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IDENTIFICATION OF DRIVERS AND BARRIERS OF GREEN BUILDING PRACTICE IN IRAQ

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LIST OF SYMBOLS

N	Number of factors ranked
X2	Distribution of Chi-square
d	Deference between ranks
Rs	Spearman's rank correlation
B	Barriers

LIST OF ABBREVIATIONS

ANOVA	Analysis of Variance
ASHRAE	American Society of Heating, Refrigeration, and Air conditioning Eng
BEES	Building for Environmental and Economic Sustainability
BREEAM	Building Research Establishment Environmental Assessment Method
CBIP	Commercial Building Incentive Program
CSR	Corporate social responsibility
Df	Degrees of freedom
DOE	Department of Energy
EA	Energy and atmosphere
EED	Leadership in Energy and Environmental Design
EIA	Energy Information Administration
EOs	Executive Orders
EPA	Environmental Protection Agency's
EPP	Environmentally Preferable Products
GBs	Green buildings
GBTs	Green building technologies
GCC	Gulf Cooperation Council
IDP	Integrated design process
IEQ	Indoor environmental quality
MR	Materials and resources
NIST	National Institute of Standards and Technology
PPP	Private and puplic partership
RP	Regional Priority
SD	Standard deviation
SDGs	Sustainable Development Goals
SS	Sustainable sites
UNFCCC	Under the United Nations Framework convention on Climate Change
USGBC	U.S. Green Building Council
WCED	World Commission on Environment and Development
WE	Water efficiency

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ABSTRACT

IDENTIFICATION OF DRIVERS AND BARRIERS OF GREEN BUILDING PRACTICE IN IRAQ

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MSc. Thesis

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The impact of modernization and urbanization has encouraged improvement in the construction industry of Iraq, particularly in the development of the infrastructure. The slower rate of the construction process in the past has given a great deal of potential for integrating the green concept simultaneously with the development of the country. The insufficient amount of evidence concerning the progress of green construction in Iraq implies that this idea is not still at the top of the agenda of the construction industry yet. Proactive behavior of the government, private sector, and professional boards are highly important for bringing "greener" changes to the construction industry.

Green building (GB) is considered as a sufficient way for the implementation of sustainability in terms of environment, economy, and society in the construction industry, therefore, it is crucial to gain a clearer comprehension of the main problems that influence its progress.

This research has the aim of investigating the main aspects of adopting the green building in Iraq by determining major drivers for adopting GB and barriers that inhibit adopting GB. Twenty six drivers and twenty barriers were identified by administering a questionnaire. respondents were from Iraqi universities (civil engineering and other engineering disciplines).

According to the questionnaire results,

Conserving energy, environmental protection, water conservation, developing government legislation and increase knowledge and awareness, and information were the most significant drivers. The main barriers for the adoption of green building were

determined as lack of its promotion by government, lack of government incentives and rules, lack of information of the green product, and unavailability of approved green materials and technologies.difference in the perceptions of civil engineering and other engineering disciplines are further analyzed with Spearman's rank test and analysis of variation to control if there is a consensus between groups. Both tests showed that there was no significant difference in the perceptions of GB drivers and barriers statistically.

The results aim to provide a significant reference for practitioners and researchers of the industry for deepening their understanding of the main problems influencing the decision-making of the green building, and for policymakers that aim to promote adopting green building in the construction industry for developing proper policies and incentives in Iraq.

Key words: Green buildings, Drivers, Barriers, Sustainability

ÖZET

IRAK'TA YEŞİL BİNA UYGULAMALARINI ETKİLEYEN FAKTÖR VE ENGELLERİN BELİRLENMESİ

Mustafa Jamal ALAZAWI

İnşaat Mühendisliği Anabilim Dalı

Yüksek Lisans Tezi

Tez Danışmanı: Doç.Dr. Aslı Pelin GÜRGÜN

Modernizasyon ve kentleşmenin etkisi, Irak'ın inşaat sektöründeki, özellikle altyapının geliştirilmesinin iyileşmesine teşvik etmiştir. Geçmişte, İnşaat sürecinin kısıtlı hızda bulunması, ülkenin gelişimi ile yeşil kavramın entegrasyonuna aynı anda büyük bir yol açmıştır. Irak 'ta yeşil binanın ilerlemesine dair kanıtların yetersizliğinden dolayı bu fikirin hala inşaat sektörünün gündemin üstünde bulunmadığın anlamına gelir.Devletin, özel sektörün ve profesyonel kurulların proaktif davranışları, inşaat endüstrisi için "daha yeşil" değişikliklerin getirmesi son derece önemlidir.

Yeşil bina (YB), inşaat sektöründe çevre, ekonomi ve toplum açısından sürdürülebilirliğin uygulanması için yeterli bir yol olarak kabul edilir. Yeşil binayi benimsemek için başarılı ve popülerlik kazanımın devamı lazım, bu nedenle, onun ilerlemesini etkileyen ana sorunların daha net bir anlama elde edilmesi çok önemlidir.

Bu araştırma, Irak'ta yeşil binanın benimsemesini motive eden ana yönleri ve benimsemesinin engelleyen ana faktörleri belirleyerek araştırma amacı vardır. Yeşil binaların benimsemesine olan yirmi altı önemli güdü faktörlerin belirlemesi ve benimsememesine olan yirmi önemli engellerin belirlenmesi için ortalama puanları normalleştirip değerlerini hesaplayarak elde edilidi. Bu hedeflere ulaşmak için, bir anket uygulayıp Irak'taki üniversitelere ve diğer mühendislik disiplinlerinine dağıtılıp toplanıldı.

Anketin sonuçlarına göre,

Enerji tasarrufu, çevresel koruma, su tasarrufu, hükümet mevzuatı geliştirmesi ve bilgi ve farkındalık artışın, önemli güdüleri olarak tanımlanıldı.Yeşil binaların benimsemesine önündeki başlıca engeller, hükümet tarafından teşvik edilmemesi, hükümet teşvikleri ve kurallarının eksikliği, yeşil ürün hakkında bilgi eksikliği ve inşaat mühendisliği algılarında onaylanmış yeşil malzemelerin ve teknolojilerin bulunmamasıdır.

Diğer mühendislik disiplinleri ve gruplar arasındaki algılamalar daha fazla Spearman rütbe testiyle analize edildi, varyasyon analizi de fikir birliği bulunma durumunda ise kontrol etmek için yapıldı.Her iki test'te de, istatistiksel olarak Yeişl binaların güdülerin ve engellerin algılamalarında önemli bir fark olmadığını göstermiştir.

Sonuçlar, yeşil bina sektörün uygulayıcıların ve araştırmacıların karar alma sürecini etkileyen ana sorunların anlayış derinleşmesi için ve gelişmekte olan inşaat endüstrisinde yeşil yapıyı benimsemeyi amaçlayan politika yapıcılar, Irak'ta uygun politikaların ve teşviklerin geliştirmesi için önemli bir referansın sağlamasını amaçlamaktadır.

