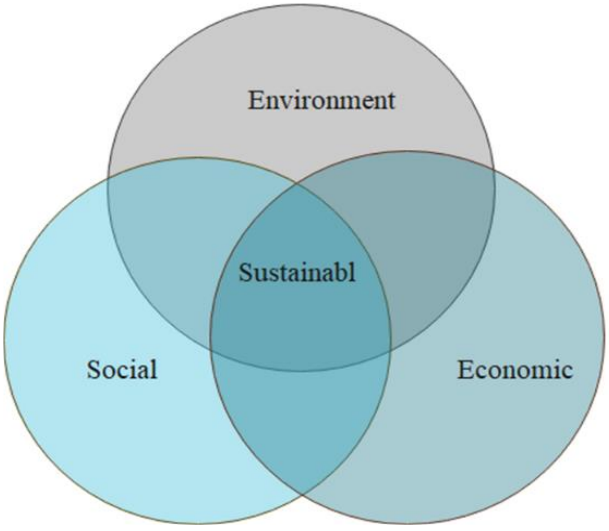

Figure 2.1: Sustainable Development Involves Economic, Environmental, and Social Aspects

Source: Du Plessis, (2007**)**

Another variant of sustainability, including political, technological, and cultural, has been articulated elsewhere in the literature. But the triple backbone row remains a strong model in industrial construction and thus for justifications for the latest inquiry,

The word sustainability is about preserving sustainability, which is to say, maintaining the sustainability of the three aspects of the social, economic, and environmental factors of construction, It can be enhanced by preserving consistency both between the social, economic, and environmental elements and the costs and profits of this process (Sorani and Sohail, 2011).

Studies show that there are still three elements of the SD concept that are being challenged. While Lehtonen (2004), the strategic-structure-archetype of SD is criticized due to its basing on four essential reasons, whereby the first essential reason is that the strategic-structure-archetype of SD can reinforce the present situation by encouraging the policymakers and establishments that explain their individual sustainability goals.

Secondly, since social or economic problems are isolated out the broader social context, there is the concern that we lose essential economic policies. As Bancroft observed, demonstrating SD in that conduct may want to contribute to a negative attitude of inconsistency among the three elements that reflect weaknesses in the correlations between the aspects.

The third critique of Lehtonen would be that the three-element description not really offers guidance between the possible conflicting priorities about trade-offs and synergies within environmental, social, and economic elements.

Lehtonen's fourth critique bases solely on the statement that the three foundations no longer equal qualitatively, and instead refers to the differences in the three elements hierarchy. Lehtonen provides the diagram shown in (Figure 2.2) according to the three elements to correct these vulnerabilities.

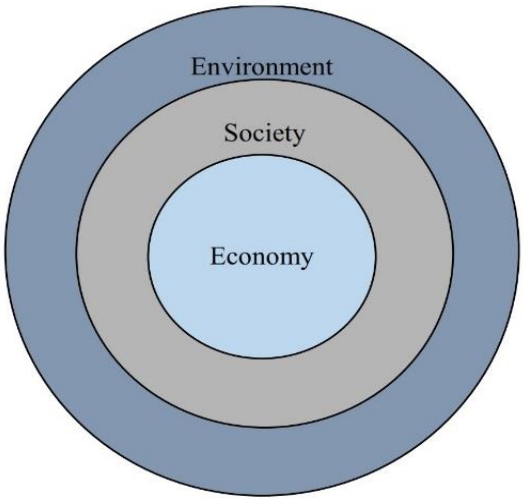

Figure 2.2: Modified Representation of Three SD Elements

Source: Lehtonen, (2004)

The template of SD shows how human society's actions must be held within environmental limits and the economic activities carried out by the human society as a whole must be transmitted (Lehtonen, 2004).

A deep green representation because the environment is the largest SD portion. In various cases, Lehtonen notes that the hierarchy of the three elements varies according to their relative value.

This indicates that the environment does not often remain the key element, socioeconomic factors could also be considered as significant at each time or under any circumstances because their position does not weaken the environment.

The deep green representation of the vital link between human cultures and the biosphere is according to Gibson a series of concentrative circles with economic circles within the circle of society that is within the ecological cycle.

This is no longer the definitive way of looking at the world of cultures to the position that the economy tends to be regulated. Durability, though, is, of course, the obvious way things are.

The relationship is that something that in smaller circles undermines the greater weakens its individual base (Gibson, 2001).

This indicates that the climate does not always remain the most significant factor, social or economic factors still remain considered to be almost important, provided

that their role does not undermine the environment, in any relevant situation and period.

There are numerous proposals to categorize SD definitions and Mebratu (1998) has named and SD words to be classified into three principal categories as bureaucratic, ideological, and academic.

Mebratu criticizes conceptually the meanings that fall into these categories and focuses on the questions of where does the crisis lies? Where's the solution proposed? Where's the forum for a solution? And where is the solution tool due to the solution?

Hopwood et al., (2005) describe that the concept of sustainable development reflects a shift in recognizing the location of humanity on this planet, but it starts with the meaning that everything is from nearly meaningless to a deep reverence for humanity, this is just an area of debate, regardless of the point of view, and the recognize the in-depth talks and ambiguities about sustainable growth.

(Kates et al., 2005) Addressed the problem, while SD definitions typically deal with issues of development, environment, and resources, differences occur inside them, such as looking at the strength of the elements, where they are to be retained, where is to be

built, and what depends on relationship environment and growth, and since the duration of the service life is equally long, SD identification could be described as a social selection of whether to improve, where, and how to sustain.

The distinction between SD and other phrases such as sustainability, sustainable improvement is essential, these terms are considered SD, such these terms shall be assumed to be SD, but the review also shows that the words above have different meanings (Robinson, 2004).

2.3 SD in Industry of Construction

2.3.1 Defining sustainable in industry

Sustainable construction is a strategy commonly applied to the construction industry in order to improve sustainable growth. When looking at the construction industry, it is defined as a whole community of individuals who create, establish, manage,

design, construct, change, or save the current environment, and consists of providing the materials and producers for those clients, or users.

The sustainability framework can be got as a subcategory of sustainable growth, covering things such as the design of things, the purchase of things, the planning of the locations, the choice of things it is being recycled, and the minimum waste requirements (Khalfan, 2002).

Du Plessis (2002) defines another SC as the holistic method through the principles of sustainable growth, from the extraction and use of raw materials to the preparation, design, and construction of buildings and infrastructures to the potential final demolition, and the management of events waste.

The more recent definition of SC is a way of looking at construction company operations that incorporates environmental, social, and economic concerns in their values.

This proposal places sustainable development concepts in all the buildings and facilities that we create from natural resources to the management, configuration, and implementation of facilities, and the management of waste (Tan et al., 2011).

The construction industry refers in particular to the workplaces that which can cause a lot of the people to suffer from bad weather conditions and the subsequent illnesses, as it

affects entire social activities of people in our life and because of that, can have a great effect on our health and well-being, which plays a significant part in our social life.

In order to determine where the industry requires to modify and improve its processes, it is first important to consider which industry has the largest impact.

2.3.2 Effect on the construction industry of sustainable development

Pollution from manufacturing and other economic actions on habitats have detrimental effects not only on the environment but also on humanity itself. A number of studies have found that water, environmental, and earth emissions cause about (40%) of the world's deaths. Furthermore, (15-37%) of whole animals and plants would face a danger of extinction if emissions of greenhouse gasses continue at their current pace by 2050 (Thomas, I., 2004).

Since the industry is not completely accountable and does not eliminate climate change and its associated consequences, this contributes especially to other industries' range of effects.

The distinction among various issues in regards to problems like population rise, environmental destruction, and technology evolutions in the past and present is that these changes have all taken place slowly and make the changes only perceptible by means of an individual lifestyle (Meadows, 2014).

Moreover, the sluggish speed of progress meant that the time had not been right for all problems to be overcome or for any solutions to vanish, not in the past two centuries, when the SD problem existed as above and the response rate of the planet was greater than its potential.

Everybody agrees that as the current consumption of resources increases, there is not chance that we will be able to satisfy this demand in the coming decades.

The ability to respond to the needs of the future populations with current economic and social changes and higher living requirements was therefore highly doubtful (Elliot, 1999).

The effect of SD on the construction industry can be calculated by its advantage in joining the basic wishes of societies, businesses, and governments in terms of housing and social infrastructure. To meet these needs, the entire industry's intent and its high economic value have resulted in significant environmental and social impacts, including air pollution and health harms (Hategan and Ivan-Ungureanu, 2014).

The main pollution due to industry, and it responds to carbon dioxide due to the energy used for manufacturing, transport, construction, and operation of raw materials, repair, demolition, and generation of waste (Sorrell, 2003).

However, for any country's economic development innovation in the built environment remains important. The BSI (2008) has shown this: this is a critical region in the economies of the country; a key factor for helping poor people to create, function, and sustain to reduce poverty; it is the main provider of employment; it is a large volumetric resource that is absorbed; it is a significant pollutant in the environment; and it contributes to the growth of jobs (Sev, 2009).

The industry has passive environmental economic and human effects as demonstrated in (Table 2.2).

Table 2.2: Major Effects of the Construction Industry

Impacts	Environmental	Social	Economic
*Excavation and use of raw materials, subsequent depletion of capital	•		
*Alter of land use, including flora removal	•	•	•
*Usage of energy and related greenhouse gas pollution	•		•
*Other pollution both indoor and outdoor	•		•
*Degradation of esthetics		•	
*Usage of water and development of wastewater	•		•
*Increased transport requirement according to the position	•	•	•
*Creating waste	•		•
*Corruption potential		•	•
*Community disruption, including improper design and materials		•	•
* Risks to health at workplaces and construction staff		•	•

Source: Sev, (2009).

Sinha et al., (2013) stated the building industry has a major challenge not just to enter in a socially and ecologically responsible way the necessity for adequate housing and infrastructure. As a result, Sustainable Development is now attracting a lot of attention from experts and is being focused on individual well-being, economic productivity, preserving climate, and preservation of ecological and optimizing community life.

That may why SD is increasingly concentrating on expert construction and focusing on economic efficiency, conservation and restoration of environmental structures, and the enhancement of human good lives (Sinha et al., 2013).

Buildings also need to be designed so as to have a common minimum human need and a minimum standard for reduced environmental impacts.

2.3.2.1 Consumption of source

The reduction and use of natural sources are unusually detrimental for our world. The industry consumes more than its simple wishes and the useful resources, eco-systems, and bio systems of the earth are at risk (David et al., 2007).

Society now absorbs vast elements of the natural resources of the earth, but the greatness of the harm is due to future generations; thus it is no longer possible to build the model we have used for the industrial revolution by continuing with such a route puts burdens on the planet since we are unable to maintain it (Murray 2011).

During the entire construction stage,

The recycling that must be taken for the along time of the design process, emphasizing the concern for sustainable design and how that its effect on the life's buildings, would reduce material consumption (Anastas and Zimmerman, 2003).

In the construction industry, however, the environmental, social, and economic considerations of the use of reclaimed elements are often misunderstood.

The designers are going to plan to integrate reclaimed materials in the construction of eternal buildings in the design argument that the use of recovered materials presents an entirely new stage of complexity.

Regarding Gorgolewski (2008), the recycling and reuse of building materials can have a huge effect on the sustainability dimensions of environmental, economic, and social.

2.3.2.2 The energy

Construction infrastructure consuming to 50 percent of the overall UK energy usage, where 45 percent for heating, lighting, and ventilation buildings 5 percent of construction consuming for energy. The UK has committed itself to cut greenhouse gas pollution by around 80 percent by 2050 in line with the Climate Change Act (CCA) in the form of 2008.

Though the spent effort on reducing energy consumption, others, including the Real Institution of Chartered Surveyors (RICS), agree the government has to struggle to make enough differences in its energy policy, then from the government and industry

needs a more concerted effort. The industry uses a significant proportion of the energy by incarnated energy and energy usage.

The energy used in the extraction, manufacture, and transport of materials to the building site constitutes embodied energy.

In simple terms, the building embodies, in addition to the energy used in its construction, the amount of energy that has been used to manufacture all its portions.

This includes energy consumed in the strategy for the construction of a building, from natural sources to purchase, from mining to industrial machinery, and from the transportation of the product between premises (Mansfield, 2009).

The incarnated energy also has to consider the recurring energy consumed by buildings materials and components to sustain and refurbish their strategies and the energy needed for demolition to deconstruct structures and disposal of materials (Sandrolini yet Franzoni, 2010).

The government which destroying the present stock because of perceived passive environmental results, failure to comply with new building legislation, or the lack of ownership/occupation claims, this is an energy waste and when it is recycled, we reaffirm the value of recycling materials (Mansfield, 2009).

The WBCSD (2007), states to which energy usage in buildings would drastically grow if no work is carried out is intended to substantially reduce pollution of carbon dioxide from energy, each producing and consuming energy.

The International Panel on Climate Change noted that opportunities exist worldwide to reduce energy consumption and the greenhouse gases in the building area (WBCSD, 2007).

Some of the current activities to be employed are:

- Lighting and daylight quality.
- More eco-friendly electrical appliances, heating, and cooling.
- Enhanced the insulation.

• Solar technology for heating and cooling in passive and active form.

• The longevity of fluorocarbon gas recycling and reuse.

Environmentally conscious developments such as heating systems for biomass, photovoltaic converting light to electricity, solar thermal receptors that translate sunlight to heat, and ventilation applications are just some of the applied studies that can merge to further minimize the energy impact of buildings.

Careful integration of these goods by design and layout is required to add to the carbon-neutral requirements of the Climate Change Act (Mansfield, 2009).

The WBCSD furthermore stipulates that energy savings can be achieved through:

• Minimize energy usage – reduce building energy demand by better design, more energy-efficient isolation, and equipment.

• Make more regional electricity – regional renewable energy generation and other energy waste.

• Energy sharing – buildings capable of producing energy balance and feeding it to the smart grid system for energy stability of other buildings' needs.

The construction industry could have a significant impact in this respect and, in order to make an effect, it is obvious that integrating the energy-efficient applied sciences as mentioned above must now begin.

2.3.2.3 Waste

In addition, the waste primarily having an environmental impact, waste generation by the construction industry is important in that the costs are prescribed by industry and its relative contribution to total national waste loads (Saunders and Wynn, 2004).

In the building industry in the UK, more than (420,000,000) tons of raw materials are consumed each year and (360,000,000) tons are being inserted in productions, of which about (120,000,000) tons are used (Osmani et al., 2006).

Despite the fact that waste is a significant obstacle to the building, the industry remains reluctant to minimize waste.

For example, the reactions of the subcontractors interviewed in the study by Saunders and Wynn indicate that although they know waste is an industry problem, they are prepared to take waste levels of 10 percentage, while they are aware of the

problems that they more than happily produce the current waste stages (Saunders and Wynn, 2004).

In 2003, the quantity estimated for construction, disposal, and landfill were (9,000,000) tons in the UK, up from an estimated (69) million tons at the beginning of 1999 that was greater than a waste reduction (ODPM, 2004).

Modern construction methods (MMC), which have been promoted as a way of reducing waste, have demonstrated the efficiency of such techniques to Ozorhon, who has

presented the results of three award-winning UK-wide construction projects using Sustainable Building Practices (SCPs) (Ozorhon, 2013).

With the support of MMC, the housing association that manages and operates houses in the UK reduces waste rates by more than (50%). By using timber frames, increasing

environmental efficiency, enhancing thermal output and reducing the environmental impact by reducing carbon emissions, the waste reduction by 6 percentage is reduced by waste disposal and (74) percentage is increased to (10) percentage by recycling goals (Pan et al., 2007), where he start of landfill tax-assisted to reduce and mitigate waste in line with the higher costs associated with the ways of waste disposal.

2.3.2.4 The usage of water

There may no alternatives for water, where it's important for the life cycle, and therefore a reduction of water use and increase of water quality are key factors in SD (Conard, 2013).

Water is important to our health and welfare as well as to agriculture, industry, and transport. For a high-quality natural environment, safe water supplies are needed. Water gives us innumerable advantages as we swim there, sail there, water our gardens, and enjoy the animals and plants that rely on it. Healthy waters, such as wetlands and flood lands, allow for the conservation of safe water and flood control (Defra, 2008).

Building industry consumed for 12 percentage of the potable use of water-based on the impact on water supplies depletion, while water use has risen by using 7 percentage over the past 30 years in the UK, with 4,100,000 new households

expected to be in the UK by the end of 2016, these necessities will be increased and have a further impact on water providing (Edwards, 2010).

Furthermore, statistics like those from the World Health Organization (WHO), who spoke in 2000 of them (1,1) billion human deficiency security for drinking waters and recently said that by 2015 this amount would almost double, make water an important resource and a matter of urgency.

World Wide Nature Fund (WWFN) 2008 spoke about the moderate to extreme water stress in around fifty countries during that period.

In recent years, climate change has led to a decrease in rainfall, ensuring the water availability is scarcer.

Some long-term predictions for the environment by 2080 predict half the summer rainfall (Defra, 2008).

The annual reports of 42 construction firms in the UK were analyzed, and small data concerning sustainable development were revealed and relatively small-large corporations changed their works paradigms (Myers, 2005).

According to US research, which analyzed over 200 civil engineers, nearly all respondents believed that sustainability in the construction industry is necessary or relatively essential, but on the contrary stressed that their true application and implementation is exceptionally restricted by their organizations (Chong et al., 2009).

The industry needs a more concentrated effort in line with their SD practices; the demand for economic growth and development indicates no indication of decrease; with World Watch Institute forecasts that by 2030 the world will continue to diminish a range of raw materials used for building, water scarcity and hunger, efforts are necessary (Olinto et al., 2013).

2.4 Sustainability Evaluation Tools in Construction

The overall environmental performance of a building needs to be tested before it is completed, where more methods have been created over the years to measure the sustainable general efficiency of a building in helping SD in the current environment.

According to Carmody et al., (2009) these evaluation tools play a necessary role in increasing consciousness and developing the construction industry into increasingly sustainable building procedures across the world.

This leads to sustainable building achievement and is an instrument that motivates the design, service, maintenance, and deconstruction of sustainable buildings. They lead to greater convergence between environment, social, economic, and other parameters for choice (Braganca et al., 2010).

In order to inspire designers and builders to enhance the efficiency of the building, they have objectively been designed to calculate the effect of a project on sustainable qualities, these assessment instruments have been developed 15 years ago, to determine the viability of a building through a variety of parameters (AlWaer and Kirk, 2012).

Where building evaluation methods perform significant importance in the evaluation of sustainability and in evaluating different levels of sustainable development (Reed et al., 2011). The collected of 3 categories: Systems for Cumulative Energy Demand

(CED) focusing on energy use, Life Cycle Analysis focused on the environmental aspect, and System Total Quality Assessment (TQA) (Hastings and Wall, 2007).

2.4.1 Systems for cumulative energy demand

Systems Cumulative Energy Demand (CED) has popularly been recognized for evaluating building energy use.

However, Tronchin and Fabbri (2008) clarified the partial measures such as energy and emergency do not apply where energy is the most beneficial assignment which takes a system into a thermal balance, and solar energy is not used directly in a transformation director but is directly available.

These units of measurement as per Marszal et al., (2011) are related to thermodynamic concepts of the useful utilization of resources and whilst may also be more suitable for determining the use of heat in buildings than for electricity.

CED technologies monitor and analyze the energy usage of buildings, such as heating, ventilation, air conditioning, heating and electricity, and communications (Berardi, 2011).

2.4.2 Net zero energy

The Net zero-energy buildings (ZEB) are a domestic or industrial building that needs substantially fewer energy thanks to efficiency features that allow renewable energy balancing. Despite the fascination of the term "zero energy," we need a joint description of what it means or a common understanding (Torcellini et al., 2006).

In terms of energy usage and the climate, buildings have a major impact. Industrial and residential buildings in the United States use about (40%) of critical energy and about (70%) of power (EIA, 2005).

The energy used by the building partition continues to rise, mostly because of the fact that new buildings are designed faster than old ones. Between 1980 and 2000 the use of electricity in commercial buildings is doubled and by 2025, another (50) percent is projected to rise (EIA, 2005).

Energy consumption will rise in the commercial construction sector before buildings can generate sufficient energy to offset the building's increasing energy demand. In order to do this, the US Department of Energy (DOE) has the strategy for creating a low-budget zero energy commercial building (ZEB) base with technical know-how and capacity by 2025.

Depending on the constraint and metric, the ZEB may be defined in different methods. Depending on project wishes and the principles of the design community and building owner, different meanings can also be preserved. Building owners, for example, are serious about the cost of electricity. Organizations like DOE have broad country numbers and are typically interested in mainstream or source energy. A building designer may also be involved in using energy for energy codes.

Finally, those interested in polluting power plants and fossil fuel combustion should also engage in pollution reduction. Four major concepts: net-zero energy, net-zero energy sources, net-zero energy costs, and net-zero energy pollutions, there are four common definitions (Petersburg et al., 2006).