Anahtar Kelimeler: yeşil binalar, sürücüler, engellerin, sürdürülebilirlik

CHAPTER 1

INTRODUCTION

1.1 Literature Review

With the world's supply of fossil fuels increasingly depleted, the price of energy rises thus every country is taking steps by establishing policy instruments to correspond the sustainable movement. All sectors like business, transportation and manufacturing have started to develop and implement sustainable strategies into their processes in order to protect the environment and to improve the quality of life for future generations. The construction industry's "cradle-to-grave" activities in the built environment have a huge contribution on global environmental impacts including the depletion of natural resources and negative effects, solid wastes, air and water pollution etc., and demand on natural resources – especially for housing and infrastructure, which are very resource-intensive. Construction industry has a responsibility to minimize negative environmental and social impacts and maximize positive contributions to environment and economy. Building market is a major part of construction industry. The buildings, in which people live and work, have an enormous impact on the environment, including its location, construction, design, operation and demolition. The primary greenhouse gas, carbon dioxide is emitted from buildings due to natural gas, fuel oil combustion and electricity usage. Currently, many studies and reports in the literature argue the effects of building activities on environment, energy consumption, global climate change and human health. According to U.S. Energy Information Administration (EIA) data [1], buildings consume almost half (42%) of all U.S. energy consumption, with 23% coming from the residential sector and 19% from the commercial arena. In the light of these facts, sustainable building movement which works for the balance between environmental, social and economic performance is gaining momentum in recent years. It brings a wide range of sustainable practices and techniques to minimize these negative effects of buildings on energy

consumption, environment and human health. The Middle East Region's main problems are water shortage and high temperatures during summer. Many argued that these conditions create unique set of difficulties in incorporating green elements in construction projects [2]. Blessed with huge oil reserves, little attention is thus given to the need to save energy. Middle Eastern countries are at the top of the list of largest per capita ecological footprint, with Qatar being the highest at 44 metric tons per person annually [3]. The booming construction sector has resulted in escalation of domestic energy consumption per capita, putting these countries as among the highest contributor to CO2 emission per capita, [4]. Green building industry is very young in Iraq. Hence, the construction sector needs to have a better understanding for implementation of sustainable strategies. Interest in green building is increasing; on the other hand, useful and practical knowledge of green buildings is limited. Very little research has focused on identification of drivers and barriers for the green buildings in Iraq. This study aims to fill this gap in green building area and to look and understand the real impact of sustainability issues in practice. in iraq Going green is the way forward for the industry's long-term sustainability. For example, Al-Qasim Al-Khadra University is a specialized university in the agricultural and veterinary sciences and the supporting sciences for the Ministry of Higher Education and Scientific Research in Iraq, the objectives of the project owner were to achieve a high level of quality and the use of innovative sources and technology, and Get LEED certification [5]. Iraq also realized the need to improve its infrastructures and buildings, with the government investing continuously in developing infrastructure all over the Iraq. In the last five years, the country has seen rapid movement in the construction sector. Nonetheless, it is believed that Iraq has been left behind on green development movement because unlike other countries that experienced pollution problems and rise in energy costs, Iraq continues to enjoy cheap energy and acclimating to arid weather. Green construction offers an opportunity to leave a lighter footprint on the environment through numerous benefits to society and their surroundings besides providing a sound business case. It is commonly associated with the use of green technology specially to reduce energy consumption, indoor cooling, water saving, green materials etc. There are many terminologies used to describe green construction such as sustainable construction, eco-friendly concept, environmentally-responsible design, energy-efficient approach and others. Bringing change to the construction industry such as pushing for green construction requires numerous efforts from many stakeholders and the transition from conventional to green approach will invariably consume time [6]. The

concept of green construction, although lauded by many countries, is still in its infancy to Gulf Cooperation Council (GCC) countries. However, the Middle Eastern region has made great progress in recent years with more designers pursuing green design [3]. The current construction progress in Iraq provides huge opportunity for the green concept to be integrated in tandem with the country's growth. Economically booming Iraq has many new projects in store. As such, it is pertinent to push the green concept diligently into the construction industry to optimize the opportunity of building green for these projects. In this research, the term (drivers) is defined as the reasons why stakeholders decide to use GB. Previous studies have addressed various factors that drive the implementation of GB practices and technologies in construction. For example, Ahn et al. (2013) presented the major drivers as energy conservation, improving indoor environmental quality, environmental and resource conservation, waste reduction, and water conservation. innovations still face challenges in their market penetration, there are several concerns about their implementation. What are the Barriers blocks that prevent the GB market from growing and expanding? There is a need to better understand the barriers to the implementation of green innovations to help find ways and means to overcome them. Several Researchers and practitioners have investigated the barriers hindering the use of green innovations in construction. For instance, cost, implementation time, and the shortage of knowledge and awareness of GB are well documented in previous researches.

1.2 Objective of The Thesis

Growth in the number of green building projects in the world and the potential for the green building construction in Iraq has led to the need to answer the critical questions:

1- Investigate the current state of sustainable development in Iraq.
2- What are the greatest barriers and drivers to green building movement in Iraq construction market?
3- What are the solutions that will facilitate the widespread adoption of sustainable buildings in Iraq built environment?

There are so many reasons to construct green buildings, but there are many factors on the contrary. The aim of this thesis to answer the questions noted above through a questionnaire survey. Because the best way to get a better understanding of drivers and barriers and direct the sector towards a sustainable agenda can be achieved by learning from the actual practitioners in the sector. It is expected that the results will provide

benefits to both government and market participants in order to promote green building market in Iraq.

1.3 Hypothesis

The hypothesis stems from the following fact (Lack of sustainable design in Iraqi construction). This lack causes large water and energy consumption in buildings more than global average consumption; therefore, the need arises to use sustainable design techniques by determine what drive people to build or prevent adoption the Green buildings to reduce consumption and make buildings less damage to the environment. This study suggest the Iraqi construction need to Establish the awareness, support from the government and the need for sustainable construction.

1.4 Thesis Structure

The thesis on green building movement in Iraq is organized by the following components and as shown in Figure 1.1.

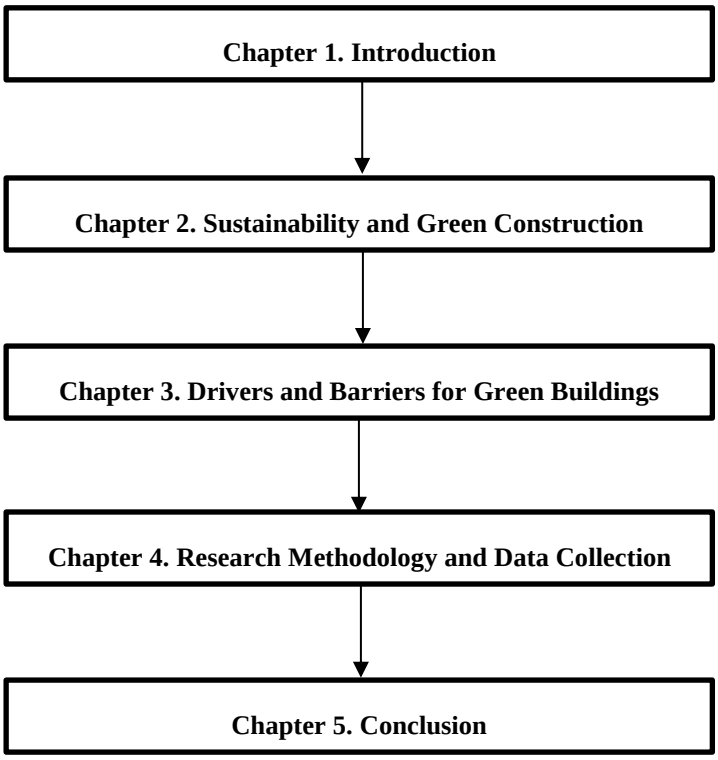


Figure 1.1 Thesis Structure

Chapter 1: Presents a general introduction to the subject of research, research objective and question and thesis structure.