• Net Zero Energy Pollution: A net-zero pollution building produced at minimum as much pollutions-free renewable energy as it uses from pollution-producing energy sources.

• Net-Zero Energy: A Site ZEB creates at least the same amount of energy used on the site in a year.

• Net-Zero Energy Source: A source ZEB creates at least as much energy in a year, when taken into account at the source.

Energy source refers to the primary energy that is used to create and supply the site with energy. The related site-to-source conversion multipliers are used to measure the total energy source for a building. Imported and exported energy.

• Net-Zero Energy Costs: The money that the service provider spends on the cost of ZEB the power supplier of buildings is equal to the amount of electricity the owner pays for the energy supplies and the energy used during the year, at least to the amount the building exports to the grid.

2.4.3 Life-cycle analysis

The Life Cycle Analysis (LCA) centers on the SD environmental element and provides construction materials and products with environmental impact evaluation.

These assessment methods include environmental assessment systems such as Environmental Risk Assessment (ERA), Material Flow Accounting (MFA), Input-Output Analysis (IOA), and Life Cycle Assessment (LCA), where LCA is the system more widely used (Hauschild et al., 2018).

The LCA separates the construction of basic operations and raw materials and measures the environmental effects of the building from the cradle to the grave over the life cycle. where the capacity to extract or process raw materials, to generate, transport and distribute raw materials, to use, reuse, maintain, recycle and finish disposal (Hauschild et al., 2018).

In addition, by defining and quantifying resources, materials, and wastes produced by the environment, LCA also assesses the environmental burden associated with a product, process, or operation.

It also measures the environmental impacts of goods and recognizes and evaluates ways to change the environment (SETAC, 1993).

LCA is also an international instrument for assessing the effect of products and structures on the environment during their lives.

LCA allows engineering experts to analyze various building designs on the basis of the environmental effects and to implement educated decisions about the relevant materials. The LCA enables assessment of the environmental effect of various building structures in a single area and different building types in different geographical areas (Zabalza et al., 2013).

The LCA includes four interconnected steps, due to Weißenbergera: description of aim and scope; analysis of life cycle inventory, evaluation of the effect of the life cycle; and analysis of the outcome.

The objective and the scoping stage constitute the definition of the aim and scope in accordance with standards.

The second phase, the life-cycle inventory review, involves the quantification of whole substance and energy flow input and output in a generally thorough lifestyle inventory assessment. At this point, the information obtained in the life cycle inventory analysis (substances and flow analysis) is analyzed in accordance with its possible environmental impacts.

The third phase, the life cycle effect assessment. And at the end, the fourth phase includes the review of life cycle inventory outcomes and the evaluation of the life cycle effect cycle to extract environmental effects and to offer submission of decision-makers (Weißenbergera, 2014).

This is not only because of the functionality of the buildings but because the life length of the buildings makes it more difficult to use LCA over the entire life cycle; because of the improvements in the life cycle of the building, because of the simplicity of the

making such modifications and the minimal environmental effect of these modifications. For almost all phases of the building life cycle, therefore, new alternatives must be created (Khasreen, 2009).

The application of LCA in the field of construction is a particular practice in contrast with other sectors and is currently the main important sector of LCA application.

There is a constraint LCA technologies, in which it tests the environmental concept of SD without acknowledging social and economic impacts (Hauschild et al., 2018).

Berardi (2012) recommends a mixture of LCA and Life Cycle Cost (LCC) analyses in order to comply with this restriction.

The utilization of LCC is the capacity to measure the expenses related to the construction method for the whole facility.

LCC is the means by which costs of the whole construction phase are recorded and these costs are usually reduced to their present value.

Reducing entire installation costs makes it possible to compare alternative building systems and compares a selection of alternative systems' current value (Hodges, 2005).

Restricted application, limited versatility, and limited accessibility are the majority of open methods used for LCC and LCA execution in the building industry.

They demand that the enhanced design and efficiency of the SD lead to effective tools for LCAs.

The normal practice of implementing fixed criteria for the life-cycle analysis and for life cycle evaluation stages is restricted to LCA, where the operating stage of the longest period building can have significant effects on the environment, resulting in variations that are often greater in this phase than the total effects of materials, design, or life-time end (Dyckhoff and Kasah, 2014).

2.4.4 Total quality assessment system

The total quality assessment system (TQA) aims at three elements: the environmental and energy pollution factors; investment economic factors and equity, and social needs such as the accessibility and quality of the areas. The system aims to achieve a total system for sustainable development of buildings. Moreover, Multi-Criterion systems are called TQA (Cai and Zhu, 2015).

Multi-criterion systems include the Building Research Establishment Environmental Assessment Method (BREEAM) developed in the UK, the Leadership in Energy and

Environmental Design (LEED) developed in the US, Comprehensive Assessment System for Built Environment Efficiency (CASBEE) developed in Japan, Sustainable

Building Tool (SBTOOl), Green Building Index (GBI) developed in Malaysia, Hong Kong the Building Environmental Assessment Method developed in Hong Kong, the

Australian Building Greenhouse Rating (ABGR), the Green Home Evaluation Manual (GHEM), the Chinese Three Star, the US Assessment and the Rating System (STARS), and the South African Sustainable Building Assessment Tool (SBAT) (Alyamia and Rezgui, 2012; (Shi et al., 2012;).

While frameworks assist to identify sustainable construction requirements, where these multi-criterion frameworks are composed of several specifications that quantify the sustainability of a building (Carmody et al., 2009).

Each method weights a guaranteed number of points available over the total evaluation.

TQA with respect to sustainability is the compilation of results from the evaluated parameters and states that the system's summing process is important because it assigns rankings to elements that have been positively assessed.

It is generally understandable and can be implemented in steps for each criterion, allowing a building to be assessed at different stages from design to design and, moreover, over the entire construction as correctly as possible (Berardi, 2012).

The three main types of Multi-criteria are recommended by Srinivasan et al. (2014), which are: evaluation frameworks, evaluation of research tools, and metrics.

The evaluation frameworks are interconnected and standardized evaluation models that provide tools for a comparison of a variety of project alternatives.

The evaluation of research tools helps to analyze and provide potential solutions for specific problems during the construction of a house, these instruments are divided into tools for reduction and non-reduction (Srinivasan et al., 2014).

A cost-benefit analysis was used to assess output by minimizing the challenging structure according to fewer variables and combining its properties, these simplistic methods involving non-reductionist instruments involve a multi-criteria analysis that involves partly subjective analytical equivalents (Henrichson and Rinaldi, 2014).

Performance indicators as per Srinivasan et al.(2014) to evaluate the sustainability of the building that includes the Ecological Level (like the Environmental Impact), the

Building Level (like Zero Energy), and the Building Environmental Level (like LEED, BREEAM, and GREEN GLOBES, SBTOOl, GBI, SBAT, and so on).

2.4.4.1 BREEAM

The BREEAM is mean a Building Research Establishment Environmental Assessment Method, was created by the BRE and is a template used for the design of sustainability evaluation instruments worldwide, such as the Green Star in Australia and the HK-BEAM in Hong Kong (Ding, 2008).

In more than (425,000) facilities with BREEAM evaluation tools accredited and about two million authorized for evaluation in greater than fifty countries as of 1990, BREEAM is the world's widest environmental evaluation and inspection framework for structures (Yuhui, 2013).

BREEAM has an extensive building measurement and definition system (BREEAM, 2012), in which guidelines are set for best practice in the building industry, BREEAM has a broad structure.

In the following places, BREEAM tests the efficiency of buildings:

• Management: Regulation for general management, site management overseeing, and procedural matters.

• Energy: issues of pollution and running energy.

• Pollution: consideration of air and water pollutions.

• Health and well-being: health and well-being considerations indoors and outdoors.

• Transport: carbon due to transportation.

• Land usage: places of the green and brown region.

• Ecology: protection of the ecological benefit and site improvement.

• Materials: impacts of environmental-related to construction materials.

• Water: water quality and consumption.

• Innovation.

The BREEAM application requires an examination of the above categories in terms of practice and results, which allows for the award of credits in the 10 grades (Pitt et

al, 2009), a method to measure the BREEAM values of Great Britain as demonstrated in (Figure 2.3).

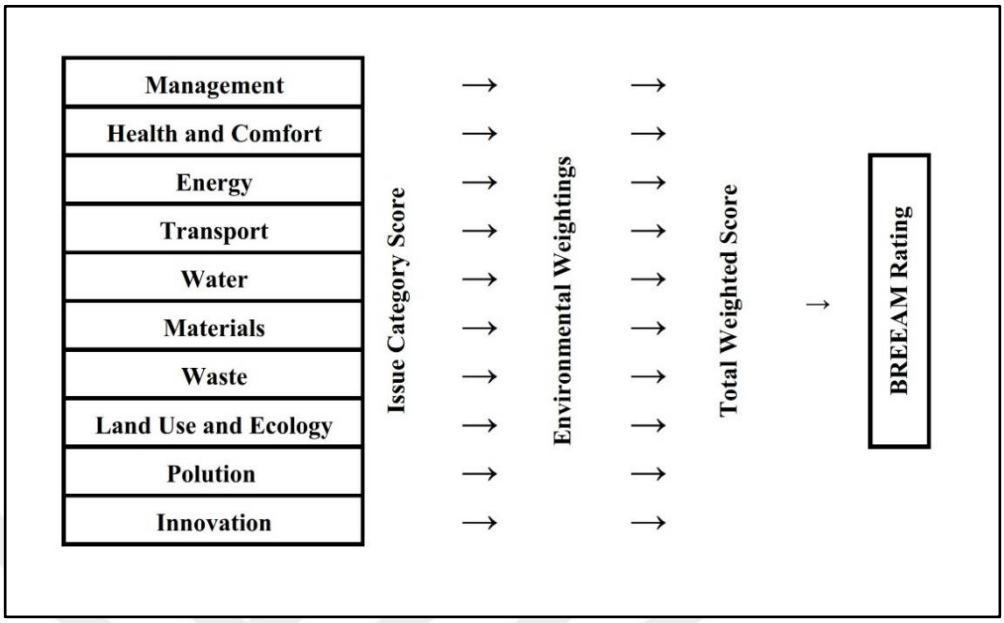

Figure 2.3: BREEAM Scoring Estimate of UK

Source: Pitt et al, (2009)

Each category has different requirements, as shown in table (2.3), where the contributions may be attributes or produced on the basis of such parameters. The weightings were developed during the national advisory process in the UK (Sev, 2011). These attributes are accumulated in order to generate a level cumulative ranking on a level of strong, very strong, or excellent.

Table 2.3: Credits Weighting of BREEAM

Criteria	Weightings %	Attributes
Management	12	10
Health and Comfort	15	14
Energy	19	21
Transport	8	10
Water	6	6
Materials	12.5	12
Waste	7.5	7
Land Use and Ecology	10	10
Pollution	10	12
Innovation	10	10

Source: Sev, (2011)

2.4.4.2 LEED

This was founded in 1998, by the United States Green Building Council (USGBC), with several parties involved, to turn to a demand for green buildings (Zimmerman and Kibert 2007).

Regarding USGBC, LEED is the second most commonly used sustainability assessment tool in the world with (20,000) projects that were approved and registered, where LEED that accounts for energy and environmental design leadership.

Members of the design team will control the progress of their project toward a LEED rating without the need for specialization of consultants during the project itself. It is well-founded in science and is linked to its demand.

LEED evaluation consists of three phases:

- Pre-requirements: the specifications to be achieved once the proposal can be evaluated.
- Core attributes: credits provided to meet or exceed the criteria of the 5 first criteria.
- Innovation credits: performance credits offered; key credits issued in the past.

Alyamia and Rezgui (2012) describe in order to provide a systematic, simple framework to evaluate overall the building performance and to achieve the sustainable development goals, the LEED evaluation was created through a consistency process involving a key actors, the different sustainability classes are evenly the weighted and different points are taken into account, and the credits allocated to each form are joined together.

The table (2.4) showing the evaluation attributes.

Table 2.4: Division of LEED Points

Criteria	Attributes
Sustainable Location	26
Quality of Water	10
Environmental and Energy	35
Products and Materials	14
Interior Quality of Climate	15
Innovation	6
Regional Priority	4

Source: LEED, (2011)

These evaluation methods helped develop SD skills and understanding in the construction industry. However, Gifford (2008) indicates that the BREEAM evaluation range is broader and that its standards are more complex to follow with the LEED criteria, which means that the BREEAM comparing with LEED is a much more complete technique.

2.4.4.3 SBTOOL

The concept of SBTOOL has a framework for building efficiency assessment which is utilized by the third side, to create evaluation systems for a number of different regional criteria and facility types, and the rating system toolbox may also be considered.

The SBTOOl is concentrated on the concept of adapting a rating system to local requirements before its findings can make sense. The system, therefore, has a typical structure to identify local context conditions and establish excellent weights and benchmarks in local non-commercial organizations (Larsoon, and Macias, 2012).

Through the global effort for a sustainable construction environment, SBTOOl was developed by the collaboration of over 20 the governments as the sustainable building

method. The tool has been developed so that countries can create their own local rating systems to fix local climatic conditions and languages (Larsson, 2014).

It helps users in various regions and countries participating in this assessment process to represent the different goals, technology, building tradition and cultural values.

This is why national groups can boost their benchmarks and weightings using different methods such as the analytical hierarchy system as shown in table (2.5) (Knollenberg et al, 2014).

Table 2.5: SBTOOL Environmental Credits

Criteria	Weightings (%)
Location Choosing, and Project Managing	7.6
Energy and Products Utilization	21
Environmental Factors	25.2
Interior Quality of Climate	21
Quality of Services	15.1
Elements of Socioeconomic	5
Elements of cultural and behavioral	5

Source: Knollenberg et al (2016)

2.4.4.4 CASBEE

The CASBEE is Japan's green construction management system, and it represents the "Comprehensive Assessment System for Built Environment Efficiency", where the rating instrument uses a weighting system that allows for the positioning of environmental concerns in the sense of a conditional environment.

CASBEE is an assessment tool introduced by Japan's state, established under the Building, Infrastructure, and Transportation Ministry to evaluate the overall environmental performance of a facility (CASBEE, 2011).

The four main elements of CASBEE consist of the 80 sub-criteria for energy conservation, resource efficiency, the local environment, and the indoor environment.

In addition, these groups are re-classified into two main groups: Q (quality), and L (loading) (Horvat and Fazio, 2005).

Rather than simply applying attributes points combined, the CASBEE integrates the concept of building environmental efficiency, as seen in Equation (2.1) (BEE),

Excluding the weighting factors for the classification of different kinds of buildings, the execution of its particular plan to achieve the final results is differentiated from the other evaluations, where those are focused primarily on the results of a survey of response stakeholders like designers, occupants of buildings, and customers. The answers are then evaluated by analytical hierarchy.

$$BEE = \frac{Efficiency\ of\ Environmental\ construction}{Processing\ of\ Environmental\ \ Construction} \quad \textbf{(2.1)}$$

2.4.5 Developing the evaluation tools of the building sustainable

More than 600 sustainability evaluation systems available worldwide, but neither of such systems will prosper effectively if they have been utilized in nations where they were not initially intended to operate (Saunders, 2008).

Because of who it is being built, each tool must be customized according to take into account the local climate.

To attain sustainability, Comparisons of actual person projects evaluated by each strategy often need to be communicated

Such direct assessment of the rating categories within each system isn't really easy and at the same time expensive (Saunders 2008).

Frameworks of sustainability evaluations vary from overall energy efficiency assessment towards multi-dimensional performance evaluation (Berardi, 2012).

Therefore, the viability of the building should be evaluated for any sub-element, like the services, the system structure, and the construction as a whole; therefore, the need for different evaluation and ranking tools must be evaluated (Langston, 2008).

Following the implementation of the Sustainable Building Alliance, these variations between systems have led to the establishment of common assessment categories and the improvement of comparability between systems (Berardi, 2012).

Although the resources for sustainable building evaluation tools have increased, Seles involving researchers such as Rumsey, McLellan (2005), Schendler, and Udall have been criticized for engaging in their evaluation process (2005).

The US National Institute of Standards and Technology (NIST) analyzed the LEED system in the light of LCA; they put an end to its confined scientific marker system that is not a credible sustainability evaluation regulation (Suzer, 2019).

LEED is increasingly being enhanced to develop the building's sustainability efficiency.

LEED-NC is currently in operation for the design of housing, the construction of new buildings for schools, residences, hospitals, data centers, warehouses, etc. LEEDs for external plans, LEEDs to current buildings, and LEEDs to new property improvement projects are also available (USGBC, 2016).

Over the years BREEAM have developed, where the (BREEAM-NC), a guide with more than 400 pages that may be utilized for urban, private, residential, and industrial structures,

Including construction modifications, was originally published on a BREEAM 20 pages long and deals with a variety of issues (Soulti and Leonard, 2016).

The BREEAM is available for current non-residential facilities and the BREEAM communities planned for the sustainable design of new communities' master plans or redevelopment projects.

BREEAM is also eligible for rehabilitation of existing buildings with the international renovation and fit-out technical requirements (BREEAM, 2016). However, it promotes the adaptation of these instruments in countries that have not yet built their own resources, attention to sustainable buildings.

2.5 Results of Chapter

This chapter provides a theoretical context to the history of the idea of sustainable construction, where provides the history to this analysis and SD is the originator of sustainable buildings.

An analysis of other concepts for SD led to the concept of SD in this study as the economic development mechanism that increases people's health care and has a lower environmental effect.

The chapter addressed the sustainable construction of buildings due to the environmental, social, economic, and management effects of SD on the construction

industry, where the chapter explains why these concepts were implemented in the facilities industry and where they developed into a sustainable construction method (SC).

SC was discovered, however, not to be sufficient in itself because this is just a mechanism that must be implemented to achieve the ultimate goal of sustainable construction growth.

Sustainable buildings are considering to be another part of the sustainable development process through the accomplishment of operations that are built sustainable buildings.

The third chapter explores the factors that make a sustainable building, where it's centered on the environmental social, economic, and management elements of SD involving the construction of this building.

3. INGREDIENTS OF THE SUSTAINABLE BUILDING

It's necessary to clarify the main ingredients to be satisfied with the criteria of sustainable building. This chapter has highlighted sustainable construction (SC) as the main aim of sustainable development (SD), where this chapter broaching a lot of definitions of sustainable building and specified the ingredients of sustainable building related to environmental, social, and economic, and management factors regarding SD and life-cycle.

This chapter looked up the main ingredients of the sustainable building regarding an allusion to international criteria.

3.1 Sustainability of Building Construction

The effect of sustainable development (SD) within the construction industry has resulted from sustainable construction SC that objectives to fulfill the necessity for dwelling, assignment environments, and facilities except prejudice the capacity of the future community to get together their personal desires with coming time. additionally, the SC develops the quality of residing by related to sustainable criteria because of attaining sustainable buildings (Ali and Price, 2019).

Also, sustainability becoming the main aim for constructing practitioners to reach with satisfying objects of economic performance, defending and return ecological scope, and developing the human prosperity (Arijit et al., 2013). The aim of SC is to generate and turn on an environmentally and healthy construction consist of the main environmental design and efficiency of resources (Berardi, 2013).

As far as Du Plessis (2007) is concerned, sustainability a stage in the correct way to SD to establish a qualified and productive construction field and a sector that reacts to the requirements of SC in its operations, however, this could only be accomplished if all stakeholders are interested in implementing it.

Sev (2009) developed a framework of sustainable construction resource management principles and strategies, including resource planning through the optimized usage of

the resource's energy, and land area, and the life-cycle of the facility through the usage of techniques before and after construction procedures.

Stakeholders in the construction industry will support the SD strategy if they properly grasp SC, where their personal efforts and opinions will lead to mitigating the passive effects on the environment (Parkin, 2000).

Their personal actions and behavior will help mitigate the harmful environmental impacts if they have insisted to correct SD from the client's opinion, through this procedure can be a significant environmental benefit (Roaf et al., 2003).

Stakeholders must initiate the design procedures in order for SC to be accomplished and it has prompted priorities in sustainable development, where sustainable construction design ensures that the long-term success of the construction is taken into consideration by the existing decision-making processes (Guy and Kibert, 1998).

SC concepts involve the use of originally used sites in new construction reduced water consumption and the use of recycled building resources, interior air quality assurance, and managing to utilize the natural and renewable resources (Doan et al, 2017).

Sev (2009) proposed a sustainable building design life cycle scheme and involves pre-construction, construction, and post-construction techniques, such as the pre-construction technique; choosing an appropriate location, versatile design, and choosing green materials.

The construction plan involves minimizing the effects of the site, utilizing non-toxic construction materials and goods, and pollution management, after this, the post-development plan involves the adaptive reuse of existing structures, reuse of building manufacturing process, and products for recycling, SC systems have contributed to sustainable buildings.