Chapter 2: This chapter shows the concepts of sustainability, sustainable development, green buildings and their concept evolution, in addition to global standards and guideline.

Chapter 3: This chapter shows the drivers and barriers Which apply to the Iraqi construction market.

Chapter 4: A brief outline of the research methodology and data collection is also introduced in this chapter. The questionnaire survey data are analyzed and an overview of the critical drivers and barriers facing the industry are given. Discusses the Findings, Results and Solutions for the identified barriers and recommendations for both government and researchers are offered.

Chapter 5: It Concludes the findings of the research. Limitation of the study and future research areas are explained in order to promote the sustainable design.

CHAPTER 2

SUSTAINABILITY AND GREEN CONSTRUCTION

2.1 Introduction

From the start of the millennium, political leaderships in the world started implementing sustainable development as main model for social development. Nonetheless, sometimes the terms “sustainable development”, “sustainability” and “sustainable” are misrepresented despite the agreement among practitioners and scholars regarding the meaning of the concept. Though the notion allows many sustainability interpretations to coexist, random conceptions that do not agree with essential sustainability values weaken the objectives of the concept to steer the actions [8]. The terms: green buildings (GBs), sustainable developments, sustainability along with their history will be discussed in this chapter, in addition to the standards and guides at the global application of this concept.

2.2 Definitions

Recently, when discussing policies of environment and resource usage, the term sustainability emerges as a widely used term. Prior to discussing the subject extensively, there is a need to specify and correctly review the used term.

Because of their complexity, defining the terms of ‘sustainable’ and ‘construction’ is still subjected to arguments. In some languages, the word ‘durable’ is used as a translation for ‘sustainable’ [9].

“Construction that is durable” is not a wrong definition to be used, however it must be taken into consideration that the term could be changing because of the planned aims, Thus, some important questions must be examined: in what way this sustainability is used and for whom? [10]

Although some terms linked to sustainable constructions, like GBs were used for regularly, for the first time in the year 1994 the term of sustainable constructions was suggested through First International Conference on Sustainable Constructions. Charles Kibert [11] specified sustainable constructions as “creation and responsible management of a healthy built environment based on resource efficient and ecological principle”.
Additional description “Sustainable construction, in its own processes and products during their service life, aims at minimizing the use of energy and emissions that are harmful for environment and health, and produces relevant information to customers for their decision making” [9].

2.3 Concepts of Sustainability in Construction

Sustainable construction is defined as the activities of construction whose positive influence is increased and their negative influence is lessened for achieving a stability regarding social, economic and environmental performances [12].

2.3.1 Sustainable Development

The public and private sectors have increasing demands to fully grasp the concepts of sustainable construction., these demands are due to realizing that these sustainable concepts are helpful for operators and owners. These practices not just help the environment but also, they could enhance the social alertness and economic effectiveness.

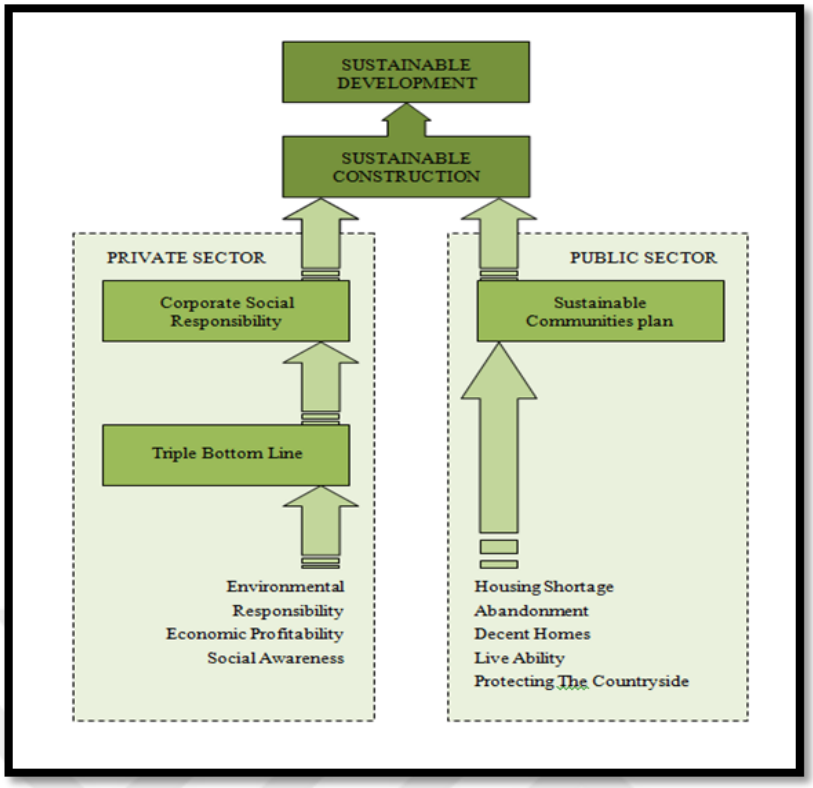


Figure 2.1 Sustainable development is applied in the public and private sectors of the construction industry [13]

2.3.2 Sustainable Construction

Sustainable construction means applying sustainable development to construction field, it is also referred to as (green buildings or green constructions) it defined a construction and utilize a process which is resource-efficient and environmentally responsible through the life cycle of the building: siting, designing, construction, operation, maintenance, renovation, and demolition. This method complements and expand the traditional building design issues of comfort, utility, durability and economy [13].

While the innovative technologies are regularly advanced for complementing recent application in creating greener buildings, the main aim is to utilize GBs for reducing general influence of construction environment on natural environment and health of individuals through the following:

- Use water, energy and other resources in efficient way
- Enhancing the productivity of employees and protecting the health of occupants
- Decreasing environmental degradation, pollution and waste

The notion of natural buildings is similar concept that is utilized typically on less important scale and lean towards focusing on utilizing natural materials which are obtainable locally. Green architecture and design are considered additional related matters.

Sustainable construction can be specified as creating and managing healthy built environments depending on ecological principles and effective resources. Sustainably designed constructions intention is to reduce their influence on the environment by energy and resources efficiency. It comprises the principles mentioned below [13],[14]:

- Reducing the consumption of non-renewable resources
- Improving natural environment
- Reducing or eliminating the use of toxins

2.4 Sustainable Design

Sustainable constructions and designs make best use of construction applications, effective materials and renewable energy sources; improves using on-site sources; offer hygienic and comfortable indoor working environments; utilize effective equipment and minimum fuel for meeting air conditioning, lighting, and other requirements; it also utilizes effective waste and water management applications [15].

Khalfan (2002) suggested that the sustainable design can be defined as a considerate incorporation of architecture structural, mechanical and electrical engineering. Along with the traditional aesthetics of light, shadow, scale, proportion and massing, the team related to facility design must to be focused on long-term costs: human, economic and environmental[16].

Sustainable design strategies bring many benefits, which are often the result of applying common sense to a particular situation [17]:

- Astute site selection and appropriate structures minimize intrusion on ecologically sensitive terrain such as wetlands, agricultural lands, flood plains, wildlife habitats, or green spaces.
- Passive design creates a building envelope that uses natural systems in place of mechanical equipment.
- Computerized building designs provide assistance to the designers to compare and predict the performances and interactions of alternative systems and designs.

2.4.1 Principles of Sustainable Design

Sustainable design needs advanced solutions to technical issues. The influence on the environment must be always considered by these solutions. Advanced solutions that are cost-effective, preserve natural materials and energy, lessen the effects of pollution while offering comfortable and healthier internal environment could be meet only with success [16].