Sustainable buildings involve active processes in which SC is supported by government policies and voluntary organizations. Sustainable buildings interested Investments, developers, and consumers who are aware of sustainable development and are active in encouraging SC (UNEP- SBCI, 2009).

3.2 Ingredients of Sustainable Building

This research describes the ingredients of a sustainable building, where the ingredients are considered as activities leading to sustainable building efficiency and are categorized as previously described according to the ecological, economic, community, and administration parts of SD. With regard to environmental elements, where the buildings are accountable for the release of pollutants that have a harmful effect on the environment.

Due to the combustion of energy used to manufacture renewable construction materials, transport, construction, operations, maintenance, and destruction, which is why buildings with a lower effect on the environment are required.

The social element is about enhancing the level of quality of life as far as buildings are concerned, the social dimension seeks to ensure health, accessibility, and happiness for the residents, both negative and positive impacts can be encountered by buildings on the inhabitants (Rwelamila et al., 2000).

These negative health effects have an impact on performance, but sustainable buildings contribute to building occupants' wellbeing, efficiency, and living standards.

In the economic element, healthy structures offer financial incentives for owners and consumers of buildings. The annual electricity, water, maintenance, and repair costs and other running costs of sustainable buildings have been seen to be decreased, where they establish a network of economic activities through the building, operations, demolition or reuse methods, supplying the products and services required for human life and social progress (Kats,2003).

The management dimensions apply to those procedures that contribute to ensuring efficient building efficiency during operations. Processes such as post-employment appraisal, building user guide development, commissioning and handover programs and a 6 to 12 months default liability cycle, and building air leakage control to mitigate energy usage.

While for traditional buildings, these strategies are conducted forward as normal, BREEAM-NC (2018), LEED-NC (2009), and ISO 15392 are highlighted as methodologies that lead to sustainability.

Other concerns closely relevant to sustainability involve the planning of waste recycling, technical advancement to improve building sustainability, developing legal and binding climate protection programs.

SD's natural, social, economic, and management divisions are used to categorize sustainable building ingredients into ecological, economic, community, and administration divisions. These were achieved on the foundation of the sustainable construction concept of the SD principle.

Any ingredients, however, existed in more than one division. For e.g., resources often existed under the environmental component of energy efficiency.

This is because energy conservation saves money for the building consumer while reducing the harmful effects on the climate.

These harmful impacts include greenhouse gas emissions. Another illustration is the building's productive usage of water, which is both environmental and economic.

It is normally classified as environmental but is categorized as economic in this study. This is attributable to the study's emphasis on buildings and construction customers.

Effective utilization of water for buildings contributes to lower expenses for people, more precisely due to the effective control of water systems in buildings.

The use of water-saving techniques requires the use of environmentally friendly hydraulic equipment that greatly decreases the use of water, saves the cost of building consumer services, and profits economically (Ma et al., 2012).

where decreasing water use in buildings decreases the amount of water collected, treated, and pumped from the sources public water supply systems and reduces effluent volumes pumped and treated within public drainage systems, and constantly increases energy efficiency.

Another ingredient is material quality, in terms of the limited use of energy, ground usage, and environmental impact, and the manufacture of products. This approaches everything from the environmental and economic point of view, and therefore graded as renewable materials under the environmental angle and as material quality under the economic aspect (Gunhan, 2019).

3.2.1 Management of waste

Waste involves the extraction, refining, usage, and recycling of raw materials to satisfy human requirements. However, the rest is discarded as waste after man has used what seems useful to them. With regards to SD, the planet could not matter how long stand to resource more waste resources in SD, especially when non-renewable resources are exhausted (Mavropoulos, 2015).

To satisfy SD standards for the construction industry, waste management would be implemented as the criterion for sustainable building growth. Waste exists in the design, service, and renovation processes of the building life cycle as a significant contributor to environmental contamination. It is thus important to control construction materials after construction in order to utilize residual materials, instead of disposing of them as waste (Dania et al., 2015).

Ajayi et al., (2014) state that the solution to waste during construction is to reduce and reuse material that can be recycled as much as possible.

During activities, waste treatment requires the supply of separate collection facilities for household operational and recyclable waste sources for buildings to discourage waste from being sent into deposit or incineration (DTI, 2004).

The preparation and calculation of the correct amount of materials required to create a building at design stages to discourage unnecessary materials used during construction are fair to assume that waste management is a sustainable building component. To minimize environmental emissions, landfill treatment requires further waste management.

This generally involves the implementation of a waste recycling management strategy, which the facility manager also designs.

3.2.2 Management of pollution

As a sustainable building ingredient, pollution requires 6 linked ingredients, which are a reduction in parking space, a reduction in building carbon emissions, pollution of construction sites, light-emitting pollution, pollution of rainwater runoff, and discharge of municipal wastewater.

Minimum parking space as a construction aspect of urban growth requires the provision of restricted parking for building tenants to mitigate transport emissions.

Transport has a major environmental effect and a challenge to the health and well-being of the public by giving the right to access employment, company sites, education, markets, entertainment, and other facilities (Roaf et al, 2003).

As per BRE (2008), transport is a significant cause of carbon dioxide (CO2) and has a major impact on the environment. If buildings with a small car park, the owners would have no choice but to restrict their number of vehicles, which will minimize the number of cars on the streets and reduce emissions that affect the environment.

The decrease of carbon dioxide (CO2) in buildings is related to the pollution of carbon gases that are the result of fossil fuel production for energy supply, the building level often generates significant air pollution (Vanags and Mote, 2011).

According to Milani (2005), contamination includes all pollutants from mines and factories used to manufacture construction products, emissions of formaldehyde used

to clean and preserve the content. Pollution often happens as a consequence of the material's final incineration. Performance refers to the manner in which the substance can fulfill its intended function so low-lasting materials cannot be considered

sustainable. The use of energy was a significant source of gas pollution in buildings with regard to UNEP-SBCI (2009).

The burning of carbon fuels for heat process, illumination as well as electrical equipment results in both of these contaminants. Sustainable construction is a way of creating more energy-efficient buildings, enabling construction manufacturing to practice an important presence in decreasing the danger of rising temperatures.

The utilize of machines and equipment using gasoline, oil, and also the chemical products such as lacquer, solvents, and cleaners, is a major cause of greenhouse emissions where penetration of such products into the earth and water influences the survival of plants and water (Vanags and Mote, 2011).

Electricity is typically provided through oil, diesel, gas, and fossil fuels through construction, where diesel is the main combined pollutant from these four sources. (UNEP-SBCI, 2009).

Components like coolants for heating, ventilation systems, and other substances with high greenhouse amplification effects should be avoided and systems that mitigate

NOx pollution must be built to eliminate or reduce emission-related pollution (ISO 15392).

Gustavsson et al, (2010) as well mentioned the buildings are among the major sources of energy consumption and thus pollution, which have an important role in the damage of the atmosphere. These GHG pollution have an effect on the global climate, the most important of which is carbon dioxide (CO2).

The buildings should also be planned to reduce their earliest construction carbon dioxide (CO2) emissions. Early stages will minimize carbon dioxide (CO2) emissions

through the use of low-carbon construction materials and recycling (Sartori and Hestnes, 2007).

Various research on carbon dioxide (CO2) emission reduction has been successfully performed since the 2000s to encourage sustainable buildings.

These studies involved the implementation of the Life Cycle Assessment (LCA) framework to improve environmentally friendly installations and materials and to develop sustainable construction (Gartner, 2004).

Diesel emissions are a major participant to building-related environmental effects, where the building of any kinds relies extensively upon the utilization of diesel equipment, where these equipment are big pollution the source of carbon dioxide,

nitrogen oxides, overall hydrocarbons, and sulfur oxides emissions (Marshall et al., 2012).

LEED-NC(2009) states that the following shall be implemented to reduce or eliminate contamination from rainwater rushes, through a rainwater management strategy incorporating the construction of facilities to prevent or minimizing pollutant quantities regular rainwater flows through infiltration, vegetable gardens, and landscaping, by applying designs for ensuring to reuse of stormwater in the field of irrigation.

The designs that mitigating the risk of localized floods, pollution from the rivers, and other environmental losses and must limit or prevent rainfall discharges into public drains and watercourses must encourage it (Venters et al, 2005).

In particular, light pollution is a source of health problems. When there is excessive illumination around houses, this creates a lack of sleep, which in turn causes poor health.

BREEAM-NC (2018) allows outdoor lighting to be focused only on necessary areas to minimize the impact of light pollution and states that the lighting faces upwards. Such initiatives will minimize discomfort, decrease energy consumption, and will not affect neighboring properties.

As per LEED-NC (2009), only protection and relaxation areas can be illuminated to minimize or remove the pollution of night light emission. Buildings must be planned to include minimal car parking, low energy systems, rainwater gathering instrument, minimum lighting intensity, and low-carbon machines during construction, and mitigate harmful environmental effects.

3.2.3 Land using

Land usage as an ingredient of sustainable construction includes three related elements, the utilization of previously developed earth and didn't utilization of the new earth, try to the protection of the environmental significance of ground, and the sustainability and optimization of earth use biological diversity.

Land is one of the most important components that support the life of the planet must consequently need to be managed very carefully. Land utilization includes biodiversity protection and improvement.

It also requires the restoration of existing natural vegetation to establish greenery and encourage biodiversity, according to LEED-NC (2009).

It is understood that the supply of vegetation surrounding a building provides psychophysiological balance for building users (Heerwagen, 2012).

In order to use the land effectively, must be used previously used the land to conserve the environmental system. Previous applications may consist of any form of facility, including industrial applications linked to contamination (Sassi, 2006).

The use of pre-used sites and the preservation of the environmental significance of the earth are criteria for meeting the criteria for sustainable construction as laid down in BREEAM-NC (2018) and in ISO 15392.

These reports note that effective utilization of soil involves the utilization of predefined areas and/or damaged soils to protect ecology from the utilization of virgin ground. Efficient ground utilization requires a strategy for site conservation to ensure that threats to the site's natural ecosystem are reduced.

A site maintenance strategy involves control of erosion and sedimentation to minimize soil losses, reduction of contamination at surrounding sites and water supplies, reduction of site disruptions, and on-site project strategic planning (Cetiner and Ceylan, 2013).

While human activity has major barriers to land vegetation and wildlife, Yoong et al (2017) addressed the need for sustainable buildings to use sites and land responsibly and effectively through ecological protection and to enhance biodiversity during the site planning and completion phases of the project. A building will lead to environmental protection if this can be done.

This approach eliminates construction on undeveloped ground and brownfield areas and often incorporates newly built design concepts such as main buildings and previously utilized building materials that can be recycled or reused into a new facility, enhancing the site and the local environment.

3.2.4 Energy

Energy as a research ingredient involves the effective use of equipment, the environmentally sustainable management of buildings in the energy sector, the reduction of carbon gas pollution from cooling equipment and the production of warm water, the optimum use of renewable resources like as solar technology and energy in buildings for efficient transportation networks, and the reasonable use of local renewable energy production.

Renewable energy is the natural and continuous energy that occurs in the environment, such as wind, sunlight, and hydro energy, renewable energy is inexhaustible and does not contain emissions like carbon dioxide that eventually contribute to climate change (Catto, 2008).

Often during construction service, the successful use of renewable resources for machinery takes place. A building is designed at this stage to use the sun's renewable energy to power heat, light, and power supplies.

Small power devices like microwave stoves and boilers and large power devices like lifts are used in energy systems. Therefore, increasing the use of renewable energy through sustainable buildings requires the implementation of technologies that actually allow power plug-ins, like microwave stoves and cookers, refrigerators and, vacuum cleaners, washers and dryers, swimming pools, etc. (Cooke et al., 2007).

The environmental management of construction sites concerning renewable energies needs the utilization of renewable energy at locations for applications of illumination and electricity generation (BREEAM-NC, 2018).

Through the use of renewable energy, countries have been developing economically, socially, and environmentally. Renewable resources cannot be exhausted because, opposite that, fossil fuels traded on the global economy, the natural supplies continually replenish them (Bilgen et al., 2008).

Sustainable production of reliable and efficient alternative energy sources, without negative social effects, is required to achieve SD. Consequently, the aim of reducing greenhouse gas pollution from cooling and warm water processing as a sustainable building is to incorporate renewable energy may prompt a minimal harmful energy product (Panoutsou et al., 2009).

Increasing utilization of sunlight energy as a part of sustainable buildings requires passive solar construction, which optimizes site utilize, building design, and building

orientation to achieve increasing utilization of solar energy in the created environment It also includes gardening, natural shade, sunlight, and efficient use of heating and cooling (Billie, 2012).

Passive solar construction designs are planned to capture, store and distribute solar energy in winter, including windows, walls, and floors, and refuse solar energy in the summer (Silverman and Mydin, 2014).

Passive solar design is often referred to as environment technology because excluding solar energy heating systems it cannot require the use of mechanical and electrical technologies.

Solar technology also involves a photovoltaic system, which has already been a key factor in building sustainability.

The photovoltaic system, which involves solar panels, is utilized to convert energy effectively from sun to power without pollution and with the minimal visual effect, promotes real resilience, and is among the most promising renewable energy innovations to achieve SD (Tiwari et al., 2011).

Energy is used in the preceding tasks According to Abdallah et al., (2015): processing of construction material, movement of material from production facilities to construction sites, construction, construction, and destruction (and recycling) of building.

Energy has an important role to play in economic growth, change, and development helps to alleviate poverty and helps the stability of every nation. Energy encourages the provision of vital necessities such as cooked food, a comfortable living temperature, lighting, equipment uses, water piping or sewerage, health items of essential value, educational assistance, communication aid, and transportation. Energy always promotes beneficial sectors such as farming, trade, production, industry, and manufacturing (Bhattacharyya, 2013).

The ongoing energy supply is required for economic development and greatly depends on long-term energy accessibility from sustainable, accessible, and environmentally friendly sources.

To meet SD with regard to buildings, a substantial source of renewable energy needs to be generated, which justifies the optimal utilization of renewable energy for sustainable building ingredients (Bhattacharyya, 2013).

3.2.5 Sustainable products

An ingredient of sustainable building, sustainable materials include responsible materials, building materials with minimal environmental effects, and designed in an environmentally friendly way concerning product use. The construction industries contribute greatly to the global economy, but as previously mentioned, they are one

of the principal contributors to the use of resources and the production of waste and play a fundamental role in SD.

BREEAM-NC (2018) promotes the concept of construction materials that have a low environmental effect on the building lifecycle, which involves the utilization of life cycle evaluation instruction to calculate the environmental effect of building facilities over the life cycle.

This also specifies that building materials should be developed and used properly. Sustainable products have a major effect on a building through gross significance to cost and capability to construction. The careful use of sustainable materials as a sustainable building component had become described as the easiest and simplest way in which planners can attempt to integrate sustainability concepts into construction projects (John et al., 2005).

Sustainable materials may also be described through material resources, production methods, transportation, and ultimate disposal, they have energy-friendly or strong thermal insulation, roofing, lighting, air conditioning, and ventilation systems (Billie, 2012).

The choice of materials happens primarily in the comprehensive design process, where crucial decisions that decide building efficiency are taken. where the biggest problem is the determination of content collection parameters (Gething, 2011).

The six considerations which may be used in the choice criteria for building products have been taken from Akadiri and Olomolaiye (2012), namely: the environmental effects, the resource quality, waste minimization, cost of the life cycle, social gain, and performance potential.

These requirements have been extracted from the survey by expert opinion and are thus ensured to guarantee the feasibility of development projects.

While the three highest requirements for the selection of construction materials were considered, the outcome of their survey showed "architectural", "maintenance" and "energy provision". However, the most general parameters in the choosing of construction materials are sources management, pollution, and quality of indoor air, and efficiency according to Spiegel and Meadows (2011).

From John et al. (2005), it can be concluded that safe construction materials help shield building residents from air pollution indoors, where indoor air pollution includes coal pollution, carbon dioxide, and other gases coal, and paraffin hydrocarbons.

Though, timber is an environmentally friendly material that emits minimum emissions and creates minimum waste than other building products when not burned (Petersen and Solberg, 2005).

Life-cycle analyses also indicate that the timber to biological sustainable potential, hence, Arijit et al., (2013) recommend the utilize of a life-cycle study for creating new timber products.

The use in sustainable buildings of kenaf-fiber insulation boards is also strongly recommended. A high percentage of generated carbon dioxide (CO2) is capable of absorbing by Kenaf and is typically used in thermal insulation, it may thus list a renewable material (Ardente et al., 2008).

The reuse of current construction materials, infrastructure parts, and recycling materials decrease the harmful effects of waste processing (Sassi, 2006).

The reuse of current construction materials has been one of the sustainable development goals and requires minimizing the use of materials (Arijit et al., 2013).

Sustainable materials may be classified by the raw material, the production process, the criteria for transportation and disposal practices.

They can involve energy-saving or maximum level materials for insulation, flooring and glazing, illumination and warming, and conditioning instrument (Billie 2012).

The degree of people satisfaction is often motivated by the objective of sustainability, which determines the process of material selection, therefore, the essential feature of the content selection is its environmental costs (Arijit et al., 2013).

3.2.6 Minimizing of water pollution

Minimizing water pollution as an ingredient of sustainable construction requires water quality related to the provision of suitable water for human use. Clean water access is a critical requirement of life (Roaf et al., 2003).

As per LEED-NC (2009), the introduction of a storm-water management scheme will ensure water quality. This decreases impermeable protection, encourages penetration, and manages the drainage of tempest water by using appropriate best management practices. These activities include the use of vegetated floors, pavements that can trap rainwater, and the recycling scheme of rainwater.

Furthermore, BREEAM-NC (2018) explains that a sustainable building should be looking at reducing water pollution and ensuring that safe supplies from freshwater for buildings use. That may be achieved by making sure this is the water supplies at the building follow health and safety requirements.

The efficiency of the water in a facility can be adversely affected through rainwater that causes pollution of the water; however, the proper construction of the site will mitigate the effect of the water from the outset. The project design should include: restoration and preservation of stream fields, waterways, and the current vegetation for draining, storing, and filtering runoff water; conservation of natural drains and topographies; minimization and disconnection of impermeable surfaces such as house stiffness, patios, driveways, and transport infrastructure; the stormwater flows strategically from the first touch to the point of release, storage, and treatment of stormwater (Keeler and Burke, 2009).

3.2.7 Visual convenience

As a sustainable ingredient of a building, visual convenience includes the design of a building to optimize daylight in terms of building orientation and perimeter. Concerning BREEAM-NC (2018), visual convenience is included daylight, artificial illumination, light control, viewing, and interior and exterior lighting.

The design includes the integration of shading instruments, high-performance vitrification, and auto photocell-based functions.

ISO 15392 suggests that the visual convenience of the service is to provide a functional environment for the visual operations of the building that improves the architectural and building structure to the gratification and well of the customer. Suitable illumination and in particular, solar lighting may be seen as an important requirement for design, the skylight has been important for the incorporation of natural lighting into the building and should be taken into consideration through

building designing, where these skylights have transmitted the illumination (Brown and Dekay, 2001).

Sunlight is a significant feature through the illumination of the interior of the building and, in particular, in minimal energy buildings, where it permits the vision of the external area of the building. Researchers have found that supplying daylight to a building is a significant element in assessing the satisfaction of occupants (Leaman and Bordass, 1999).

Many people want to work in a daytime environment, where people want to view through a window, even if the vision is not so good or enjoyable, also that daylight entry into a building helps to lighten and make the interiors more comfortable (CIBSE, 2015). A view offers communication with the external environment and helps their eyes towards relaxed, especially if the information is required for the work (Brown and Dekay, 2001).

There are numerous recorded facts to support the absence of daylight that contributes to a rise in occupational malaise which can have detrimental impacts on efficiency. While daylight may the major product of natural light, it may also change the interior light levels and cause stress and overheater, particularly in occupants sitting near the window.

In addition to artificial illumination, most buildings, therefore, allow for some monitoring of daylight (blinds or curtains), in particular at the front end of the buildings, which frequently gets direct sunlight (Nicolet al., 2006).

3.2.8 Thermal convenience

Thermal convenience is a condition in which a person is not obliged to correct the climate (Hensen, 1991). Thermal convenience is a criterion of mind that communicates satisfaction with a building's inner surroundings (ASHRAE, 2004).

It can be used as an aspect of sustainable construction in almost all approaches and instruments of building sustainability assessment; it explains the synthesized feeling about the thermal condition of the body (Steskens and Loomans, 2010).

Thermal convenience in buildings is an important aim of creating a safe indoor atmosphere due to varying temperatures and seasons (Bolattürk, 2008).

BREEAM-NC (2018) states which design and functions should achieve appropriate thermal convenience levels to ensure a thermally relaxing environment for the residents within the building.

To meet personal comfort standards, LEED-NC (2009) notes that personal convenience regulations be offered for a minimum of 50 percent of building users.

In sustainable buildings, there was a greater degree of satisfaction with interior thermal convenience conditions than in traditional buildings, where temperatures and air quality indicators in the analysis for sustainable buildings were higher than a number of traditional buildings on average (Baird, 2014).

Charde and Gupta (2013) were also investigated the effect on components of thermal convenience construction design, which include a fixed sunshade, hollow fence, and a hollow ceiling, where the research has shown the soundproofed hollow walls in brick structures are best than rigid brick walls, that the constructed sunshade is paired with low temperatures for the warmer portion of each day, and that hollow roof walls reduce temperature swings.

Their investigation also shows which a mixture of these components, especially in the summers provides the highest thermal comfort indoors.

Bolattürk (2008) states that specific reductions in temperature leakage or heat retention by building components are not sufficient for thermal convenience, indicating that the achievement of thermal convenience is planned to minimize thermal through the winters and to produce thermal in warm weather by maintaining an internal and an external building envelope.

The concept of building enclosure is known as another standard energy-saving strategy and operates as a functional divider for indoor thermal comfort from indoor conditions. (Koo et al., 2014).

Through the design process, an early study is conducted to determine a design appropriate for the temperature levels of buildings that may require different wall styles according to regional climatic and seasonal conditions (Siew et al., 2011).

3.2.9 Accessibility

BREEAM-NC (2018) addresses the necessity for a safe building to involve amenities that promote efficiency minimal risk, accessibility to the building. This involves

excellently sidewalk lanes and walkways that are easily accessible from the building, as well as simple links to public cycle and sidewalk paths and public transport, as well as the sustainable buildings supporting with dedicated supply access.

ISO 15392 encourages designs to ensure secure access to construction workers and inhabitants during their operations to and from the site.

It also facilitates convenient and easy access to multiple areas for inhabitants for all forms of use. Therefore, protect access as an ingredient of sustainable construction requires designs to guarantee the protection of building occupants.

3.2.10 Impact of space use

The management of space is one of the integrations of all activities relating to the planning, design, and management of a facility to assist an entity to achieve its objectives, according to Becker (1990). According to Park(1998), the physical location is coordinated and the layout of the building and the contents are concerned. Where space management requires the efficient use of space and communication of people and work in an organization of the physical working space.

The successful use of space as an ingredient of a sustainable building requires the distribution of space, resources, and facilities to enable allow to express and interact with themselves. It provides users with a sense of well-being, contributing to the increased efficiency of a building (Ihfasuziella et al., 2011).

BREEAM-NC (2018) is interested in the provision of outdoor spaces like private gardens, balconies, terraces, and courtyards in sustainable buildings. It notes the need for an outdoor area that gives people confidentiality and a sense of well-being. However, personal indoor spaces are needed to achieve maximum occupants' health, efficiency, and comfort.

ISO 15392 tackles space in consideration of performance and reliability by analyzing which space of the facility to see whether it satisfies the desired function.

Steiner (2005) verifies the beneficial effect of space on occupant performance, where if space is well built it contributes to an efficient demand for space which can positively affect the well-being of the inhabitants of the building in exchange.

3.2.11 Quality of interior environmental

Interior environment quality as a part of a sustainable building ingredient, the quality of the inner atmosphere of the building in terms of occupants' health and well-being.

Interior environments are where people spend the most time and health and well-being are of major importance, where The interior environment offers a high degree of safety against extreme weather adverse health effects (Billie, 2012).

A favorable internal environment is indeed a human right as specified in the World Health Organization Constitution (WHO). Including the right to safe air, thermal comfort, and visual well-being and convenience (WHO, 2006).

BREEAM-NC (2018) is concerned with minimizing air pollution sources and rising the healthy ventilation capacity in a faculty. LEED (2009) located in building construction an external ventilation system must carry outside air to enhance interior environment quality to promote occupant health, well-being, and efficiency. It proposes that the design must in addition to the windows, provide grilles and high filtration systems in air conditioners so that interior and exterior air can be exchanged effectively.

Siew (2011) notes that the implementation of the air gap in walls increases ventilation based on seasonal conditions, thus avoiding unnecessary interior moisture, also he suggests that adequate ventilation, comprised of natural and mechanical components, will prevent diseases affecting the occupants' everyday lives.

As per him, Passive techniques like air well, obstruction, insulation, airflow opening, parapet, hallway, and shading may also be incorporated for airflow as well as for the ultimate convenience of building users.

ISO 15392 indicates that a good ventilation design removes excess moisture inside a building.

Billie (2012) also notes that the following construction measures must be introduced to improve the interior environment: proper ventilation, use of reduced pollution building materials, preparation of interior environment strategy for construction, the designation of interior areas as non-smoking, and installation control systems to improve the interior environment.

Regulation of the interior air temperature also leads to the quality of the interior environment. Ventilation systems may involve vented air voids and shaded areas on walls attributable to brick reflections to better monitor the interior atmosphere (Charde and Gupta, 2013).

Wargocki et al., (2008), advanced a sample was established that improved working conditions with improving the quality of the interior environment that leads to increased satisfaction of users and thus increase financial benefit.

This proves that a healthy building with a high-quality interior environment increases productivity and results in financial advantages, thus maximizing the benefit of the building.

3.2.12 Risk management

Risk management as a part of the sustainability of construction is linked to interior environmental quality. The applies to risk management by allowing a healthy interior environment allowance. It notes that the interior environment pollutants prompt odorous effects which irritate and damage installers and users' comfort and well-being. These pollutants include tape adhesives, wood floors, rubber floors, ceramic tiles, paints, and coatings (LEED-NC, 2009).

It also addresses the development of provisions to reduce exposure for building users in areas such as garages, washing facilities, and copying rooms to potentially dangerous pollutants and chemical pollutants.

BREEAM-NC (2018) addresses health and well-being risk management and states that risk management must be carried out through stages of the suggestion plan or construction level to mitigate or invalidate the impacts of natural hazards in structures.

This should be accomplished by an appropriate individual or individual to locate possible natural risk in the planning area and if a potential risk is detected, appropriate steps should be taken to minimize its impact.

ISO 15392 promotes steps for detecting hazards to the well-being of the soil, asbestos, electric waves, carbon dioxide (CO_2) poisoning, smoke, foul odor, pollution in the choice of planning and building principles. It addresses steps to discourage occupants from being vulnerable through these risks.

3.2.13 Legacy and local cultural

With regard to ISO 15392, the sustainable building must strive for consistency of culture, which should include the degree to which building practice will conserve and revive established Local Cultural and Legacy; interactions, and diversity; and make social and cultural knowledge networks convenient for citizens.

As per Parr and Zaretsky (2010), the protection of cultural heritage is a positive social influence.

Social advantages involve, a sense of belonging, social justice, ethnic and heritage connection, and a safe environment for its residents. Where the positive social impact recognizes the behavioral and psychological health impact of the building on its inhabitants (Berardi, 2013).

3.2.14 The ethical criteria

Berardi (2013) refers to the usage of the ethics criteria through the development team, planning team, implementation team, and the building operation team which relate to the maintenance of safe and healthy buildings to achieve sustainable buildings. It explains the effect between persons and structures, including guidelines for proper behavior towards the construction, design, and operation of buildings.

The ethical criteria include providing both people and the world with technical innovations that are healthy (Kibert, 2016).

Standards like the BREEAM and LEED have been identified as ethical criteria used to meet the environmental requirements of a building. BREEAM is aligned with the 'BRE Global Code for a Sustainable Built Environment'.

Where this code is a collection of guiding concepts and criteria that describe an effective approach to environment design, management, assessment, and certification (BREEAM, 2018).

LEED also helped improve the buildings' sustainable values and environmental effects.

The criteria are intended to promote the implementation by all building stakeholders of the specific concepts of sustainable development at each step of the construction process. These standards are intended to create a sustainable environment and it will

last through generation. When used in construction materials, they help to create sustainable structures.

3.2.15 Capacity to adjust for different uses

The capacity to adjust for various usage concerns a building meeting that ensures a combination of service types and promises consistency to fulfill the desires of the occupants where possible.

With regard to WGBC (2013), such parameters involve the simplicity of space adjustment to meet evolving consumer requirements and can be adapted to modern technologies, new systems leading to improved climate and comfort. It also requires any step to ensure that a building remains a relevant asset.

As per ISO 15392, the capacity to adjust for different uses as part of a sustainable building for many purposes includes determining the degree to which this building can be adapted over a long period to alternative uses. It includes construction systems that can alter, relocate or delete building components.

It also involves the design to permit elements of the building may be demolished or improved before negatively impacting the effectiveness of any portions of the facility. Because elevated slabs and adjustable divisions grant the resident reasonable autonomy to reconfigure without unnecessary interference, downtime, or costs (WGBC,2013).

Where a building that is durable must also be able to adapt throughout building a life and at end planned life. Buildings must adapt to new constraints by adjusting the performance

and efficient procedures. When constructing a structure for potential adjustment to a variety of applications, it's indeed necessary to choose the construction materials that may appropriate for this function (Gething, 2011).

Developing the structure in a manner that involves minimal or no necessity to modify the structural members where renders the building flexible for many purposes.

Building adaptability requires the application of basic flexibility, and adaptability requirements, this importance as an ingredient leads to sustainable construction (ISO 15392).

3.2.16 Vocal comfort

Vocal comfort as a sustainable building ingredient affects the comfort and its absence may contribute to well-being disturbances of the user. The WHO describes a variety of serious adverse health effects caused by noise penetration in the area. That involves psychiatric disorders, sleep disturbances, psycho-physiological discomfort, or adverse effects on adult well-being and children's learning capacity.

As per BREEAM-NC (2018), the vocal efficiency of a building that contains soundproofing must meet the required specifications for its function, it ensures which a voice expert is used to supplying initial design instruments on potential external products of the building.

Where building's voice expert can evaluate the building based on sound acoustics, the acoustic specifications for particular hearing and communication requirements, and the vocal design of the various areas and facades of the building.

ISO 15392 notes that sound conditions should be modified to gain vocal comfort of the planned operations in the building, including vocal attenuation and mitigation of

the noise to the satisfaction and well-being of the users and respect for external and indoor noise supplies.

According to Rasmussen (2010), effective product insulation must be utilized for vocal control to create a safe indoor atmosphere in sound terms. It was recognized in the early 20th century that inadequate sound insulation could lead to conflicts and therefore to reduce the well-being of the building users.

Sound insulation designs in buildings can achieve vocal comfort which is a significant task in the regulation of ambient noise.

Therefore, buildings may also be protected from extreme noise with the general principle of "environmental noise management" using technological solutions, planning, and regulations (Kurra, 2020).

Building laws detailing specifications for new residences soundproofing effects and noise thresholds through transportation and the technical developments are also in place to make

sure voice comfort in buildings, appropriate construction tools are required to meet particular sound insulation requirements efficiently and effectively, and there should be a high degree of linkage between the designed ones (Rasmussen, 2010).

3.2.17 Accessibility to network transportation

A sustainable building must provide suitable links to transit in terms of proximity to a strong transport public network. Accessibility to network transportation means providing occupants with more accessible public transport alternatives and designing a building with a quick connection to public transport.

According to Parr and Zaretsky (2010), it is important to incorporate sustainable buildings into the plans and designs of the city or town on which it is located, including the transport system.

BREEAM-NC (2018), LEED-NC (2009), and ISO 15392 addressed the decent public transport and regional amenities and facilities must be close to sustainable buildings.

It could supply the occupants with connections to alternate modes of transport, thus helping to minimize the noise and congestion associated with transport.

Like that, these standards argue that the design should provide accessibility for cycling trails and that bicycle storage and parking should be provided to promote the use of bikes as a mode of transport because they're particularly energy-saving means of transport.

3.2.18 Efficienciency of usage water

Efficiencies in water usage have been one of the essential elements of ingredients to sustainable buildings and water conservation to minimize costs. The use of water in housing and industry is essential for any economic system and quality of life, but unless

managed properly, can lead to cost increases and negative effects in waterways and biodiversity of the essential elements of ingredients to sustainable buildings and water conservation to minimize costs.

The use of water in housing and industry is essential for any economic system and efficiency of life, but unless controlled properly, maybe result to cost increases and passive effects on waterways and biodiversity.

Building users must be instructed on water infrastructure inside their building and methods aimed at reducing the usage of water and waste due to accidental leaks (Pahl-Wolst et al., 2007).

According to Billie (2012), the sustainable construction required involves interior and exterior water management, the sewage treatment used to support water conservation strategies.

The application of water innovated equipment such as electric showers, jacuzzis, and warm tubs have improved the requirement for water at facilities, where these lead to increasing in water demand has resulted in necessity the management of water supplies related to its low supply (Hoolohan and Browne, 2016).

This method has called water conservation and thus can be done by minimizing the amount of wastewater by, using a shower rather than a bath, by using water-efficient fixtures by using water-efficient appliances like washing machines, and by means of water conservation schemes such as stormwater crops and gray water recycling.

BREEAM-NC (2018) seeks to reduce the use of drinking water for sanitation by using water-efficient materials and water management schemes in buildings from all sources.

LEED-NC (2009) promotes concepts supporting a reduction in the consumption of drinking water by (50%) and an expansion of reclaimed sewage and greywater for irrigation purposes.

As per ISO 15392, a foundation for improving water quality and minimizing water use should be developed through the implementation of technologies that enhance efficiency through minimal or no water use, sanitary fixtures, and the recycling and reuse of rainwater and gray water.

Odey (2003) proposed methods through how water can be efficiently controlled to achieve sustainable building.

Such methods involve decreasing the amount of water utilized by different sources such as toilets, urinals, taps, landscaping, cleaning, and washing facilities which contribute to keeping sustainable water consumption.

Kibert (2016) proposed that wastewater recycle and gray water should be used for domestic use in toilets and gardening, where gray water is obtained separate from several sources like washers, showerheads, baths, and drains.

Auto irrigation instruments for greywater are recommended to ensure water and environmental protection (Yoong et al., 2017).

They claim that highly efficient buildings can minimize water consumption reach to 50 percent by selecting water-saving fixtures like toilets and urinals with high efficiency. The use of alternate water sources, including rainwater and gray water, will further minimize the potable water consumption from (50) percent to (25) percent of the typical facility water system (Yoong et al., 2017).

Yoong et al (2017) advocate the collection rain water principle as seen in figure (3.1) for a means of water usage production for residential uses.

This method gathers rainwater from building roof surfaces and then gathered it inside a storage tank after that passes through a filter to eliminate waste, this method can be fitted with distribution pumps.

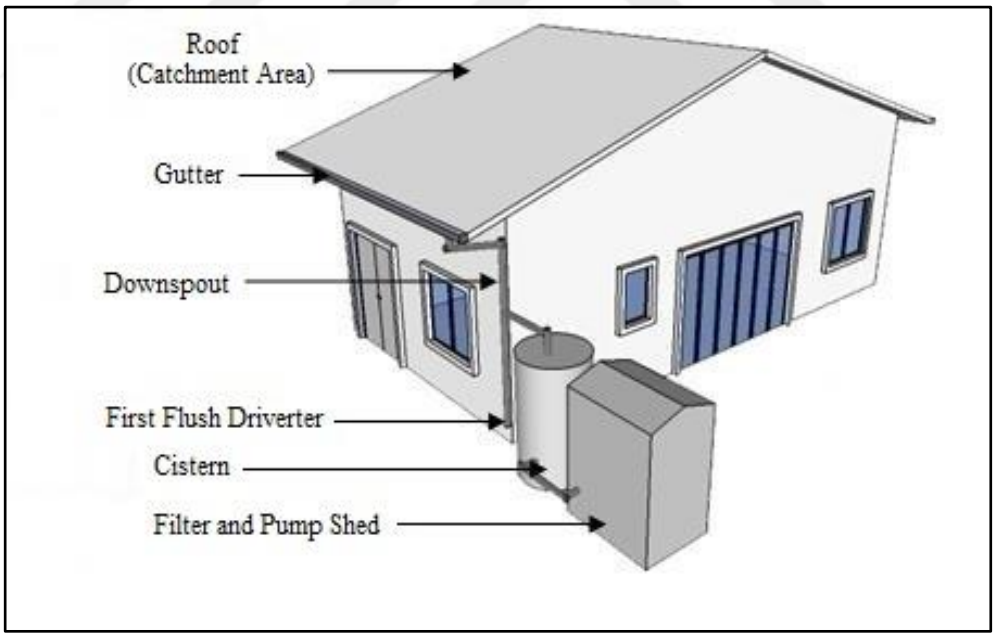

Figure 3.1: Collection Rain Water

Source: Yoong et al, (2017)

3.2.19 Performance of material

The performance of Material means supplying material services with less material output and distribution, thus reducing production costs. Where the expense of

construction is minimized and the cost to the customer who owns or pays rent is decreased.

Efficiency decreases material waste and provides a significant effect on the expense of construction, if construction materials have not been utilized properly, they result in increased demand for materials and then increase the production of these, so should be replaced with limited effect (Gunhan, 2019).

The rise of demand for products leads to further resource mining, resulting in higher production and labor costs, which lead to higher construction costs.

Material expenses are up to (15%) to (40%) from the total cost of the project, including labor expenditure, site depreciation, taxes, and contractors' charges (Salmi et al., 2013).

It is therefore important for reducing material loss through building construction and optimize material usage.

LEED-NC (2009) promotes the reuse of construction materials and goods to minimize the request for raw material and to minimizing waste, thus minimizing the effects of pure resource production and processing.

LEED-NC (2009) promotes to utilization of the construction products obtained and generated inside (500) miles from the project site at a minimal level of (10%) of the overall cost of the materials and decreases the environmental impact of transport.

BREEAM-NC (2018) is also promoting the reduction of replacement rate to avoid unnecessary use of materials and enhance the efficiency of materials.

For the construction process, the efficiency of the material requires the utilization of regional materials which processed and produced in the building project area, thereby minimizing production and distribution costs. The utilization of regional materials promotes decreased transport environmental effects (Salmi et al., 2013).

Adequate materials are chosen to reduce the environmental effects of construction, consequently, that's the need at design step to selecting appropriate products to minimize pollution and potential environmental impacts(Carpio et al., 2016).

3.2.20 Maintenance

Maintenance has different definitions, one of which is a combination, including supervision, of both technical and administrative operations, undertaken to preserve or repair an element to a state in which it can perform its required purpose. Maintenance is the management position of the facility manager, provided the management experience of sustainable buildings. Despite the inability of the facilities manager to perform the technical portion, he coordinates the repairs to ensure that the building is properly maintained and repaired.

With respect to building maintenance, the CIOBE(2004) defines facilities maintenance as work implemented to conserve, renovate or enhance each building component, its facilities, and its surroundings to specific requirements, as specified by the equilibrium among the required posed and resources obtainable.

BREEAM-NC (2018) mentions the facilities maintenance requires life cycle costing and life preparation to inform recommendations on design, specification, and life and operations.

Shah (2007) promotes an independent consultant agent's contribution to the building's upkeep.

3.2.21 Efficiency of energy use

The efficiency of energy usage ensures that the same service is supplied with less energy. Wang et al., (2012) explain the use of less energy without decreasing building efficiency and as a method to reduce energy use and its negative effects on the environment.

The efficiency of energy quality in appliances and fittings greatly leads to working more for less energy. Its benefits include effective natural resource utilization and decreased energy use which results in lower energy-related expenditure by building users.

Energy is used for all operations happening through the service life of any buildings. The design step, whatever, is the step where minimal energy consumption may be calculated (Mwasha et al., 2011).

BREEAM (2018) promotes the control of major consumption mechanisms such as warm water, conditioning, ventilation, illumination, humidity control, and energy-efficient light fittings.

BREEAM (2018) also encourages the local production of electricity through sustainable sources the implementation of energy-efficient cooling services the minimization of GHG pollution from the energy use of the system and the design and implementation of energy-efficient transport processes.

As per LEED (2009), when evaluating energy usage in a building, the minimum energy efficiency specification should be calculated, and on-site use of renewable energy technologies to offset the expense of houses.

Where refrigerants and HVAC&Rs are to be listed and used that reduce or remove the pollution of compounds leading to ozone destruction and greenhouse gases.

Energy management enhancements may include the use of air conditioning and energy-saving technologies for heating and air conditioning, hot water systems, illumination fixtures, and indoor transport, including elevators, escalators, etc., all of which are part of building services.

Building facilities involve warming, air operation, illumination, and other comfortable services. It is fair to assume the building without these facilities cannot prove useful for which it has been built. These facilities are part and parcel of the building. Their energy efficiency is central to their service (Malina, 2013).

As per Malina (2013) an energy management strategy should be built for energy-effective activities in a building as shown in figure (3.2).