Sustainable principles are responsible for clarifying interrelationships between the design of the building and the site, identifying cooperative operation between design alternatives and natural elements, and promoting building design for flexibility to adjust to the future technologies and programs.

Sustainable principles bring forth common sense solutions for minimizing damage to local ecosystems, using resources carefully and efficiently, increasing operational savings, improving indoor air quality, and enhancing occupant comfort and performance. Six sustainable design principles and their relevance to building construction [17]:

1. Integrated design process (IDP)

   It can be defined as system-thinking, or complete method. Decisions related to ventilation, lighting, building envelope, orientation and site design and selection are regarded as interdependent instead of being mutually independent.

2. Life-cycle costing

   Financial comparisons must include more than the costs of construction. The total cost of the project could be diminished, and the resources could be used more effectively when consider life-cycle costs early in planning and design of the project.

3. Site ecology / building-site relationship

   Make use of the natural features of the site not just lessens local effects, but also avoids the costs of development and infrastructure otherwise needed to overcome environmental challenges.

4. Eco-industrial networking

   Industrial ecology finds ways in which one system can make use of another system's waste energy and byproducts, saving costs while reducing harmful emissions and waste streams.

5. Designing for the future: future proofing

   The key principles of designing for the future are adaptability, flexibility, and durability. These three criteria should be considered when making choices about design layout, products and materials, and building systems.

6. The 3Rs: reduce, reuse, and recycle

   The 3Rs are essential principles of sustainable design. They refer to practices that conserve primary resources, decrease waste, and, if incorporated in the building design, reduce the overall environmental impacts of building.

2.4.2 Practices of Sustainable Design

Designers can help shape a sustainable future for society. Sustainable design studies the economic, social, and environmental effects of a building over its entire lifetime. It emphasizes resource conservation, protection of the natural environment, environmental performance, occupant health, life-cycle performance.

This section offers real-world method from which the designers have the ability to construct more sustainable buildings. The extents that call for environmental alertness are [17,18]:

1. Sustainable Site Planning: Preserving the sedimentation, erosion and character of the site.
2. Water and Waste Management: Enable effectiveness in using resources of water.
3. Integration of Renewable Energy: Using energy effective fixture, materials and integrating energy sources.
4. Building Envelop Design: Ideal Design as per climate environments and energy conservation building codes.
5. Ecologically Sustainable Material: Depends on low or zero toxicity that decreases adverse environmental influence.
6. Indoor Ambience: Ventilation system to meet minimum indoor air ventilation rates.

2.5 The Three Dimensions

1. Economic dimensions of sustainability: can be defined as the way to create new opportunities in the market for the sales to grow, reducing costs via effective enhancements and reduced energy and raw material inputs, and creating more added values.

2. Environmental dimensions of sustainability: can be defined as reducing waste, effluent generation, emissions to environment, reduced effect on the health of individuals, using renewable raw materials, and eliminating toxic substances.

3. Social dimensions of sustainability: can be defined as the safety and health of workers, Effects on local societies, life quality, and assistances to needy groups e.g. disabled. The Interaction of three basic pillars of sustainability concepts are shown in Figure 2.3.



Figure 2.2 Three basic pillars of sustainability concepts [19]

The Royal Academy of Engineering, United Kingdom in their Report "Engineering for Sustainable Development: Guiding Principles" described the way experts encounter 3 classes of issues, as development is advanced [20].

- Technocentric issues, encompassing technoeconomic systems other skills which engineers have to keep deploying and the economic system in which they are deployed.
- Sociocentric issues, or the expectations and aspirations of people.
- Ecocentric issues, which refers to the capability of the earth in sustaining people, both by the provision of materials and energy requirements and via the accommodation of emissions and waste.

The challenges encountered by engineers in the sustainable development process is contributing to society for:

- Reducing unfavorable social and environmental features of development
- Improving the environmental performances
- Improving their influence to make high life quality
- Helping the community to adopt sustainable style of life
- Ensuring that the infrastructure, services and products meeting these standards are considered competitive in the market, and preferably the most competitive in the market.

2.6 Green Building

Over the last ten years, the number of building owners who applied for GB certification from U.S. Green Building Council (USGBC)'s Leadership in Energy and Environmental Design (LEED) program has raised rapidly. When making permeant structures, GBs take the environment into consideration, these considerations consist of some factors that defined the building's quality such as preserving water and energy, reducing emissions and wastes, and encouraging healthy indoor environment [20]. The term 'green building' or 'GB' is used only recently. The focus of GBs is improving the existing standards, constructions and designs to make the buildings which are built currently last for more time, more effective, economically efficient to operate, and help offering healthier working and living surroundings for residents, thus help in increasing the productivity. GBs are also about improving built environment in order that communities, individuals and ecosystems grow and thrive; protecting the natural resources; and increasing the effectiveness with which the building and its site use materials, water and energy [22].

2.6.1 Green Buildings and Sustainability

Some terms related to environment and buildings must be clarified before further discussion. The most widely used terms are: whole building design, high performance buildings, sustainable design and green buildings. These terms could be used separately or interchangeably [23].

Although there are main differences between them, yet the terms 'sustainable' and 'green' are frequently utilized interchangeably. Generally, GBs are the process of constructing and designing that aim to create buildings which are less harmful to individuals and

environment, while sustainable buildings seek out models for unknown future state of community. see Table 2.1.

Table 2.1 Defining Green Buildings, Sustainable Buildings And Restorative Buildings [23]

Green Buildings	Sustainable Buildings	Restorative Buildings
● Reducing undesirable effects on environment ● Keeps relying on stored stocks of the natural capital ● Some external costs remain Weak Sustainability	● Eliminating undesirable effects on environment ● Relying only on current flows of natural capital ● the external costs are internalized	● Desirable impact on environment ● Reinvesting and restoring natural capital ● External or public benefits Strong Sustainability

2.6.2 The Environment of Green Building

One of the methods for improving the environmental performance of the building is to select building materials that are environmentally desirable. Practically, the environmental performance should be balanced against the economic performance. Even the manufacturers of building materials and designers that are considered environmentally experts will eventually want to measure environmental advantages against economic cost. These designers and manufacturers seek to recognize the building materials which enhance the environmental performance with no or little increase in costs [24].

Building for Environmental and Economic Sustainability, which can be abbreviated to (BEES) can be defied as one of the top structures in the United States for estimating environmentally Preferable Products (EPP) for private and public purchasing, created via the National Institute of Standards and Technology, which can be abbreviated to (NIST).

As stated by NIST: BEES estimate the environmental performance of building products through utilizing life cycle assessment method species in ISO 14040 standards.

All phases of product life are examined: getting raw materials, manufacturing, transportation, installation, utilizing and recycling and waste management.

The economic performance is evaluated utilizing a standard life cycle cost approach, that cover the costs of primary investments; operation, maintenance, repair, and disposal. Economic and environmental performances are combined into a total performance measure.

NIST collaborate with United States Environmental Protection Agency's (EPA), National Risk Management Research Laboratory, Air Pollution Prevention Control Division, developed by 1997 a standardized methodology and publicly available database for balancing the environmental and economic performance of building materials. A database of environmental performance is being developed by EPA, and by the help of EPA, methodology is being developed by NIST and implemented in decision-support software for manufacturers of materials and designers of buildings. BEES 2007 Economic performance data is being added to the database by NIST. The decision-support software is going to access the database product referred to as BEES.

2.6.3 The Economics of Green Buildings

The total value of GBs market is approximated to be between $36 billion and $49 billion and by the year 2013 the expected total value of the market value is between $96 billion and $140 billion. In addition to these total market values and the increasing trend of GB applications, the green market brought main enhancements via using green building applications. Main drivers stated in the study for adopting GBs such as improving the quality of indoor environment, increasing satisfaction, productivity and health of workers, diminishing the maintenance and operating costs [25].

Kubba (2009) states that there is common thought in the industry of real-estate that adopting GBs cost more than traditional development approaches. The financial advantages of adopting GBs include less water costs, waste disposals and energy, less emissions and environmental costs, less costs for maintenance and operations, and savings from improved health and productivity[22]. These advantages vary between being predictable (water, wastes and energy savings) to quite indeterminate (health/productivity advantages). Water and energy savings could be anticipated by reasonable precision, observed and measured over time. On the contrary, health and

productivity advantages are less comprehended and far more difficult to anticipate with precision.

According to A Report to California's Sustainable Building Task Force (2008) [26], more than forty agencies related to California state government, discovers that an investment of less than 2% of the costs of construction yields life-cycle savings of more than 10 times the initial investments. As an example, initial investment of $100,000 for incorporating GB features to a $5 million plan will bring about savings of $1 million or more over the life of building, expected predictably to be twenty years.

Kats, G. (2009) conducted a study to analyze 150 recent green and conventional in 33 states in the US and ten other countries, they study reached a conclusion that the cost of GBs is four percent more than the conventional buildings, with the most of GBs cost only one or two percent more than the similar conventional buildings [27]. The study suggested that the energy usage is reduced through GBs by an average of 33%, and the energy cost savings alone over a twenty year outweighs the initial cost premium paid in these buildings. The study approximations the savings in water, energy, health and productivity costs to be 4 to 5 times larger than initial cost premium paid in GBs over twenty years [28]. The reduced liability and economic opportunity for the building projects which adopt GB measures, the covered areas consist of the following:

2.6.3.1 Energy Efficiency

This is a huge subject, that is why only some main concepts will be introduced. A report made by the American Solar Energy Society in 2007 suggested that energy efficiency (preservation) and renewable can annually provide carbon reductions with an average of 1,200 million metric tons by the year 2030, helping the United States to achieve their goals under Kyoto Treaty. Energy efficiency can provide 57 percent of total, renewable 43 percent [29].

About fifty percent of building's energy usage is dedicated for creating artificial indoor climate via lighting, ventilation, cooling and heating. A general energy bill of a building constitutes about twenty-five percent of the whole operating costs of the building. Approximations specify that the climate-sensitive design utilizing accessible technologies can cut cooling and heating energy consumption by 60% and light energy needs by 50% in United States. Returns related to investments for energy efficiency

measures could be higher than the return rates on conventional and high yielding investments [30].

2.6.3.2 Waste Reduction

Reducing energy waste, materials and water utilized during the construction process is focus for green architecture. As an example, in California, commercial buildings are responsible for about sixty percent of state's waste [31].

Reducing the amount of materials that are going to landfills is a main goal during the construction process, the amount of waste that is produced by residents can be reduced when utilizing properly-designed buildings, through providing on-site solutions like compost bins for reducing matter going to landfills [27].

Waste related to construction constitute twenty-five percent or more of the contents of landfills and it is equal to the overall waste of garbage generated in US [32], because of this waste amounts, permission will not be given to more landfills or are extra charging for dumping waste related to construction. Thus, debris' recycling is expanding at the job sites. Some materials could be reused or if it is not possible then it can be recycled, examples of these materials are disassembled components of buildings, bricks, steel, aluminum, glass, carpet and gypsum. Along with recycling waste related to construction, the industry of building is starting to reach important reduction of wastes via adaptation and usage of more buildings, as instead of demolition. In the last ten years, the direction was to raze a building to the ground at the end of its first life (expected to be "beneficial" life) and replace the building with new one. With inventiveness, old buildings could be effectively renewed to efficient and cost-effective "new" buildings. Purchasers and sellers could get financial savings when adopting reusing of old buildings.

2.6.3.3 Water Efficiency

One serious problem related to the consumption of water is that in various fields, the demand to be supplied from aquifers surpass its capability to be refilled again. To the greatest possible level, the dependence on water (collected, used, purified, and reused onsite) must be increased by facilities. Preserving and protecting water during the life-cycle of the building could be achieved through designing dual plumbing which recycles the water when flushed in toilet. Using water preserving methods, the waste water could be minimized, these methods include shower heads with less flow and very low flush

toilets. Reducing water in circulation, improving, the quality of water and energy efficiency could be achieved by using water heating and treatment methods. Using non-sewage and greywater for onsite application like the irrigation of sites can diminish the demands on local aquifer [26]. Water-effective fixed appliances and equipment, changes in behavior and irrigation approaches could be beneficial for reducing consumption by thirty percent or more [33]. Investing in these measures could yield payback in 1 to 3 years. Fixture rebates, complimentary surveys on water and other incentives are offered by some water utilities, these incentives could result in higher returns.

2.6.3.4 Construction

Adopting GB ideas could yield far savings throughout the process of construction. The listing below suggests some possible areas for cost saving [34].

- Lower energy costs, by monitoring usage fixed appliances.
- Less costs for water, through obsercing reusing and consumption of construction waste water and/or storm water when feasible.
- Less costs for site-clearing, through diminishing the disruption on site and earth movement, and installing artificial systems.
- Less landfill dumping payments and the related hauling fees, by recycling and reusing demolition and construction debris.
- Less cost for materials, with additional care in reusing and purchasing materials and resources.
- Likely incomes from sales of reusable items removed throughout demolition of the building.
- Less health issues related to workers happening from bad quality of indoor air.

By more integrated and cooperative methods, the team of the project can specify other possibilities. The contractor has the ability for improving the relations with the owner of the building and the community through considering them as an important part of the team work for implementing environmentally sound construction measures.

2.6.3.5 Building Operations and Maintenance

The measures related to GBs could result in not only less expenses for operating buildings through reducing the costs of utility and waste disposal, but also less costs for maintenance of buildings, ranging from wages to supplies. Green standards that are

designed at start of the project are retained through ensuring that operations and maintenance personnel are part of the development and planning process of the project.

2.6.3.6 Insurance and Liability

The operational practices, constructions, conventional office design has diminished the quality of indoor environment in the last 10 years, causing new health issues and related liability and economic costs. The United States Environment protection Agency, which can be abbreviated to (EPA) ranks to public-health, the indoor air is considered unhealthy in 30% of renewed and new buildings [35].

2.6.3.7 Local Economic Development Opportunities

The local governments encountering increasing operational and building costs could discover that implementing green practices may cut public expenses for waste, energy and water processing. New opportunities in economic development could be generate d by implementing and promoting GBs within the community. These opportunities could be: Trainings about new green products and business; developing business districts that are environmentally oriented; improvement programs for resource efficiency which help the current businesses to lessen operational costs; and developing new businesses for meeting the demands of green services and products.

2.6.3.8 Occupant Health and Productivity

Providing shelter for residents is not the only purpose of building, but also providing an environment that is beneficial and offer high-performance for all intended activities of residents. New studies suggested that the productivity of workers could be increased by (6%-16%) in buildings with good general environmental quality, such as good acoustics, quality of indoor air, proper or natural lighting levels and effective ventilation [36].