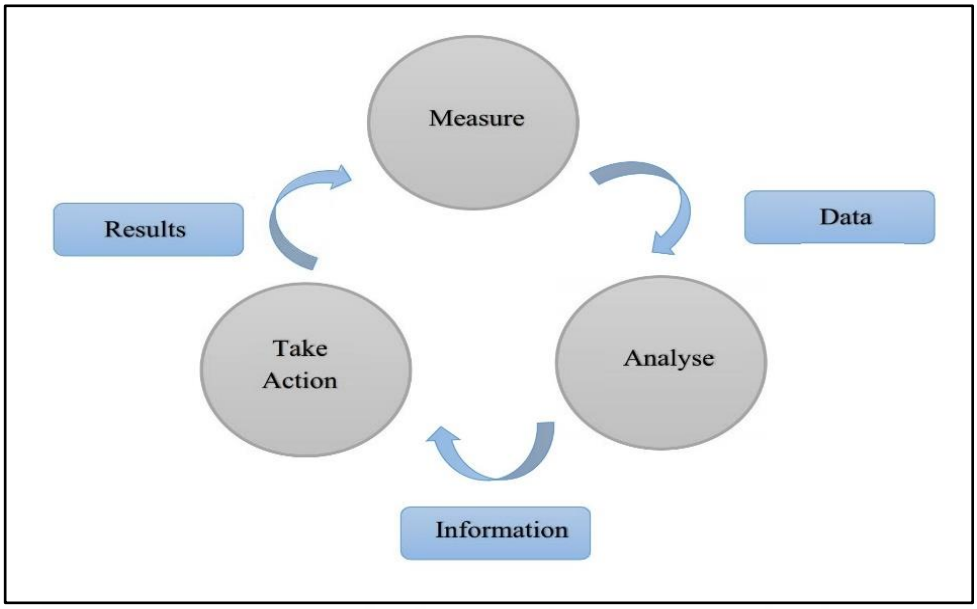

Figure 3.2: Cycle of Energy Conservation

Source: Malina, (2012)

Energy must be calculated to obtain readable information that can be determined by the energy planner to supply the building owner with the correct information and thereby enable the building operator to save on costs.

Yoong et al, (2017) state that the construction of low-energy buildings would be a possible goal for sustainable building and propose a zero-emissions building as a way of achieving sustainable building.

Energy-sustainable construction involves several types of energy-efficient buildings with lighting, space heating and ventilation (artificial and natural), passive solar architecture, and safe energy transport systems (lifts, elevators, escalators) (Mwasha, 2011).

Various studies have shown that buildings characterized by energy-efficient structures, such as low energy, and super low energy, are sustainable buildings (Yoong et al., 2017).

3.2.22 Costs of life service

The costs of life service costs for the building could be described as a mechanism that allows for long-term operating and maintenance costs of building facilities to be taken into account during the design phase of the building.

The idea of life-cycle costs originated in the 1930s when people began to understand that construction costs were way above building costs and that since then life-cycle

costs have been used to demonstrate to building consumers how a small incremental expense in advance could yield substantial savings in the long run (Roaf et al., 2003).

The concept of life-cycle costs in construction is that the cheapest option should not be selected when assessing the cost alternatives of the proposed construction project, Instead, it is more productive for the lengthy period, bringing into consideration respectively the early installation costs and the potential costs and advantages of the building's operating life (Khasreen, 2009).

Emblemsvag (2003) states that life-cycle costs serve three main purposes: an effective manufacturing and procurement engineering tool, a cost management and control instrument, a technology and engineering instrument for an environmental specific purpose.

However, what is important for all three motives is that life-cycle costs offer insight into all potential cost concerns.

BREEAM-NC (2018) notes that a life cycle cost review can be used to guide decisions on construction and repair requirements and procedures during the design process.

3.2.23 Post-occupancy assessment

Post-Occupancy Assessment is a method for standardized evaluation of building efficiency after completion and occupation of the property for some period (Preiser, 1995).

BREEAM-NC (2018) insists on using post-occupancy assessment information to accurately assess the perspective of building occupancy on the buildings they occupy.

The post-occupancy assessment review how well buildings satisfy the needs of the users and also defines means of enhancing the construction's, efficiency and purpose. The data generated from the post-occupancy assessment is then used for the preparation of the brief, which is a documentation of customer expectations for building improvement.

ISO 15392 refers to post-occupancy assessment as information from users and learning from previous experience to continually increase the efficiency of building and reliability of the users.

ISO 15392 promotes post-work evaluation documents for consistent decision-making and distribution of relevant information based on information currently available. The received data is used in the design to assist in the potential maintenance and operation of the building.

3.2.24 Innovative technology utilization

Innovation is a new concept or a more efficient method for the execution of a procedure. innovation maybe take place in products, technologies, services, businesses, or construction. In buildings, innovation can identify some helpful technological improvements in terms of energy and water usage, building data systems, production of less harmful construction materials.

BREEAM-NC (2018) refers to that's the innovation of any advancement that may be seen to enhance the sustainability efficiency of a construction design, house, service, maintenance, or destruction of any technology, system, or procedure.

According to LEED-NC (2009), innovation creativity helps the production and project to achieve outstanding performance in components such as energy performance and water quality above the criteria of any sustainability review system.

ISO 15392 promotes the investigation of new ideas and methods to make building construction sustainable.

Therefore, advanced technology can be said to be used in sustainable buildings with innovative technology that does not have a negative environmental impact but instead helps boost building sustainability.

3.2.25 Systems of building management

System of Building Management is a technology control method installed in buildings to control mechanical or electrical devices like ventilation, illumination, heating, fire fighting instrument, and protection systems of the building.

The advantages of these systems are internal comfort controls, individual room controls, increased efficiency of workers, the effectiveness of the monitoring, and the energy usage

targeting enhanced plant performance, and Life cycle, productive response to HVAC concerns, and save time and money in repairs (Pinho, 2015).

BREEAM-NC (2018) promotes the utilization of a system of building management to control energy resources in areas such as space heating, district heating, humidification, conditioning, fans, lighting, bathing, hydrotherapy baths, cooking facilities, freezers, cleaning services, elevators, and escalators.

LEED-NC (2009) also promotes the incorporation of the system of building management into the architecture of building envelopes optimize and the energy output of the building and recognizing the most economic energy conservation steps.

ISO 15392 suggests examining the building management system to monitor the efficacy of the management system and if possible, improving it.

3.2.26 Initiatives of environmental management legal and contractual

Initiatives of Environmental Management Legal and Contractual as sustainable building ingredients has involved the inclusion of the Environmental Management Systems (EMS)

as a part of a series of procedures to help the implementation team to minimize environmental effects and enhance management efficiency (EPA, 2020).

As shown in figure (3.3), the Environmental management implementation process has been established by the ISO15392 standard.

The process included five main phases, the development of an environmental management strategy, the preparation of some kind of procedures to minimize the environmental effect of the building, the applying the plan, the evaluation, and calculation to achieve its fulfillment. The benefit of EMS defines the potential for enhancing environmental efficiency (EPA, 2020).

BREEAM-NC (2018) states that for a building project, EMS can be applied by the main contractor. Construction services and equipment needed for any building projects to be completed for ecological conservation objectives must regulate energy usage. The use of water, the transport of most building materials on the project, and construction waste from the location must also be regulated.

ISO 15392 includes the implementation of a sustainability strategy in which customers along with the design and the construction team discuss key sustainable elements to achieve sustainability of a building.

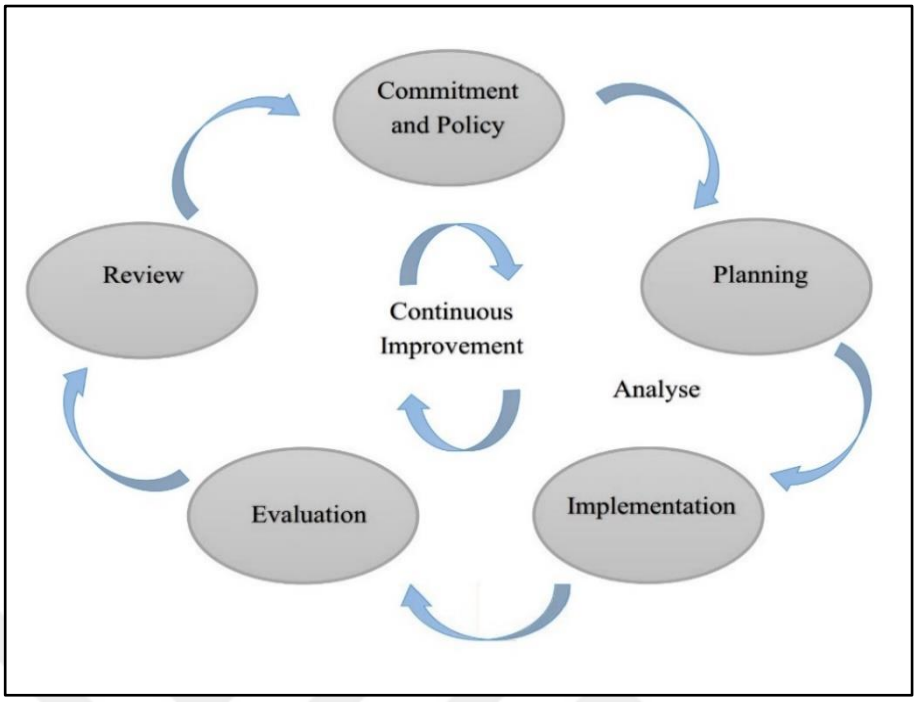

Figure 3.3: Enviromental Management Imlementation Process

Source: EPA, (2020)

This strategy is conveyed in the design and development phases to all stakeholders.

These strategies are being processed and evaluated as proposed by EPA (2020). Where the policy is discussed with users during operations and programs are created to inform them on how sustainability functions in buildings, where successful communication of such a policy will lead to improved user behavior and boost building sustainability.

This will promote environmental practices by users that are also an ingredient of the sustainable building belong to the management element.

3.2.27 Roles of sustainable construction specialists to submission of sustainability evaluation plan

LEED-NC (2009) mandates to employ a specialist in construction projects to simplify the application and qualification process during the design and construction phase. Whereat least one major mission staff participant is a LEED specialist, the task of which is to educate project team members on sustainable design and construction.

BREEAM-NC (2018) already includes a BREEAM adjudicator to evaluate the sustainable status of buildings using suitable evaluation instruments and calculators in the design and post-building phases.

ISO 15392 promotes an integrated interdisciplinary approach to the involvement of practitioners who can contribute to the incorporation of their respective sustainability priorities and methods in the design and development phases of the project team.

They also stress that team participants must understand their evaluation tools and process' eligibility requirements and credit criteria.

3.2.28 Guideline of building users

A guideline of building users is nontechnical guidance including details to guarantee the effective performance of facilities.

Concerning BEEAM-NC (2018), this guideline provides building users with details on the concepts behind building design and their impacts on the operation of the building; the building's efficiency standards; energy saving initiatives; water cost savings; functioning heating, lighting, cooling systems, and implications of inappropriate use; entry, protection, and safety systems; methods to the monitor problems; provision of car

parks and walking, local public transit, and wastewater management. It can also provide recommendations for managers of facilities and repairs and other contractors.

Where guideline of building users provide useful knowledge for building users to familiarize themselves regarding building-integrated technologies and how the technology can be used efficiently.

Guideline of building users, as an ingredient of sustainable building, are generally promoted even in traditional buildings, but they also need to be given in sustainable buildings enough so building occupants could a collection the guidance there assists them with the operation of building facilities.

3.2.29 Handover and commissioning initiative

Handover and commissioning Initiatives are procedures in place to ensure the efficient operation of all building facilities. The commissioning may be defined as bringing the implementation to fulfillment to a degree if the designer requirements are stated accordingly (CIBSE, 2012).

Handover and commissioning Initiative includes construction facilities, like air conditioning services and a power source. Although this process is typically carried out in traditional buildings when construction is finished, this process is still required also to sustainable buildings.

The commissioning of sustainable buildings, with respect to the WGBC (2013), leads to decreased operational, and maintenance costs. Where depends upon the detailed design and execution of plans during building installation, where successful commissioning is important for energy efficiency.

CIBSE (2012) also promotes the use of mechanical system commissioning technology. CIBSE is a globally recognized body that establishes criteria for the commissioning of systems for facilities services.

Building commissioning decreases maintenance costs due to improved energy consumption by around (5) percent to (10) percent, improving comfort conditions, thereby improving efficiency, eliminating the failure of building facilities, and enabling a fully operational building since the starting day of activity (Kibert, 2016).

3.3.30 Period of deficiencies responsibility

The duration of defects of responsibility is typically from half year to year, whereby the contractor is responsible legally bound to correct any mistake that has resulted in the contractor's work. Concerning CIBSE (2012), a period of defect liability is beneficial to obligate the contractor to fix all defect work at less than the expense of damage to pay to the customer or the owner of the building, the benefit of fixing all defect to enable the building to perform optimally.

During this time, consultants and contractors guarantee the building's efficiency and fix any problems with performance. While adherence is conducted in traditional buildings to the period of accountability for defects, it is a mandatory period that must be followed in sustainable buildings.

3.3.31 Adjusting of building

Adjusting of the building is a process by which a building is continuously modified to give optimum output and starts after the handover of a building.

Adjusting typically takes place after the commissioning of a building and is usually performed roughly (12) months after the handover. To guarantee which the building may undergo regular changes during the year, the occupant should always take a reasonable amount of time to use the building (WGBC, 2013).

Regarding GBCA (2016), although a building is properly established, the pressures of the construction process and the shortage of understanding of the different processes included in the construction functions adversely impact performance.

Adjusting the building is a way to compensate for the deficiencies in the commissioning step and to guarantee that the building facility preserves energy, a stable process, and relax feeling for occupants of the building. Adjusting of buildings may assist to control pollution produced from the building.

According to Lundan and Li (2013), it's necessary to ensure optimal relaxation and energy-efficient facilities for occupants during their residence, building adaptation is therefore encouraged, while its usage causes buildings and their facilities to be worn out related to.

Adjusting of the building also has other benefits, including allows building operators to good recognize a building, to ensure the optimal building efficiency is preserved, and decrease the building's ability to generate pollution carbon dioxide, where allows responding to various occupants requirement (Kos et al., 2014).

3.3 Challenges to Achieving Sustainable Building

The construction process is a long cycle that can have an impact on regional and national ecosystems, depending on the scope of the projects, where preparation and scheduling are the priorities of sustainable construction to fulfill the specifications of the sustainable project, where these projects must implement sustainability activities in addition to traditional construction activities (Khodadadzadeh, 2016).

Significant challenges mostly in the sustainable construction process include the environmental effects, cost reductions, healthy issues, and safety assurance, human resources, and learning and training.

3.3.1 Cost reductions

Another challenge to sustainable construction practice is believed to be greater initial costs since this challenge is one reason widely placed forward regarding sustainable building procedure. The development teams and the community assume that it costs more than traditional buildings for sustainable buildings. Sustainable buildings produce higher upfront costs, this expense has long-term advantages like reductions in energy and water usage, decreases in the substitution of materials utilized in construction structures, and reduced amounts of waste (Jaworski and Samanta, 2006).

The expected greater initial costs may be due to the expense of unfamiliar methods, the lack of prior experience, extra tests process, missing of assistance from manufacturers and suppliers, and a shortage of performance knowledge (Khodadadzadeh, 2016).

3.3.2 Environmental effects

Most construction procedures have different environmental effects like material mining and utilization, emission of contaminant gases and fluids energy consumption, and solid production at destruction and construction locations.

Griffith (2002) mentioned the environmental effect of construction operations is among the main problems in sustainable development, where a sustainable building policy can reduce the insufficient influence of the building procedure on the environment.

These environmental effects continue to affect it and the construction phase recently, therefore, could be an obstacle for an effective sustainable building procedure to comply with these effects. General, the preparation for adapting to environmental concerns must be carried out during the sustainable design process, but the execution of these plans may be seen as a challenge through the sustainable construction stage.

3.3.3 Health issues and safety assurance

This could be assumed which sustainable construction when accomplished whenever health issues are reduced, where consideration of health concerns is one among the important obligations of developers in the construction stage (Griffith, 2002).

Health issues and safety assurance should be considered as among the significant aspects of the responsibility of the designer.

Construction managers can apply these criteria of health issues through the implementation of the health and safety assurance system during the construction process.

3.3.4 Human resource

It is possible that, while increasing the expense of a project sustainable building products may not produce the desired efficiency or quality, these must be selected and accurately monitored at the construction stage to make sure the required quality and efficiency in this situation.

Environmentally conscious building products identified as sustainable construction products are a relatively unexplored sector due to the nature of the green construction industry (Robichaud and Anantatmula, 2011).

Hills et al. (2008) acknowledge the essential function of project managers who affect business efficiency throughout a supply chain of products.

Project managers may monitor a supply chain through negotiating delivery times, testing the performance and progress of the factory, and complying with the standard on supply and project implementation.

3.3.5 Knowledge and learning

Another of the main challenges to sustainable construction was its lack of knowledge and learning for sustainable construction.

Robichaud and Anantatmula (2011) propose a sustainable construction project management strategy for on-site preparation and learning for construction workers to initiate construction practices with a KOM in which to teach them about various elements for sustainable construction.

Monthly workshops at the site including sustainable building knowledge and learning are also important to all the workers at the site. In this strategy, an analysis of sustainable needs before start-ups is also undertaken with each contracting company (Robichaud and Anantatmula, 2011).

Where developments for subcontractors by on knowledge and learning workshops need to be encouraged.

Therefore, preparation and training for staff and contractors must be supported by ensuring that these workshops be held on the schedule while the project manager is responsible for scheduling the project staff meetings and becoming in command of such meetings as per Arditi et al (2009).

3.4 Results of chapter

The chapter focused on the different meanings of sustainable building, where it's described sustainable building through the scope of study to a healthy construction

facilities, planned and constructed from the start of life until the completion of a resource-efficient way, using environmental values, equity of social, and performance of life value, and fostering a feeling of community.

The initial results of the first step show that (31) ingredients of sustainable building are described in this chapter, where the study has highlighted on the summarization of these ingredients to (26) ingredients that achieving sustainable building were represented the environmental, social, economic, and management parts.

The ingredients consist of (5) ingredients belong the environmental part, (9) ingredients belong to the social part, (6) ingredients belong to the economic part, and (6) ingredients belong to the management part.

The chapter also focused on achieving sustainable principles is confronted with challenges may as lack of professionalism and experience, lack of learning in sustainable building activities, shortage of awareness in sustainable buildings, expected higher initial costs, lack of incentives, shortage of governmental initiatives to encourage sustainable buildings, etc., which prevent them for achieving these practices.

4. RESEARCH METHODOLOGY

4.1 Introduction

The study methodology has been described in this chapter to achieve the purpose of the study and explains the approaches of study used to gathering and analyzing data, where describes the three main steps of this study research framework. Stage one, review of relevant literature on sustainable buildings. Stage two, questionnaire survey of Iraqi Engineers Association members.

Step three includes validating the development of a management system to achieve sustainable buildings in Iraq. The research methods described above are discussed in depth in the following sections.

4.2 Research Design

The research design is a structured overview of how the research study is to be performed, where the overall approach is chosen to systematically and logically combine the various components of a study effectively solving the research issue and forming a basis for data collection, calculation, and analysis.

The selected approach can be qualitative, quantitative, and mixed methods to guide research procedures, that follow some philosophical theories, design techniques, and study methods (Creswell, 2018). Figure (4.1) demonstrates the definition of a research design.

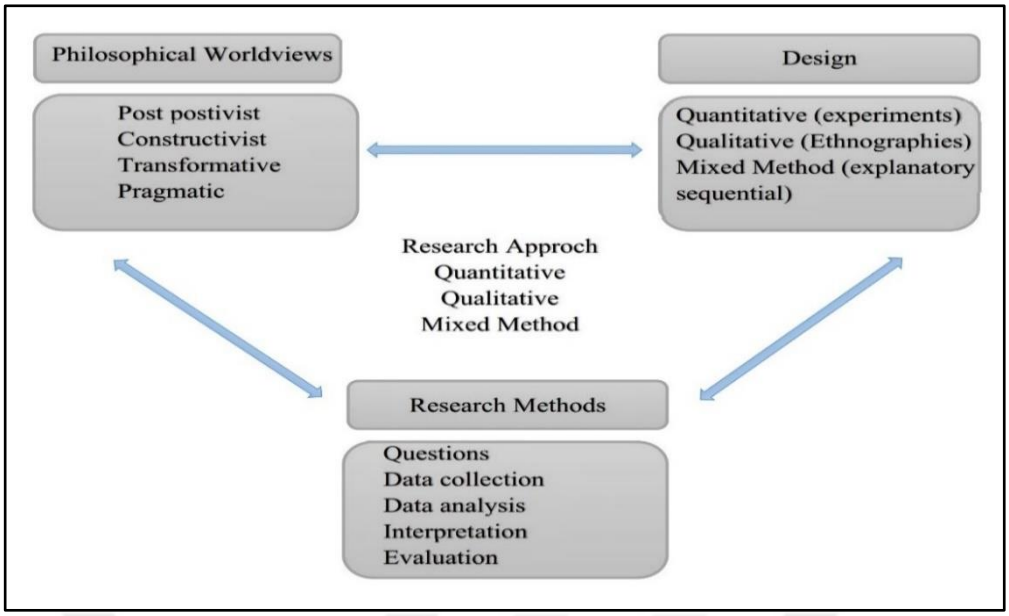

Figure 4.1: Framework for Research Design

Source: Creswell, (2018)

4.3 Philosophical Theories

Philosophical theories may be described as overall guidelines and understanding of the world or the purpose of a study carried out by the researcher (Creswell, 2018).