2.6.3.9 Building Value

High performance and efficiency of GBs could cause less credit risk for lenders and high values for property. Less costs for operations along with more effective systems could result in higher net income for buildings. Cost of construction and fees of designing of typical office-building are small amount of the entire building costs. Employees, finance, maintenance and operations are frequently account for as much as 99 percent; urgings for

increasing the investments at the design phase are persuasive. It is a brilliant business to look for construction and designing process which minimizes capital cost maximizes those qualities that contribute to improved business operations and minimizes those elements that will be a financial drain over the life of building [37].

2.7 Green Buildings Rating Systems

Globally, one aim for all construction businesses is the sustainable developmental human environment, in the present condition of high pollution and high energy consumption, it very important to adopt buildings that are energy saving, intelligent and green. Ratings and policies related to GBs have been made by various countries, some countries are drafting standards on sustainable construction. Nonetheless, because of geographical and economical variations and per capita resources in each country, various comprehensions and studies are presented about GBs [38].

2.7.1 North America - United States

1- LEED.

After creating the United States Green Building Council in 1993, which can be abbreviated to (USGBC), the members of organization thought that the industry of sustainable buildings required a system for measuring and defining GBs. The present rating systems and metrics related to GBs were being studies by the USGBC. After one year of its creation, the members of USGBC responded to the initial conclusions through creating a board that focus only on this matter. Diversity is what distinguished the committee; it consists of industry representatives, environmentalist, lawyer, owner of building, real-estate agents and architects. Depth and richness were added to the final product and the process due to the cross section of professions and individuals [39].

Leadership in Energy and Environmental Design, which can be abbreviated to LEED is registered trademark of USGBC [40]. In august 1998, LEED version 1.0, which is the first LEED Pilot Project Program, was introduced at the USGBC Membership Summit. In March 2000, and after large-scale adjustments, the LEED GB Rating System v2.0 was introduced, also LEED v2.1 was introduced in 2002, LEED v2.2 was introduced in 2005 [40], LEED v3 was introduced in 2009 and the last version LEED v4 was introduced in 2013 [42].

The program tackled new initiatives with the evolvement of LEED. As well as a rating system precisely dedicated for building maintenance and operational matters (LEED for Existing Buildings: Operations & Maintenance), LEED handle various project delivery and development processes in the United States building construction and design market, by using rating systems for precise building project scopes, sectors and typologies: LEED for commercial interiors, homes, healthcare, retail, neighborhood development, schools, new constructions and LEED for Core & Shell.

For certifying and registering projects, the project team interact with the Green Building Certification Institute (GBCI). Green Building Certification Institute was introduced in year 2008 as a separate integrated unit with the support of USGBC. The GBCI manage certification and credentialing programs associated with to GB practice. Those programs are supporting the application of proven approaches for measuring and increasing the performance of communities and buildings as stated through industry systems like LEED [39].

2 – ASHRAE Green Guide

The ASHRAE green guide was developed by the American Society of Heating, Refrigeration, and Air-conditioning Engineers to support refrigeration, air conditioning, heating and ventilation designers in designing GBs.

3 – Canada Guide

The two Canadian programs defined here are C-2000 Integrated Design Process (IDP) in conjunction with the Commercial Building Incentive Program CBIP and Green Building Challenge assessment tool (GBTool), IDP and CBIP. Commercial Building Incentive Program was introduced in 1997 in Canada as a larger national program introduced for leading the industry to effective energy.

2.7.2 Europe Guidelines

The design guidelines and standards defined in the next sections are from Germany, UK, and Netherlands.

1 - United Kingdom - BREEAM

Building Research Establishment Environmental Assessment Method, which can be abbreviated to BREEAM was introduced in 1990 through Building Research Establishment (BRE) in UK. BREEAM can be defined as a voluntary evaluation program utilized to evaluate the performance of a building depending on these areas: water, materials, land use, transport, health, energy use and management.

2 - The Netherlands - GreenCalc

DGMR and NIBE, which are respectively the abbreviations for Dutch consulting engineering firm and the Dutch Institute for Building, Biology and Ecology developed the computer program referred to as GreenCalc which compare the building's environmental sustainability. Four modules of evaluation are included in the program: mobility, water, energy and materials, depending on the information entered for these modules, an environmental index value is determined by the program for expressing the building's sustainability.

3 - Germany - Guideline for Sustainable Building

For implementing integrated principles for sustainable maintenance, construction operation, planning and using in land holdings and federal buildings, the German Federal Office for Building and Regional Planning developed the Guideline for Sustainable Building.

2.7.3 Asia Guidelines

The guidelines and standards which are defined in the next sections are from Korea, Hong Kong and Japan.

1 - Hong Kong

HK-BEAM, which is an abbreviation for (Hong Kong Building Environmental Assessment Method) was introduced in the year 1996 and it was modified to local Hong Kong environmental settings from the UK's BREEAM. The main aim of HK-BEAM is defining good practice standards for group of environmental matters related to design, planning, commissioning, construction, maintaining and managing and operating of

buildings. “Credits” are given when specified performance criteria and standards are fulfilled.

2 – Korea - Green Building Rating System (GBRS)

GBRS, which is an abbreviation for (Green Building Rating System) can be defined as innovative environmental performance assessment approach under development via the Green Building Council Korea. GBRS is a voluntary “whole building” assessment tool that covers the entire life cycle of the building.

3 - Japan

CASBEE, which is an abbreviation for (Comprehensive Assessment System for Building Environmental Efficiency) is joint industrial, academic and governmental building assessment project in progress in Japan.

CHAPTER 3

DRIVERS AND BARRIERS FOR GREEN BUILDINGS

3.1 Past Studies About Drivers for Green Building

In the construction environment, there are many recognizable drivers regarding green buildings. These drivers are influenced by the implementations of sustainable constructions and designs [43]. As an example, the Energy Independence and Security Act in 2007 and the Energy Policy Act in 2005 necessitate that the organizations and public governments apply sustainable constructions and designs in the operations and developments of their facilities, US Congress 2005, 2007. Additionally, the federal Executive Orders,to which can be abbreviated to (EOs) comprising EO13514 in 2009 about: Federal Relations on Economic, Energy and Environmental Performance and EO13423 in 2007 about: Supporting Federal Transportation, Energy and Environmental Management, setting up objectives in the fields of energy effectiveness, acquirement of facilities, renewable energy, reducing toxics, fleets, recycling, sustainable buildings, electronics management and water conservations [36], Federal Leadership Economic, Energy and Environmental Performance, 2009. These executive orders need the federal public corporations to guarantee that main renovations and new constructions of the federal facilities abide with Guiding Principles for Federal Leadership in High Performance and Sustainable Building. One of the main indicators is that a lot of green building were applied by policies, EOs, incentives and legislations can be seen in forty-five states, comprising 442 localities (384 cities/- towns and 58 counties), thirty-five state governments, fourteen federal departments or agencies, and various public school and establishments of higher-education as of Sep 2010 within the US, USGBC (2009), [41]. Additionally, international plans such as the UN Environment Programmed, the summits of G8 and G20 and UN Framework Convention on Climate Change also encouraged sustainable constructions and designs, especially greenhouse and energy gas emission reduction that is related to the change in climate, [7]. drivers of the sustainable

constructions and designs are centered on the advantages of combining the sustainable constructions and designs in present and new building plans. Whereas a lot of studies explain and describe certain advantages and drivers of sustainable constructions and designs, in this study there are various drivers of green buildings as shown in Table 3.1.