Usually, the author uses those principles and theoretical concepts in a research paper. However, some people might never agree that they should accept a particular assumption or agree on the role these hypotheses play in the study process (Mertens, 2015). Philosophical assumptions include ontology, epistemology, axiology, methodology, and philosophical assumptions of rhetoric (Creswell,2018).

Figure (4.2) demonstrates these philosophic assumptions according to Gunatilake (2013), focusing on particular issues like what is the method of the study? How does the investigator relate to the examined person? Which are the principles that contribute to the study? What was the study's reality? What's learning communication?

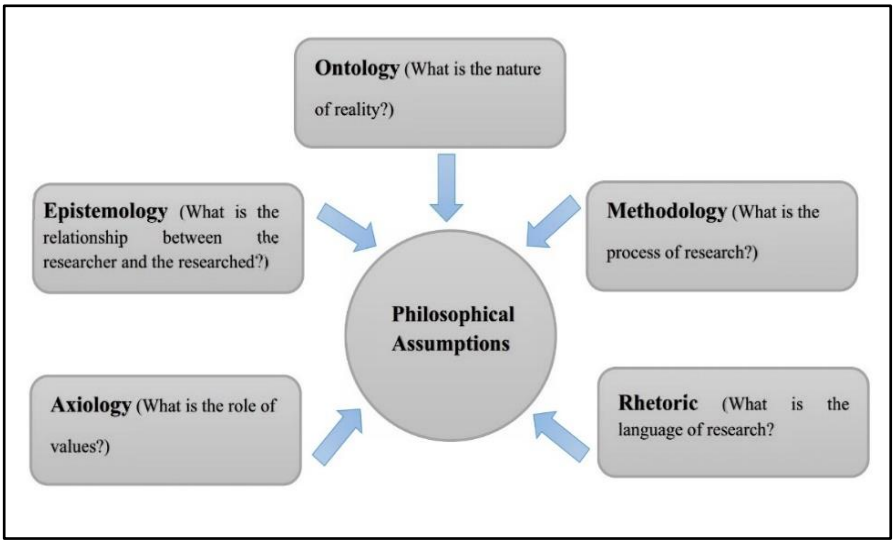

Figure 4.2: Philosophical Theories

Source: Gunatilake, (2013)

Ontology is a philosophical assumption regarding the essence of truth in which the investigators believe the multiple reality of their subjects and this is illustrated by the use of various themes using the technique (What is the study process?) Rhetorical tale (What is the language of research?). Epistemology is a metaphysical theory of the relation between the researcher and the known and how empirical knowledge has been gained. Axiology is an assumption philosophy on the role of ethics in science. The methodology is a logical theory of the research process and method, which is defined as inductive by the expertise of the scientists in data collection. Rhetoric is the practice of language study and the practice of convincing the public.

4.4 Types of Research

From the viewpoint of research goals, a research plan can be categorized as descriptive, correlational, illustrating, or exploratory. The aim of the study will decide the kind of research to be implemented from a perspective of the study goals (Neuman, 2014):

• Research is known as descriptive research when attempting to explain a situation, practice, service, or procedure in a systematic manner, or when attitudes regarding certain problems are identified, and how to study issues.

• Research includes a correlation between several parts of a situation if the study focuses on attempting to find or assessing the nature of an interaction, interdependence, or partnership.

• Research is defined as explaining when the main goal of explaining why events happen and constructing, creating, extending, or testing the theory. It helps to explain why and how two parts of a phenomenon are related.

• Research can be explorational if the purpose of a study is to either explore a field where minimal research needs to be done or to explore possibilities for specific research and to establish preliminary concepts and research issues.

The study is descriptive in concept as it aims to explain the various practices of sustainable building achievement and the challenges of implementing this concept in Iraq. The study is also considered an exploration of the method of inquiry, where the study takes both qualitative and quantitative methods into account, and the synthesis between the two methods to sufficient to accomplish the purpose of the study.

4.5 Choice of Research Methodology

The approaches of the analysis adopted by the study are based on the research researcher's philosophical concepts, research design, and fundamental research procedures for gathering, analyzing, and interpreting information according to Creswell (2018).

Study approaches are defined as the kind of qualitative, quantitative, and mixed techniques that guide the research design processes (Mertens, 2015).

Quantitative research as per Aliaga and Gunderson (2005) is effective at generating knowledge from a wide range of units in the broadest possible field, but quantitative methods can be very shallow when a topic or idea is to be studied in depth.

The qualitative method is best for a detailed investigation of a study issue. It is a system, which studies subjects in their natural environment, which attempts to explain or perceive a phenomenon with regard to the meanings that people bring to them, where data are inductively analyzed in this method based on details to general concepts, and the researcher interprets the importance of the information (Creswell, 2018).

Qualitative study can define an approach to analysis and try to understand the significance of individuals that are dedicated to social issues, where the qualitative study is intended to examine the real circumstances in their time-based and local circumstances (Flick, 2018).

On the other side, mixed methods given the quantitative and the qualitative benefits. Researchers regarded the selection between the quantitative and qualitative approaches as important. Nevertheless, they are no better than the other because they both have distinct traits and have their strengths and limitations (Mertens, 2015).

4.6 Choosing a Mixed Method

This study uses a mixed-methods approach because the study aims to get a detailed understanding of the significance of the concept of sustainable buildings and the challenge to achieve sustainable buildings in Iraq.

Regarding Creswell (2018), if a practice or theory requires to be investigated and clarified since few studies have been done, then a mixed approach is needed.

Valen and Olsson (2012) conducted a study to determine the extent of the importance of the occupational service management career for the owners of buildings in relation to their buildings in the fine, functional, and up to date conditions, by performing the questionnaire investigation and thorough interviews. The qualitative approach was the first proposed, due to limited the literature in this field, the research analysis is exploratory and required explanatory studies to validate findings. The quantitative approach was then used to verify and generalize results for a population and to analyze the results of the qualitative process by means of a questionnaire survey.

4.7 Selection of Research Methods

This section describes effective research approaches by choosing mixed approaches for this study analysis as an acceptable methodology. The search method is the technique for

the gathering of observation research information and may be classified into four main topics: documentation, interviews, analysis, and questionnaires (Denscombe, 2010).

The selected methods used for gathering information in this research include documentation and questionnaires. The study mandated an exploratory development approach involving the collection first of qualitative information and then quantitative data. The study began with gathering qualitative information from related literature and documentation to collect as much knowledge about sustainable building components, it was the first step of the study. The second step of the study

involved the acquisition of quantitative data. The results of the documentation gathered were used for designing a questionnaire that was created and then bring up to members of the Iraqi Engineers Association (IEA).

4.8 Framework of Study

The study approach implemented in this study could be shown by means of a three stages research framework as shown in figure (4.3). Stage one consists of the literature review and study of sustainable building documents and their ingredients.

Literature review on sustainable buildings was involved in the literature review and document study, stage one also included the highlight on the challenge to implement sustainable buildings in Iraq.

Stage two consists of a questionnaire investigation to assess the results review additional documents. Stage three consists of validating and analyzing the research results in depth.

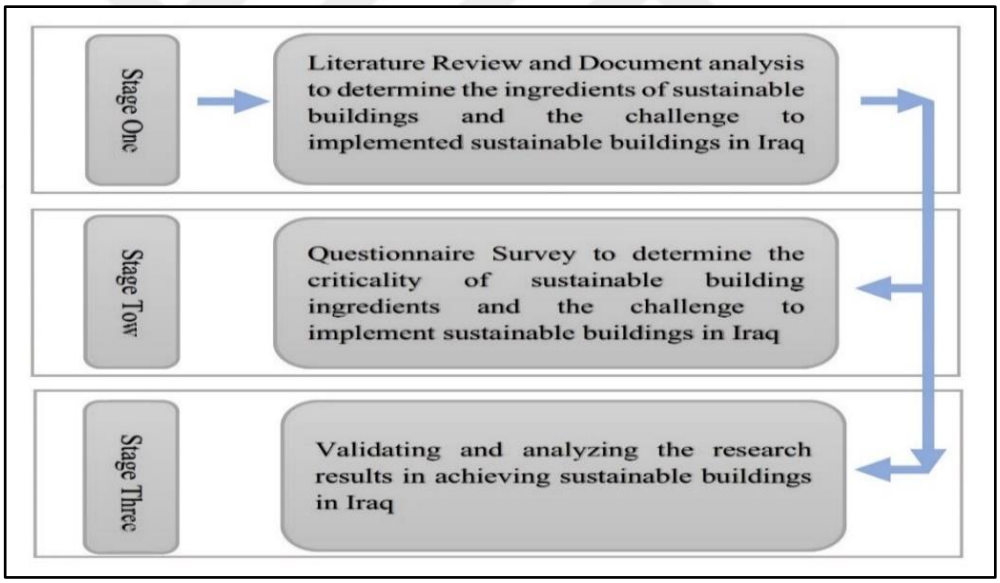

Figure 4.3: Framework of Research Stages

Source: Author

4.8.1 Literature review

The literature review in the study was presented to provide a strong theoretical structure for the field of research and to promote the study's aims and purpose. When findings were made, the literature review proceeded to the latter stages of the study process.

A review of the relevant literature positions of a study defines the information gaps, provides a structure for establishing the value of the study, and thus provides an explanation for the problem statement (Creswell, 2018).

Figure (4.4) clarify the steps of background review in the study as displayed in chapters 1 to 3. The literature review provided the study regarding the theoretical framework for sustainable building ingredients and implementation challenges in Iraq.

Denscombe (2014) suggests that such a method aims at arriving at a result on the proposed information of a subject depended on a detailed and impartial review of studies carried out on the topic. This method was helpful, where numerous publications on the study subject were identified, but these publications needed to recognize to define sustainable building ingredients.

The study was included selecting the literature from several sources including books, seminars, blogs, and databases, in addition to several journals like Journal of Building and Environment, Journal of Construction, Engineering and Management, and Journal of Sustainable Development.

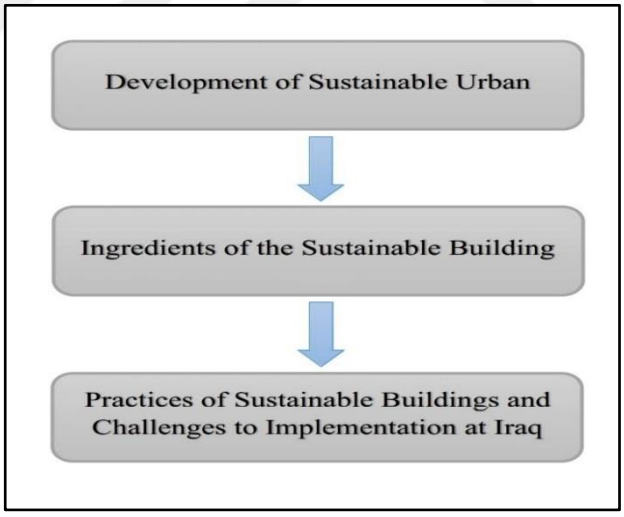

Figure 4.4: Framework of Literature in Research

Source: Author

The principle of the literature gathering was a keyword study for 'sustainable building'. The choice of literature has been dependent on background pertinence to the research, paper currency, and material quality.

Figure (4.5) shows the stages followed in this study to define sustainable building ingredients. Relevance of the analysis included results from earlier studies on the

components that establish a sustainable facility, while this consistency of the contents involved concern of the rich data on research objectives available in the literature, the results and suggestion are typically set out in the abstracts.

A total of (31) ingredients for sustainable buildings were described. The (31) ingredients were then classified as per literature into environmental, social, economic, and management aspects. Each ingredient has been refined to meet the ingredients detected in the analysis of information.

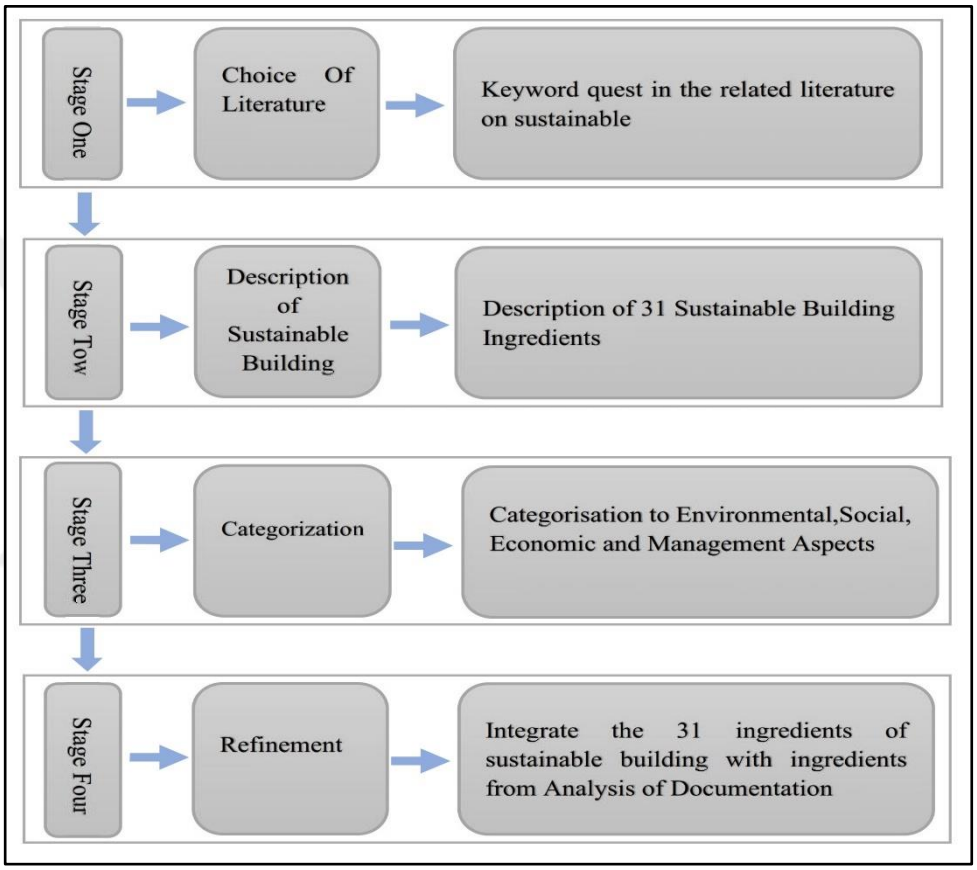

Figure 4.5: Steps of Literary Review

Source: Author

4.8.2 Questionnaire survey

Scientists have designed a questionnaire survey to offer a quantitative or mathematical explanation of population patterns, behaviors, or views by analyzing a sample of that population (Creswell, 2018).

Figure (4.6) shows the research process at this point, where this part is dedicated to designing and processing the survey questionnaire and evaluating the survey results.

The questionnaire aims to evaluate the ingredients of a sustainable building in Iraq and the challenges of implementing this concept.

Questionnaires are a documented set of queries designed to specifically gather details from persons and gather details utilized for information analysis. Questionnaires must be designed in a method that may be completed easily method and not need any help.

They can be difficult because respondents cannot speak in their own words and sometimes the researcher has no chance to verify if the responses are valid. However, these are very simple to organize and all participants have required essentially the same queries and chosen from the recorded responses, it's suitable for quantitative study (Denscombe,2014).

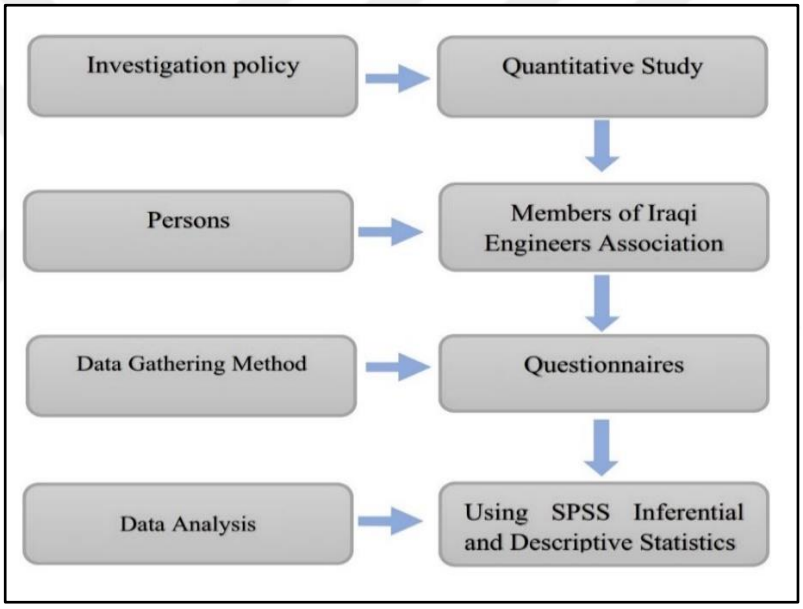

Figure 4.6: Steps of Questionnare Survey

Source: Author

4.8.2.1 Questionnaires sample

The questionnaire study includes a quantitative approach specifically to the use of the sample primarily, which selects individuals, choosing a number for several and generalizing findings that might represent a wider population.

According to Bryman, (2016) the degree to which a specimen is a community depending on specimen volume, the basic design of choice processes, and the specimen structure, where the specimen volume is the number of persons from the

community through which the investigator gets data, the specimen design or sampling the strategy be referred to the

basic plan choice process, where specimen structure is a list representing persons in a community. The questionnaires were targeted at (252) registered members of the Iraqi Engineers Association (IEA) and they work in fields of building construction. The participants were contacted by printing the questionnaire and distributing it in papers, social media numbers, and email addresses obtained from the register of the Iraqi Engineers Association (IEA) as stated above. Where participants have been required to answer the questionnaires and send them back through the same receipting method, and then questionnaires (207) have been returned after given them specific duration (15) days.

4.8.2.2 Questionnaires design

The questionnaires should be designed to gather data that could be used for evaluation, provide a list of questions, and must ask people for data on identified research matters (Denscombe, 2014). where four key criteria must be met while questionnaires are designed:

• Theoretical awareness of the study conducted and obtained by analyzing submitted literature, or other qualitative study methods that may function as a pilot approach.

• The validity of the questionnaire, how the question tests what it has been designed to test, and the reliability of the questions whether these are consistent or relevant.

• Experience in writing a questionnaire, and the utilization of a broad variety of questionnaires published.

• Knowledge of the target demographic.

A sample of the questionnaire is included in appendix A. The questionnaire includes a group of specific questions designed to gather the knowledge that will assist in achieving the aims and objectives of the study.

Specific questions are designed with answers that only permit the answers to match into categories defined by the researcher in advance.

The questionnaire also included the scales defined as measurement levels, which are a method for arranging information in the measurement of indicators into the nominal

and ordinal level, and also scales to determine the intensity, direction, amount, or power of a variable measuring in quantitative data.

Scales include Likert, Thurstone, the social distance of Borgadus, semantic differential, numerical ranking, and the scale of Guttman.

They are utilized by social scholars to provide strong data quality, high precision and reliability, compare data sets, and improve data collection and analysis (Neuman,2014).

The scale of measurements utilized for this study is nominal and ordinal (numerical and Likert) measurement scales. The nominal measurement scale is used in section 1 of the questionnaire it's required from the respondent to select the specialty of his/her occupation and years of experience.

Section 2 (part 1 and part 2) deal with issues by using the ordinary measurement scale (Likert scales), Where they included a 5-point scale Likert, which requires respondents to indicate to what extent they agree or disagree about the effects and criticality of the ingredients listed for achieving a sustainable building definition and face challenges in achieving sustainable buildings in Iraq, where; No.5=Strongly Agree, No.4=Agree, No.3=Disagree, No.2=Neither agree nor disagree, and No.1= Strongly disagree. Due to its simplicity, flexibility, and reliability, the Likert scale is the most widely used form of scaling (Neuman, 2014).

4.8.2.3 Data collection

The response ratio for the data collection is beneficial in assessing the efficiency of the questionnaires returned in the study. Table (4.1) displays the distribution of the questionnaire for the survey method. 252 questionnaires were distributed directly either by printed papers or by sent questionnaire link (google format) through the social media numbers and email addresses, and then (207) completed questionnaires were then returned, which resulted in an (81 %) of participants.