Table 3.1 Drivers for Green Building and References

Driver no.	Driver Definition	References
1	Energy conservation	Ahn et al. (2013) [7], Low et al. (2014a) [45] Manoliadis, et al. (2006) [43]
2	Green building rating systems	Ahn et al. (2012) [7]
3	Development government legislation	Low et al. (2014a) [45], Bernstein and Russo (2013) [53], Ahn et al. (2012) [7]
4	Competent team members	Low, et al.(2014a), [45]
5	Increase Knowledge and awareness, and information	Zainul Abidin, N. (2010) [47]
6	Adoption of incentive programmers (incentive schemes)	Wong and Abe (2014) [52], Yudelson (2008) [36], Ahn et al. (2012) [7], Abidin and Powmya (2013) [6]
7	Demand from clients/tenants	Hakkinen and Belloni (2011), [48]
8	Promotion and communication	Wang et al. (2014) [51]
9	Increase education and training	Niroumand, et al. (2013) [49], Udawatta (2015) [50]
10	Waste reduction (materials and construction wastes)	Zhai et al. (2014) [58]
11	Decreased construction time	Zhai et al. (2014) [58]
12	Reduced labor demand and construction cost	Zhai et al. (2014) [58]
13	Improved project constructability	Zhai et al. (2014) [58]
14	Ensure project cost certainty	Zhai et al. (2014) [58]
15	Reduced on-site worker health and safety risks	Zhai et al. (2014) [58]
16	Achieve high building quality	Zhai et al. (2014) [58]
17	Integrated design approaches	Bond, S. (2010) [58]
18	Moral imperative or social conscience	Potbhare, et al. (2009) [54]
19	Self-identify	Murtagh et al. (2016) [53].
20	Reduced whole lifecycle costs	Bond, S. (2011a) [59], Bond, S. G. (2011b) [60]
21	Increased property values	Andelin, et al. (2015) [55], WorldGBC (2013) [69]
22	Environmental protection	Abidin and Powmya (2013) [6]
23	Resource conservation	Manoliadis, et al. (2006) [43], Ahn et al. (2012) [7]
24	Water conservation	Ahn et al. (2013) [7], Devine and Kok (2015) [61]
25	Significant savings in the operational costs	Kats, (2003) [57]
26	New kinds of partnerships and project stakeholders	Manoliadis, et al. (2006) [43]

Table 3.2 Summary of Available Past Studies on Drivers

Cods	Ahn (2013)	Low (2014a)	Manoliadis (2006)	Bernstein (2013)	Zainul Abidin (2010)	Yudelson (2008)	Abidin (2013)	Wong (2014)	Hakkinen (2011)	Wang (2014)	Niroumand (2013)	Udawatta (2015)	Zhai (2014)	Bond (2010)	Potbhare, (2009)	Murtagh (2016)	Bond (2011a)	Bond (2011b)	Andelin (2015)	WorldGBC (2013)	Devine (2015)	Kats (2003)	Frequency
X1	•					•	•	•															4
X2	•	•		•																			3
X3											•	•											2
X4					•																		1
X5										•													1
X6									•														1
X7	•																						1
X8																•							1
X9															•								1
X10	•		•																				2
X11							•																1
X12	•	•	•																				3
X13	•																				•		2
X14																	•	•					2
X15																			•	•			2
X16													•										1
X17													•										1
X18													•										1
X19													•										1
X20		•																					1
X21													•										1
X22			•																				1
X23													•										1
X24														•									1
X25																						•	1
X26													•										1

3.2 Categories of Green Building Drivers

Numerous drivers prompting green buildings implementation were recognized by a detailed evaluation of previous studies. For better understanding regarding the green buildings, differentiating and classifying them is highly important. Two categories of drivers for GBs are presented in the study, external drivers, and property level drivers. An adequate investigation of past studies supposes that the classification framework of (Falkenbach et al,2010), [44], could be used for categorizing the drivers of green buildings, however, extra drivers and drivers' categories must be introduced. In this study it is suggested that the drivers of green buildings could be grouped in four key categories:

- External level drivers
- Individual level drivers.
- Project level drivers
- Property level drivers

3.2.1 External Drivers

This type can be defined as the drivers that are mostly established through external organizations, like European Union (EU), United Nations (UN), trade unions, customers/clients and governments to organizations and companies concerned with green buildings. In other words, the external drivers denote the events which happen outside the company that develop the green buildings as shown in Table 3.3. Several earlier researches found strong indications that the policies and regulations imposed by the government are significant drivers which oblige the stakeholders to adopt sustainability[7] [45]. The interviews and survey which examined the drivers to green existing and new buildings in Singapore suggested that all respondents were certain about the significance of the polices and legislations of the government to promote green buildings [45], this came in accordance with the study of Russo and Bernstein (2013), that suggested that the actions of the government, particularly the regulations concerned with environment impacted the adoption level of GBs. Awareness and knowledge are significant factors in producing sustainable industry because these factors are responsible for starting, constructing and building projects. Awareness and knowledge are considered the stepping stone for various implementations of GBs as stated by (Zainul Abidin, 2010) . For the GBs to enter the market more efficiently, the knowledge and environmental awareness of the stakeholders must be highly increased, more particularly, to spread the

information in a better way to the needs of financial and investment institutions, tenants and clients. To what range the green building are developed is based on the needs of tenants/clients. The demands of the customer are associated to some matters like cost, value, approach, supply and knowledge [48]. Recently, the improved training and education is significant for the development of GBs, education through improved communications and information has and important impact on the level of awareness and knowledge regarding the public and the clients [7], [49], [50]. Strategies concerned with communication and promotion, like training and education programs, television programs and generic marketing have driven using wood as sustainable solution for green buildings in United Kingdom construction sector [51]. The development of green buildings is also encouraged by adopting incentive systems of GBs [6],[7]. A study included 436 accredited professionals in the field of GBs, exhibited that the incentives of the market could encourage the stakeholders of the to promote and implement green buildings in Japan, financial and preferential interest rate are 2 of the most chosen incentives types [52]. For example, in the united states, many states (New York) implemented incentives like density bonus, state income tax credit and direct monetary payment for driving demand from the stakeholders for GBs [36]. In many countries, the GBs are boosted by the creation of various green building rating systems. Green buildings rating systems consist of many requirements (land, use of material, water and sustainable energy) complying with the triple bottom line of sustainable development: social, economic and environmental sustainability. Green buildings rating systems such as (BREAM, LEED, and so on) are considered important drivers for sustainable constructions and designs as they assist the construction stakeholders to set up a standard for designing, constructing and operating sustainable facilities with high performance. additionally, GB rating systems help in supporting the industry of construction to implement sustainable practices, educating the public, uplifting the model change to extra sustainable construction, [7].