Table (4.2) displays the number of responses depending on the various backgrounds.

Table 4.1: Response Rate

Questionnaire		No.
The questionnaires distributed directly	50	252
The questionnaires sent by social media numbers	172	
The questionnaires sent by email	30	
Overall number of returned completed questionnaires		207
Responses%		81%

Table 4.2: Questionnaire Distribution

Questionnaire	Rate %	No.
Civil	57	118
Architectural	12.1	25
Mechanical	8.2	17
Electrical	7.2	15
Others	15.5	32
The total number of completed questionnaires returned	100	207

4.6.2.4 Hypotheses

The initial results of the first step show that (31) ingredients of sustainable building are described in chapter 3, where the study has highlighted on the summarization of these ingredients to (26) ingredients that achieving sustainable building were represented the environmental, social, economic, and management parts. The ingredients consist of (5) ingredients belong environmental part, (9) ingredients belong social part, (6) ingredients belong economic part, and (6) ingredients belong management part as shown in table (4.3).

4.8.2.5 Data analysis

The study followed initial steps to insert data gathered in the program SPSS 22, after which the data inserted were reviewed and errors verified. It was a required practice to verify the data input process was correct. SPSS 22 was used descriptively and differentially to analyze the data from the survey.

Calkins (2005) reports that descriptive statistics typically define or identify a collection of data elements and attempt to deduct information obtained by sampling by graphically presenting the information or explaining its key patterns and how it is distributed when inferential statistics are presented.

A significant value of (5 %) was used in the study. The study involved the analysis of the percentile form, Cronbach's Alpha, and relative important index. The study also involved the engineering specialization of the different participants in the questionnaire survey as shown in figure (4.7).

The results show that (57%) have a civil engineering background that carries the highest percentage of engineers that they working in the field of buildings construction at this survey, the results also show that (12.1%) have an architectural engineering background, while the result shows 8.2% have a mechanical engineering background, the results also showed (7.2%) have an electrical engineering background, and (15.5%) have other engineering specialization background.

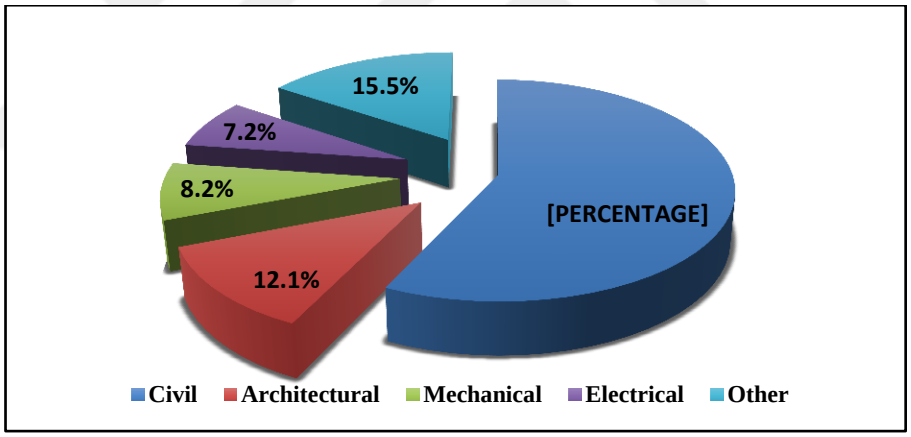

Figure 4.7: Engineering Specialization

The study shows years of experiencing the of the different participants as per figure (4.8), where (10.6%) of participants from 0-5 years of professional experience (13.5%) of participants from 5-10 years of working experience (26.6%) with 10-15 years of professional experience and (49.3%) for more15 years of professional experience.

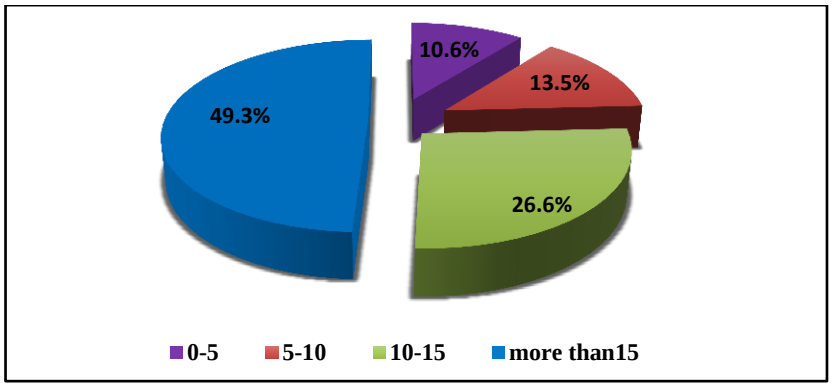

Figure 4.8: Years of Experience

Table 4.3: Sustainable Building Ingredients

Part		Sustainable Buildings Ingredients
Environmental	1	**Management of the Waste** system is efficient and suitable during stages of construction and operational life of the building.
	2	Building construction projects should be **managed within a way that is environmentally** sustainable in terms of pollution.
	3	Preserving the **ecological sustainability significance of the land** by consideration of preserving the ecosystem around the building project.
	4	Building construction must be managed in an environmentally sustainable way in terms of **energy consumption**, terms of using energy-efficient machines, and increasing solar energy using.
	5	Building construction projects must be constructed in a way that is environmentally sustainable by consideration of the **utilization of resources**.
Social	6	**Reducing the possibility of water pollution** in building facilities by planning and implementing and providing safe and fresh potable water to users of buildings.
	7	**Providing sufficient daylight**, natural lighting, and illumination controls for the convenience of users.
	8	**Providing acceptable thermal convenience** levels by designing and installation of controls to keep people inside the building thermally relaxed.

Table 4.3: Continue

Part	Sustainable Buildings Ingredients	
Social	9	**Accessible to a reliable public transport network** and local infrastructure and facilities and alternative transport options for occupants to minimize pollution and traffic linked to transport.
	10	**Space management** for the privacy and well-being of users.
	11	**Providing indoor air quality** to a healthy interior climate through the implementation of sufficient ventilation equipment requirements.
	12	**Providing risk management** means reducing the use of materials that are detrimental to users' comfort and well-being.
	13	**Preserving local heritage** and culture consisting of a building that contributes to the city's sociocultural attractiveness and provides owners and neighbors with satisfaction.
	14	**Complying with ethical criteria** in terms of meeting building standards.
Economic	15	**Capacity to adjust for different uses** and which required a combination of tenure forms to satisfy the criteria and guarantee flexibility wherever possible.
	16	**Providing vocal comfort** involving the vocal efficiency of the building, including acoustic insulation that meets the required standards.
	17	Using **Water efficient** equipment, water recycling system installations, water use control systems, water leak detection, as well as prevention devices to minimize drinking water use for sanitary and occupants.
	18	Using of **construction materials** with minimal environmental effect including the use of efficient and recycled materials.
	19	**Providing building maintenance** and facilities that ensure durability and economic benefit.
	20	Reduction of operational energy consumption, energy usage monitoring, and the use of types of equipment and energy-efficient lighting fixtures (**Energy efficiency**).

Table 4.3: Continue

Part		Sustainable Buildings Ingredients
Management	21	**Innovation of technology**, methods, or techniques that promote the sustainability of the design, development, operation, and servicing of buildings.
	22	Establishing **legal and contractual** environmental protection policies that are part of the structured construction management frameworks.
	23	Engaging **sustainable building specialists** in the application of sustainability evaluation schemes aims, and processes through design and construction.
	24	Involving a **building user guide** to assist users to learn about building functions as well as improve building performance.
	25	Involving annually **building adjusting** to ensure optimum to energy-efficient services performance and users comfort.
	26	The **costs management** must be applied at all stages of sustainable construction to achieving economic feasibility in terms of its real estate price.

The reliability test is used to assess the consistency of the selected scale and the alpha in Cronbach is the most popular reliability test as shown in equation (4.1). The reliability test carried out to demonstrated the reliability of the scales to determine what important sustainable building ingredients are for credibility in sustainable buildings and the challenge to achieve sustainable buildings;

$$\alpha = \frac{n}{(n-1)}\left[1 - \frac{\sum_{i=1}^{n}\sigma_{yi}^{2}}{\sigma_{x}^{2}}\right] \quad \textbf{(4.1)}$$

Where:

α = alpha Cronbach

n = refer to the number of scale items

σ_{yi}^{2} = refer to the variance associated with the item i

σ_x^2 = refer to the variance associated with observed total scores

Where the values of (0.70) or larger are accepted. Table (4.4) indicates that all values more than (0.70) value, its acceptable Cronbach's alpha value meaning that the scales are reliable for this analysis.

Table 4.4: The Cronbach's Alpha Values

Components	No. of Items	Value	Cronbach's Alpha	Internal Reliability
Sustainable Building Ingredients	26	0.891	$0 > \alpha \geq 0.8$	Good
Sustainable Building Challenge	15	0.938	$\alpha \geq 0.9$	Excellent

The Relative Importance Index (RII) is applied while deciding to evaluate and classify the relative results of participants in terms of a specific view or subject topic, where the RII creates rankings in an ordinal format as shown in equation (4.2). RII calculated based on the formula given by Akadiri, (2011) to evaluate the relative importance of various sustainable building practices and the challenges to implementing this concept in Iraq:

$$RII = \frac{5n_5+4n_4+3n_3+2n_2+1n_1}{5(n_5+n_4+n_3+n_2+n_1)} \quad \textbf{(4.2)}$$

Where:

$n_5 =$ no. of respondents which replied with " Strongly agree "; $n_4 =$ no. of respondents which replied with " Agree "; $n_3 =$ no. of the respondents which replied with " Neither

agree nor disagree "; $n_2 =$ no. of respondents who replied with "Disagree"; $n_{1=}$ no. of respondents which replied with "Strongly disagree".

Where table (4.5) describes the level of the sustainable building ingredients rank that belongs to the environmental part. It shows 'Building construction projects should be managed within a way that is environmentally sustainable in terms of pollution' as the maximum value with a ranking index of (0.864). This is followed by 'Preserving

the ecological sustainability significance of the land by consideration of preserving the ecosystem around the building project' 2nd rank with an index of (0.863). 'Building construction must be managed in an environmentally sustainable way in terms of energy consumption, terms of using energy-efficient machines, and increasing solar energy using' ranked the 3rd, Management of the Waste system is efficient and suitable during stages of construction and operational life of the building' ranked lowest with an index of (0.810).

Table 4.5: Sustainable Ingredients Belong Environmental Part

Environmental Part	Mean		Std.D.	RII	Rank
	St.	Std.E.			
Management of the Waste	4.048	0.053	0.762	0.810	5th
Managed in an environmentally	4.319	0.044	0.627	**0.864**	**1st**
Ecological sustainability value of land	4.314	0.040	0.577	0.863	2nd
Energy consumption	4.304	0.047	0.682	0.861	3rd
Utilization of resources	4.184	0.046	0.657	0.837	4th

The ANOVA test was performed to determine if there is an opinion difference concerning the ingredients that are known through the participants' experience. The ANOVA test is a statistical test that permits three or more groups to compare scores on a continuous variable. The ANOVA test also was conducted out to determine the degree of criticality of sustainable buildings' social, economic, and management components. The findings indicate that the opinion of engineers with different experiences doesn't vary significantly except in the two ingredients which are ecological sustainability value of land, and energy consumption with values of (0.011), and (0.013) as displayed, accordingly in the table (4.6).

Table 4.6: ANOVA Test With Difference in Opinions-Environmental Ingredients

Environmental Part	Value	df.	Asymp.Sig.
Management of the Waste	0.305	3	0.914
Managed in an environmentally	1.874	3	0.190
Ecological sustainability value of land	3.656	3	0.011
Energy consumption	4.929	3	0.013
Utilization of resources	0.231	3	0.912

These values are less than (0.05), indicating that the statistically significant variation with these ingredients regarding the engineer's opinions with the different four experience groups.

The assessment of the data collected from the questionnaire research indicates that all 5 environmental ingredients are essential to achieving sustainable buildings.

Table (4.7) shows the level of the sustainable building ingredients rank belongs to the social part. It shows 'Accessible to a reliable public transport network and local infrastructure and facilities and alternative transport options for occupants to minimize pollution and traffic linked to transport' as the maximum value with a ranking index of (0. 875).

This is followed by 'Providing indoor air quality to a healthy interior climate through the implementation of sufficient ventilation equipment requirements' 2nd rank with an index (0.863). 'Providing acceptable thermal convenience levels by designing and installation of controls to keep people inside the building thermally relaxed' ranked the 3rd. 'Complying with ethical criteria in terms of meeting building standards' ranked lowest with an index of (0.837).

Table 4.7: Sustainable Ingredient Belong Social Part

Social Part	Mean		Std.D.	RII	Rank
	St.	Std.E.			
Reducing the possibility of water pollution	4.266	0.044	0.640	0.853	5th
Providing sufficient daylight	4.280	0.044	0.638	0.856	4th
Providing acceptable thermal convenience	4.314	0.042	0.610	0.863	3rd
Accessible to the good public transport network	4.377	0.042	0.610	**0.875**	**1st**
Space management	4.193	0.045	0.647	0.839	8th
Providing indoor air quality	4.367	0.039	0.566	0.873	2nd
Providing risk management	4.208	0.047	0.683	0.842	7th
Preserving local heritage	4.242	0.050	0.717	0.848	6th
Complying with ethical criteria	4.184	0.049	0.700	0.837	9th

The ANOVA test was carried out to identify differences in the opinion of engineers with different experiences regarding social ingredients and the results show that the opinion of engineers with different experiences does not vary significantly, except for the two ingredients, providing sufficient daylight and providing risk management value of (0.017) and (0.013), as displayed, accordingly in the table (4.8).

These values are less than (0.05), indicating that the statistically significant variation with these ingredients regarding the engineer's opinions with the different four experience groups.

There was a no less critical or not critical component in the result under the social part, all (9) ingredients have been identified as critical to achieving sustainable buildings.

Table 4.8: ANOVA Test With Difference in Opinion - Social Ingredients

Social Part	Value	df.	Asymp.Sig.
Reducing the possibility of water pollution	0.555	3	0.719
Providing sufficient daylight	4.092	3	0.017
Providing acceptable thermal convenience	1.667	3	0.214
Accessible to the good public transport network	1.006	3	0.442
Space management	2.296	3	0.139
Providing indoor air quality	1.820	3	0.128
Providing risk management	4.980	3	0.013
Preserving local heritage	3.804	3	0.059
Complying with ethical criteria	1.935	3	0.269

Table (4.9) describes the level of the sustainable building ingredients rank belongs to the economic part.

It shows 'Providing vocal comfort involving the vocal efficiency of the building, including acoustic insulation that meets the required standards' , 'Providing building maintenance and facilities that ensure durability and economic benefit' and 'Reduction of operational energy consumption, energy usage monitoring, and the use of types of equipment and energy-efficient lighting fixtures' , these ingredients have the same value of RII (0.870).

So, we must re classified these ingredients according to use the values of standard deviation, where the lower value of standard deviation (0.583) of ingredient 'Reduction

of operational energy consumption, energy usage monitoring, and the use of types of equipment and energy-efficient lighting fixtures' ranked as high.

This is flowed by 'Providing building maintenance and facilities that ensure durability and economic benefit' with a standard deviation (0.616) ranked as 2nd.

'Providing vocal comfort involving the vocal efficiency of the building, including acoustic insulation that meets the required standards' ranked the 3rd with standard deviation (0.631).

'Capacity to adjust for different uses and which required a combination of tenure forms to satisfy the criteria and guarantee flexibility' ranked lowest with an index of (0.770).

Table 4.9: Sustainable Ingredients Belong Economic Part

Economic Part	Mean		Std. D.	RII	Rank
	St.	Std.E.			
Capacity to adjust for different uses	3.874	0.050	0.727	0.770	6th
Providing vocal comfort	4.362	0.044	0.630	**0.870**	**3rd**
Water efficient	4.275	0.046	0.666	0.860	4th
Construction materials	4.159	0.048	0.696	0.830	5th
Providing building maintenance	4.367	0.043	0.616	**0.870**	**2nd**
Energy efficiency	4.333	0.041	0.583	**0.870**	**1st**

The ANOVA test was carried out to identify differences in the opinion of engineers with different experiences regarding economic ingredients and the results show that the opinion of engineers with different experiences does not vary significantly, except for the two ingredients, providing vocal comfort and water-efficient value of (0.033) and (0.012), as displayed, accordingly in the table (4.10).

These values are less than (0.05), indicating that the statistically significant variation with these ingredients regarding the engineer's opinions with the different four experience groups.

The assessment of the data collected from the questionnaire research indicates that all (6) Economic ingredients are essential to achieving sustainable buildings.

Table 4.10: ANOVA test with Difference in Opinion - Economic Ingredients

Economic Part	Value	df.	Asymp.Sig.
Capacity to adjust for different uses	1.872	3	0.316
Providing vocal comfort	3.450	3	0.033
Water efficient	4.806	3	0.012
Construction materials	1.974	3	0.254
Providing building maintenance	1.256	3	0.348
Energy efficiency	3.263	3	0.021

Table (5.11) shows the level of the sustainable building ingredients rank belongs to the management part. It shows 'Engaging of sustainable building specialists in the application of sustainability evaluation schemes, aims and processes through design and construction' as the maximum value with a ranking index of (0. 862).

This is followed by 'Innovation of technology, methods, or techniques that promote the sustainability of the design, development, operation, and servicing of buildings' 2nd rank with an index (0.856).

'Involving a building user guide to assist users to learn about building functions as well as improve building performance' ranked the 3rd.

'Establishing legal and contractual environmental protection policies that are part of the structured construction management frameworks' ranked lowest with an index of (0.770).

Table 4.11: Sustainable Ingredients Belong Management Part

Management Part	Mean		Std.D.	RII	Rank
	St.	Std. E.			
Innovation of technologies	4.280	0.037	0.539	0.856	2nd
legal and contractual	4.000	0.054	0.776	0.800	6th
Sustainable building specialists	4.309	0.042	0.608	**0.862**	**1st**
Building user guide	4.092	0.049	0.701	0.818	3rd
Building adjusting	4.072	0.047	0.682	0.814	5th
Costs in the construction stages	4.082	0.045	0.645	0.816	4th

The ANOVA test was carried out in order to identify differences in the opinion of engineers with different experiences regarding economic ingredients and the results

show that the opinion of engineers with different experiences does not vary significantly, except for the two ingredients, Innovation of technologies and legal and contractual environmental management initiatives value of (0.010) and (0.003) as displayed, accordingly in the table (4.12). These values are less than (0.05), indicating that the statistically significant variation with these ingredients regarding the engineer's opinions with the different four experience groups.

Table 4.12: ANOVA test with Difference in Opinion - Management Ingredients

Management Part	Value	df.	Asymp.Sig.
Innovation of technologies	1.076	3	0.010
legal and contractual environmental management initiatives	0.856	3	0.235
Sustainable building specialists	0.871	3	0.069
Building user guide	2.208	3	0.003
Building adjusting	0.452	3	0.408
Costs in the construction stages	1.015	3	0.061

4.8.3 Challenges to achieving sustainable building

The challenges to achieving sustainable buildings have been highlighted in Iraq. Participant information was evaluated by applying the Relative Importance Index (RII), were acted to rank challenges to sustainable building achievement.

RII calculated based on the formula given by Akadiri, (2011). The challenges to achieving SBs in Iraq were seen in the table (4.13).

Where the results revealed (15) challenges to sustainable building. The first five the as the maximum value with a ranking index are: Lack of knowledge of sustainable buildings among the public (1^{st}), Lack of government policy or regulations to Encourage sustainable building implementation (2^{nd}), Lack of knowledge of sustainable buildings among building experts (3^{rd}), Lack of experience for building professionals in sustainable building design and construction (4^{th}), Public notability and the lack of government financial support for the financing of sustainable

buildings (5^{th}). While Lack of local manufacturing companies for construction materials (15^{th}).

Table 4.13: Challenges to Achieving Sustainable Buildings in Iraq

The Challenges	Mean		Std.D.	RII	Rank
	St.	Std.E.			
Lack of knowledge of sustainable buildings among building experts.	4.111	0.061	0.877	0.822	3rd
Lack of knowledge of sustainable buildings among the public.	4.300	0.050	0.722	0.860	1st
Lack of knowledge of sustainable buildings among the government.	3.995	0.070	1.012	0.799	10th
Lack of professional competence in the building industry.	3.966	0.069	0.997	0.793	12th
Lack of local manufacturing companies for construction materials.	3.928	0.064	0.924	0.786	15th
Lack of experience for building professionals in sustainable building design and construction	4.111	0.065	0.931	0.822	4th
Lack of acceptance of the role of building experts in design and construction.	3.976	0.061	0.878	0.795	13th
Lack of maintenance culture.	3.957	0.066	0.947	0.791	14th
Lack of appreciation of sustainable buildings concerning the cultural background for social	3.995	0.055	0.785	0.799	9th
Low government understanding of the benefits of sustainable buildings.	4.077	0.060	0.867	0.815	8th
Lack of rewards for sustainable development between developers.	4.077	0.057	0.815	0.815	6th
Lack of construction industry standards.	3.966	0.063	0.910	0.793	11th
Lack of government policy or regulations to Encourage sustainable building implementation.	4.159	0.065	0.934	0.832	2nd
Public notability and the lack of government financial support for the financing of sustainable buildings.	4.106	0.065	0.939	0.821	5th
Lack of use for highly efficient equipment and materials.	4.077	0.059	0.850	0.815	7th

4.8.4 Validation from the Sustainable Buildings Ingredients

The questionnaire survey was distributed among (207) respondents, where the questionnaire was implemented to investigate if registered members of the Iraqi Engineers Association (IEA) and those working in buildings construction fields are aware of the essential ingredients of achieving sustainable buildings in Iraq.

The results reveal that engineers are working in buildings construction fields they can evaluate how critical the (26) sustainable building ingredients have dictated to achieving sustainable buildings in Iraq.

This indicates that despite the variations in their years of experience, engineers are knowledgeable of sustainable building qualities.

The findings show which there was no substantial difference throughout the criticality of the sustainable construction ingredients identified within the four categories of engineers' years of experience.

The results show that 'Building construction projects should be managed within a way that is environmentally sustainable in terms of pollution', and 'Preserving the ecological sustainability significance of the land by consideration of preserving the ecosystem around the building project' as the two most important components of the environmental aspect to achieve sustainable buildings.

While the three most important ingredients belong social part is 'Accessible to a reliable public transport network and local infrastructure and facilities and alternative transport options for occupants to minimize pollution and traffic linked to transport', ' Providing indoor air quality to a healthy interior climate through the implementation of sufficient ventilation equipment requirements', and 'Providing acceptable thermal convenience levels by designing and installation of controls to keep people inside the building thermally relaxed'.

The results also show 'Reduction of operational energy consumption, energy usage monitoring, and the use of types of equipment and energy-efficient lighting fixtures', 'Providing building maintenance and facilities that ensure durability and economic benefit', and 'Providing vocal comfort involving the vocal efficiency of the building, including acoustic insulation that meets the required standards' as three most important ingredients belong the economic part.

Regarding the management part, the most two important ingredients are, ‘Engaging of sustainable building specialists in the application of sustainability evaluation schemes, aims and processes through design and construction’, and ‘Innovation of technology, methods, or techniques that promote the sustainability of the design, development, operation, and servicing of buildings’.

However, it is important to carry out more studies on the ingredients like effective utilization of energy and consumption of water, the optimal use of sunshine, sustainable products, and interior air quality in this phase of a study to discover the ingredients critical to sustainable buildings in Iraq.

5. CONCLUSION AND RECOMMENDATION

5.1 Introduction

To decrease the detrimental effect of buildings on the environment, the construction industry also developed sustainable construction strategies. Buildings have been highlighted in research studies as a significant contributor to the use of large quantities of energy and water and the intensive use of land.

Several governments have developed policies that support sustainable construction to generate sustainable buildings.

In Iraq's design instruction of building projects, sustainability is sadly neglected, this is obvious for Iraq's current unsustainable environment. There is inattention at environmental, economic, and social effects evaluation, life cycle evaluation, and life cycle cost evaluation for the completed projects or the materials that have been used, where there is an absence of evidence to recognize sustainable building ingredients in Iraq.

The main objective of this study is to spread sustainable construction concepts among building specialists in Iraq, where the study highlighted the research into indicating how important the referred ingredients sustainable building as per the scientific standards in achieving the concept and ensuring the implementation of sustainable buildings in Iraq.

To evaluate if engineers who working in buildings construction fields are aware of the essential ingredients of achieving sustainable buildings in Iraq, and to identify what is the challenges to achieving sustainable buildings in Iraq.

Through a three-stage, study approach described below, the above objectives and targets have been achieved.

The first stage was a critical analysis of SD literature and its effect on the construction industry, resulting in sustainable building advancement.

The literature review obtained (31) sustainable building ingredients and helped create a historical knowledge of the structure and its components, reviewed documents, and which included three documentations BREEAM-NC, LEED-NC, and ISO 15392.

The second stage of the study involved sending a questionnaire to (207) members of the Iraqi Engineers Association to find out what they thought was necessary for a building, as well as those working in buildings construction fields.

Step three includes validating the development of a management system with a view to achieving sustainable buildings in Iraq.

5.2 Conclusions of Study

This study described the main research results as follows: the function of sustainable development (SD) in the construction industries and as initiators of sustainable constructions (SC) at chapter 2, this chapter presented sustainable building development due to the effect of SD on the building industry and informing the environmental, social, economic, and management parts of the construction industry.

The chapter explains what these parts were implemented in the construction industry and why it became the SC practice.

SC is insufficient by itself, however, because it is only a procedure that must be applied to attain a final objective, namely the development of sustainable buildings. SC strategy culminates in sustainable buildings and includes the creation of sustainable building evaluation instruments.

What represents a sustainable building have displayed in chapter 3, this chapter discussed the different meanings of sustainable building and described the sustainable building in the scope of research as a secure building infrastructure, Planned and developed in the early stages of life, using environmental values, social justice, and the quality of life cycle to create a meaning of community.

The definition of sustainable building ingredients has been built on chapter 3 environmental, social, economic, and management parts of the SD. While these ingredients are integrated into the design process of the building life cycle, where there are more possibilities for achieving sustainable construction and challenges in achieving sustainable buildings in Iraq have been submitted to participants.

5.2.1 Effect of sustainable development in the construction industry

The incorporation of environmental, social, and economic parameters into sustainable development (SD), the achieving of a productive economy and a balanced environment, is acknowledged to meet humanitarian needs.

It provides for residents now and in the future, by enhancing their economic growth without destroying the natural resources available and without damaging the environment, and also working to create a better life.

Because of the significant adverse impact that buildings have on the climate, SD evaluation has been implemented in various industries and the construction industry in particular.

In various phases of construction, the construction industry leads to environmental emissions. Processes involve the manufacture of construction material, the construction process itself, the building's functioning, and the generation of many carbon dioxide and pollutants produced by the chemical toxic substances involved in the construction project.

Buildings are also using vast quantities of energy produced by the various processes of fossil fuels, nuclear energy, hydropower, and wind. However, these buildings may also operate as long-term assets and provide a venue for people to live, socialize, and function.

The environmental, social, and economic dimensions of SD must also be added to the construction process to optimize the productivity of the buildings. However, the research has found that a fourth element, the management dimension of SD, needs to be added to implement these three aspects.

The implementation of these four SD aspects has led to sustainable construction development that means the creation and use of materials that are not hazardous to the environment and public health by buildings in an environmentally efficient way.

The same applies in the manufacture of construction materials and the operating process and management of waste to resolve environmental pollution in a more effective and non-energy usage. Sustainable buildings are supposed to enhance the environmental effects of buildings and the efficiency of life safety and wellness.

Sustainable construction is a mechanism that enables sustainable development concepts to be enforced when planning, constructing, operating, and demolishing buildings. As a mechanism, however, it is not enough to fulfill the basic human need for refuge and comfort; it needs to be the endpoint and sustainable building growth.

Sustainable construction has made it possible to assess the success of the construction industry regarding achieving SD.

5.2.2 Sustainable buildings

Literature showing the environmental, social, and economic advantages of sustainable buildings.

Environmental benefits include the conservation of the environment by eliminating emissions, conserving power and materials using renewable resources, and reducing waste.

The social advantages include improved indoor air quality environmental, visual and auditory convenience for building users.

The economic advantages include minimizing energy usage, reusing materials, and rising water quality leading to decreased maintenance costs that improve building performance and market value, where economic advantages are improved by increased well-being and convenience of building clients, which in turn encourages economic growth and enhances efficiency in industries.

5.2.2.1 Management of SB

Another advantage of sustainable buildings is that activities that ensure efficiency and in particular building management at the operational level are emphasized, practices including post-occupancy assessment, the introduction of the building participant's manual, overseeing of any building service to promote energy-efficient facilities.

The construction of such buildings must be encouraged, evidence demonstrates that buildings not built for the purposes of sustainability generally have unacceptable impacts on the climate, the efficiency of living, and the economics.

Undesired impacts are air and water contamination, waste materials, poor health, fatigue, inconvenience, and anxiety due to bad thermal ventilation, the efficiency of indoor air, lighting, choice of materials, and increasing construction costs.

The results of this study have shown some ingredients, which enable the building environmentally, socially, financially, and managementally sustainable.

The environmental ingredients involve environmental protection procedures, the social element involves behaviors that help occupants' satisfaction and wellbeing, The economic advantages of sustainable building are part of the economic dimension, and the management dimension involves processes which at the operational stage assure the sustainability of the building.

The studies have found that a sustainable building has important features regardless of geography and climate conditions.

These features contribute to greenhouse gas pollution decrease waste management, building usage comfort, and well-being and economic benefit.

Characteristics like thermal comfort are more probable to differ due to geographic position. For instance, Iraq(especially the middle to south region) is in a hot and sunny geographical region and needs that building users are cool all year round.

5.2.3 Knowledge of study

This study knowledge about sustainable buildings by defining the ingredients of sustainable buildings through their role of specialists in building construction to achieving these types of building in Iraq.

The construction industry has been concentrating on the construction of sustainable buildings ago the appearance of SD. The SD aim raises understanding of the harmful environmental effects of buildings and the necessity to build a more sustainable world. The construction industry constantly works to minimize these adverse impacts, including sustainable building growth.

Consequently, construction specialists make attempts to achieve them. It was found which it is not one person or occupation to achieve sustainable buildings, but all participants jointly make efforts.

However, the personal tasks of all participants in the sustainable building have to be established. Also, the study highlighted the opinions that specialists in building

construction on sustainable buildings, and it turns out that there is no big difference in opinions between them.

5.3 Recommendations

Depending on the results of this study, information suggests that the Iraqi building industry does not know enough about what is a sustainable building at present. So the study suggested recommendations in two parts;

5.3.1 Recommendations for building specialists

Where the study strongly recommends that the recommendations below be taken into consideration;

1.The work of all participants of the construction project team who have detailed knowledge of the operational activities and efficiency of a building.

Where it proposed managing problems of sustainability as part of everyday building operations, to share expertise in the sustainability of a building and building efficiency from the perspective of building customers to guarantee that buildings implement sustainable building requirements, and also to ensure maximum effectiveness.

2. The project designers must consider in the design stage the advantages of applying the monitoring of buildings and energy efficiency problems in the building implementation to produce good buildings early enough.

3. To contribute effectively to design, the project manager must work with the buildings and sustainable energy management and waste management specialist, the management of waste, the provision of comfort, etc.

4.The architects and construction designers who are responsible for the structural design of the building must work together to have the aesthetic of the building and how it works sustainably.

5.The electrical and mechanical designers, engineers who are responsible for the designing of building facilities for power, heat, cooling, water supply, etc., must be work together to obtain a better understanding of a structure's sustainable performance.

6.The owner/customer should be aware of what a sustainable building is and what needs to be created.

7.The government requires to establish policies that include a sustainable building qualification environment.

The government must establish policies that promote the development, construction, and operation of buildings that are sustainable in the building industry.

8. The government must provide funding for developers to sustainably borrow money at affordable rates to facilitate the construction of sustainable buildings.

This is especially relevant in a developing country such as Iraq, which currently practices sustainable construction to a minimal degree.

5.3.2 Recommendations to future study

Information shortages are now the biggest obstacle to the specification of the processes of sustainable development in residential construction, while several qualification courses, training, and development workshops have been initiated by the building industry to educate construction specialists in sustainable methods, the effects of these steps on the fields are insignificant.

So to research the application of knowledge is recommended;

1.There is more scientific research that can be done within the environmental, social, economic, and management dimensions of SD to recognize more ingredients.

2.There is more scientific research that can be done to recognize the roles of designers and construction specialists in achieving sustainable buildings.

3. Create a framework through the description of the sustainable building ingredients and use it as a guideline for the specialists that working in the fields of building construction for achieving sustainable buildings in Iraq.

4.It is important to create a strong framework for the wide implementation of the building industry including all development practitioners to achieve sustainable construction practices.

5. The study recommends additional research to evaluate the opinions of engineers construction specialists and building users in Iraq on what they consider as sustainable buildings.

It is expected these recommendations to encourage an increase in knowledge and understanding between all industry specialists of sustainable building and to support the SD objective in Iraq.

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APPENDICES

Appendices A: Sustainable Buildings Ingredients

Sustainable Buildings Ingredients

Please indicate how important the following ingredients are in achieving the concept and ensuring the implementation of sustainable buildings in Iraq. Where it's required to agree or disagree with each of the following.
Please rate as follows: 5=Strongly Agree, 4= Agree, 3=Neither agree nor disagree, 2=Disagree, 1= Strongly disagree

Item	Sustainable Buildings Ingredients	1	2	3	4	5
1	**Management of the Waste** system is efficient and suitable during stages of construction and operational life of the building.					
2	Building construction projects should be **managed within a way that is environmentally** sustainable in terms of pollution.					
3	Preserving the **ecological sustainability significance of the land** by consideration of preserving the ecosystem around the building project.					
4	Building construction must be managed in an environmentally sustainable way in terms of **energy consumption**, terms of using energy efficient machines, and increasing solar energy using.					
5	Building construction projects must be constructed in a way that is environmentally sustainable by consideration of the **utilization of resources**.					
6	**Reducing the possibility of water pollution** in building facilities by planning and implementing and providing safe and fresh potable water to users of buildings.					
7	**Providing sufficient daylight**, natural lighting, and illumination controls for the convenience of users.					
8	**Providing acceptable thermal convenience** levels by designing and installation of controls to keep people inside the building thermally relaxed.					
9	**Accessible to a reliable public transport network** and local infrastructure and facilities and alternative transport options for occupants to minimize pollution and traffic linked to transport.					
10	**Space management** for the privacy and well-being of users.					
11	**Providing indoor air quality** to a healthy interior climate through the implementation of sufficient ventilation equipment requirements.					
12	**Providing risk management** that means reducing the use of materials which are detrimental to users comfort and well-being.					
13	**Preserving local heritage** and culture consisting of a building which contributes to the city's sociocultural attractiveness and provides owners and neighbors with satisfaction.					
14	**Complying with ethical criteria** in terms of meeting building standards.					
15	**Capacity to adjust for different uses** and which required a combination of tenure forms to satisfy the criteria and guarantee flexibility wherever possible.					
16	**Providing vocal comfort** involving the vocal efficiency of the building, including acoustic insulation that meets the required standards.					

Item	Sustainable Buildings Ingredients	1	2	3	4	5
17	Using **Water efficient** equipment, water recycling system installations, water use control systems, water leak detection, as well as prevention devices to minimize drinking water use for sanitary and occupants.					
18	Using of **construction materials** with minimal environmental effect including the use of efficient and recycled materials.					
19	**Providing building maintenance** and facilities that ensure durabi economic benefit.					
20	Reduction of operational energy consumption, energy usage monitoring, and the use of types of equipment and energy-efficient lighting fixtures (**Energy efficiency**).					
21	**Innovation of technology**, methods, or techniques that promote the sustainability of the design, development, operation, and servicing of buildings.					
22	Establishing **legal and contractual** environmental protection policies that are part of the structured construction management frameworks.					
23	Engaging of **sustainable building specialists** in the application of sustainability evaluation schemes, aims and processes through design and construction.					
24	Involving a **building user guide** to assist users to learn about building functions as well as improve building performance.					
25	Involving annually **building adjusting** to ensure optimum to energy-efficient services performance and users comfort.					
26	The **costs managment** must be applyed at all stages of sustainable construction to achieving the economic feasibility in terms of its real estate price.					

A-2

Appendices B: Challenge to Achieving Sustainable Buildings in Iraq

The challenge to achieving the sustainable buildings in Iraq

Please indicate to what extent you agree or disagree with each of the following as challenge to achieving the sustainable buildings in Iraq.
Please rate as follows: 5=Strongly Agree, 4= Agree, 3=Neither agree nor disagree, 2=Disagree, 1= Strongly disagree

Item	The challenge to achieving the sustainable buildings in Iraq	1	2	3	4	5
1	Lack of knowledge of sustainable buildings among building experts.					
2	Lack of knowledge of sustainable buildings among the public.					
3	Lack of knowledge of sustainable buildings among the government.					
4	Lack of professional competence in the building industry.					
5	Lack of local manufacturing companies for construction materials.					
6	Lack of experience for building professionals in sustainable building design and construction					
7	Lack of acceptance of the role of building experts in design and construction.					
8	Lack of maintenance culture.					
9	Lack of appreciation of sustainable buildings concerning the cultural background for social					
10	Low government understanding of the benefits of sustainable buildings.					
11	Lack of rewards for sustainable development between developers.					
12	Lack of construction industry standards.					
13	Lack of government policy or regulations to Encourage sustainable building implementation.					
14	Public notability and the lack of government financial support for the financing of sustainable buildings.					
15	Lack of use for highly efficient equipment and materials.					

B-1

RESUME

Education

Dates (from – to)	Sept. 2001 to Dec. 2002
Name of school	University of Basra, Basra, Iraq
Degree	Higher Diploma Structural Engineering
Dates (from – to)	Sept. 1996 to July 2001
Name of school	University of Basra, Basra, Iraq
Degree	B.Sc. Civil Engineering

Employment

Dates (from – to)	Sept 2017 to June 2019
Occupation or position held	**Director of Engineering Division**
Main activities	• supervise on civil, electrical, mechanical and maintenance works, • submit consultancy • follow up implementation engineers and technicians. • Prepare weekly and monthly reports
Name and address of employer	Ministry of Education, Southern Technical University, Basra, Iraq
.....	.....
Dates (from – to)	Sept 2010 to Dec.2016
Occupation/position held	**Construction Manager**
Main activities	• CW manager of construction works, for towers implementation of communication project • push the subcontractors for the purpose of completing the achievement of business in them responsibility. • follow up the activities of engineers regarding to daily reports. • Supervising follow up of construction works, follow up implementation of the construction works of communications tower in the southern region with all different types such as GF (30m, 40m, 60m), RT (18m, 21m) and GRD towers (40m and 30m). • provides engineering consultancy. • follow up quality control and quality assurance application • hold meetings with the customer and subcontractors • prepare reporting weekly schedules and progress of work in addition to the daily reports.
Name and address of employer:	Nokia Siemens Networks (NSN), Southern Region, Iraq
.....	.....
Dates (from – to)	Feb 2007 – Aug 2010
Occupation/position held	**Assistant Project Manager**
Main activities	• assistant technical manager to follow up of construction works • follow up activities of engineers regarding to daily report • quality control and quality assurance (QC/QA) • make sure of HSE requirement • prepare reporting weekly schedules and progress of work in addition to the daily reports

- hold meetings with the customer and subcontractors

Name and address of employer: MK Mahadeen contraction technical hospital 400bed, Basra, Iraq

Dates (from – to)	July 2003 to Dec. 2006
Occupation or position held	**Rollout team leader**
Main activities	• supervise on construction works. • and follow up implementation engineers to constructing steel towers. • submit consultancy • Prepare weekly and monthly reports

Name and address of employer: Huawei Tech.Co., South Region, Iraq

Dates (from – to)	Jan. 2003 to June.2003
Occupation/position held	**QA/QC Engineer**
Main activities	• Make sure to applying project of rehabilitation of Al Fayhaa Hospital • supervision of construction and repairing works. • preparing bill of quantities. • submit method of statement rehabilitation

Scientific Reports and Research

- Experimental investigation in to half scale model of block wall construction on reinforced concrete beam, the object of this investigation is to study the behavior of the half - scale model of block wall construction on the simply - supported reinforced concrete beams under concentrated load and submit to vibration.
- Designing and analyzing communication towers within height from (18 to 180) m.
- Designing and analyzing steel structural by finite elements.
- Prepare scientific training for site acquisition and technical site survey procedures for structural selection for tower installation.
- Prepare scientific report for soil improvement by using jet grout method and benefit from using this injection.
- Prepare scientific report about soil permeability for ring area form Al Qasim Bridge to Basra sport city.
- Prepare scientific report for soil improvement and soil stabilization by using natural soil layers geogrid specification.

Personal Skills

- 16 year experience in Civil engineering works
- 6 year projects management.
- More than 9 years in computer skill (offices, Auto CAD,...).
- I have certificates on QC/QA.
- I have certificate on H&S Awareness.
- Write, speak, and understand in good way, both English and Arabic.