Table 3.3 External Drivers for Green Building

Driver no.	External Drivers	References
1	Adoption of incentive programmers (incentive schemes)	Wong and Abe (2014) [52], Yudelson, 2008) [36], Ahn et al. (2012), [7], Abidin and Powmya (2013) [6]
2	Development Government legislation	Low, et al. (2014a) [45], Bernstein and Russo (2013), [46]
3	Increase education and training	Niroumand, et al. (2013), [49], Udawatta (2015) [50], Ahn et al. (2012), [7]
4	Increase Knowledge and awareness, and information	Zainul Abidin, N. (2010), [47]
5	Promotion and communication	Wang et al. (2014), [51]
6	Demand from clients/tenants	Hakkinen and Belloni (2011), [48]
7	Green building rating systems	Ahn et al. (2012), [7]

3.2.2 Individual level Drivers

In psychology, the behavior of human is heavily dependent on his motivation. Individuals are naturally driven to master their active environment; it means controlling their own lives or desiring a sense of self-regulation or competence, personal choice, and independence in their actions [53]. This type of drivers is considered quite natural and explain what drives people to achieve sustainability objectives or attempt green buildings on their personal projects as shown in Table 3.3. The architectural designers suggested that they are driven for implementing sustainability in their projects. Individuals intend to green designs when they have a desire for improving their work through achieving 'highly good job' or 'high quality work'. Respondents considered that there is solid association between their designs and their self-identity, their self-identity is considered an important element of their job [53]. The architectural designers indicated that the personal commitment and moral imperative are also main drivers, also, those architects suggested that moral imperative make the individual feel that GBs are an ethical way of building, this was also confirmed through (Potbhare et al., 2009), [54] who suggested that the social ethics is a motivation for individuals to implement green buildings.

Table 3.4 Individual-Level Drivers for Sustainable Green Building

Driver no.	Individual-Level Drivers	References
1	Self-identify	Murtagh et al. (2016)[53]
2	Moral imperative or social conscience	Potbhare et al. (2009)[54]

3.2.3 Project-level Drivers

Though several project level drivers are recognized in general, the number of academic researches offering experiential indication on each project level driver see Table 3.5, this happens because the construction stage regarding the green buildings is less focused on than the operational parts, this result is sensible because through the use stage of building most environmental influences and emissions are caused [55]. The final or overall cost regarding the buildings are heavily affected by the decisions at the project-level. For keeping the cost in adequate range, some right design decisions must be made. The cost of green buildings was diminishing due to more common utilization of integrated design methods. (Bond, S., 2010), [56] suggested that in constructing and designing green buildings work well in financially and non-financially, through utilizing integrated methods, most effective are accomplished, whereby all the parties are involved in initial designing stage, then the design team can cooperatively establish solutions.

Concerning the cost sustainable in construction field are calculated for increasing the initial capital cost usually between (1%-25%), this could frequently be offset through important savings in operative costs [57]. A public-private partnership could produce products and industry associations which will eventually impact the market [43]. An owner of the building could employ a professional building team for upgrading the building, however, a team effort is needed for integrating sustainable technologies and designs in retrofit [45]. The drivers of green buildings are well examined in the study of (Zhai et al. (2014), [58] which aimed to increase the uptake level regarding the off-site production methods are significant for addressing the rising challenges of green buildings, examined the levels of motivations and attitudes of Chinese construction business to the implement off-site production methods and developed GBs practices. The most reasons for implementing off-site production in the sustainable projects are reducing the following: the construction waste, time, material waste, labor demands, cost of

construction, on site workers health and safety risks, also improving the constructability of the project and ensuring the cost of the project.

Table 3.5 Project-Level Drivers for Sustainable Green Building

Driver no.	Project-Level Drivers	References
1	Reducing worker's safety risks and health on-site	Zhai et al. (2014) [58]
2	Reducing wastes (materials and construction wastes)	Zhai et al. (2014) [58]
3	Improved project constructability	Zhai et al. (2014) [58]
4	Competent team members	Low, et al. (2014a) [45]
5	Decreased construction time	Zhai et al. (2014) [58]
6	New partnerships and project stakeholders	Manoliadis, et al. (2006) [43]
7	Ensure project cost certainty	Zhai et al. (2014) [58]
8	Integrated design approaches	Bond, S. (2010) [56]
9	Important savings in operational costs	Kats (2003) [57]
10	Reduced labor demand and construction cost	Zhai et al. (2014) [58]

3.2.4 Property-level Drivers

This study implies that the drivers for property level in GBs could be clarified through seven different drivers as shown in Table 3.6. Maximizing the building's capital value is the main concern for most of the stakeholders. The notion that high costs for maintaining and operating the buildings can be lowered by green plan has mostly driven the market of green buildings. Indication implies that green buildings could reduce the whole lifecycle costs than non-green buildings. As an example, in New Zealand and Australia, developers, builders, architects and homeowners stated in 2 researches that reducing the whole lifecycle costs is the most significant driver for implementing green buildings (Bond, 2011a) [59], (Bond, 2011b) [60]. These researches recognized that the savings in cost were more than one thousand dollars each year, this was the motive behind adopting GBs. The decreased green buildings lifecycle cost could be related directly to some problems like decreased water uses and energy saving, concerning the decreased water, the consumption of water and energy in the buildings was studied, it was suggested that

there is less energy used by the LEED-certified buildings, by 28% than the non-certified ones, and green buildings utilize less water than non-green buildings [7]. As reduced energy and water usage lead that the expenses for owners and tenants will be low, larger rental returns are reached by decreasing the rent concessions. Regarding the operations and turnovers of buildings, the cost savings and the reduced variability must result in larger value for green buildings [61]. Value is defined by the stakeholders as the possible market value of the property they acquire, that value is affected by the desirability of that property to possible buyers, [55]. The property value is related linked to occupancy and rental charges. Thus, it is evident that the sustainability issues have important influence on value of the property, costs of operations, rates for occupancy and rents [62]. Because of its importance in energy consumption, the industry of construction is considered a main contributor to CO2 emissions [45]. Conserving the energy could be achieved through applying effective energy technologies and strategies and generating energy from renewable and natural such as geothermal, wind and sun [43]. These results support the significance of increasing innovations and research attempts for energy-associated policies, technologies and to improve the present applications in sustainable constructions and designs [7]. The impact of the industry of construction the issues of environmental world is frequently examined in association to emissions and resource consumptions. The possibility of green buildings practices in making sure that the buildings which the stakeholders include in their list are energy efficient and designed properly, thus, help in reducing the environmental influence of the buildings. Ahn et al. (2012) [7] and (Abidin and Powmya 2013) [6] There are suggestion that the decreased environmental influence provide motivation for stakeholders to be adopt the concept of green buildings. In term of resource conservation, the reduction of resource consumption in green buildings is less than other non-green buildings because it uses an integrated design method that decreases the waste of resources, thus, the likelihood of preserving limited resources increased the popularity of GBs [43], [7] . The green buildings achieve quality in terms of energy, water, design and maintenance. Zhai et al. (2014), [58] showed the Achieve high quality building the effective driver to promote green buildings.

Table 3.6 Property-Level Drivers for Sustainable Green Building

Driver no.	Property-Level Drivers	References
1	Resource conservation	Manoliadis, et al. (2006) [43], Ahn et al. (2012) [7]
2	Environmental protection	Abidin and Powmya (2013) [6], Ahn et al. (2012) [7]
3	Energy conservation	Manoliadis, et al. (2006) [42],Ahn et al. (2012)[43], Low, et.al. (2014a) [45]
4	Water conservation	Ahn et al. (2012) [7], Devine and Kok (2015) [61]
5	Reduced whole lifecycle costs	Bond, S. (2011a) [59], Bond, S. G. (2011b)[60]
6	Increased property values	Andelin, et al. (2015) [55], WorldGBC (2013) [62]
7	Achieve high building quality	Zhai et al. (2014) [58]

3.3 Past Studies about Barriers for Green Building

Numerous barriers prevent sustainable construction in development countries as shown in Table 3.7. Most of the contractors impute those obstacles to some political circumstances but other contractors suggest that insecurity and instability are highly important in stopping sustainable development. Whereas the qualities of GBs significantly fulfill the needs of the health of human and environment sustainable growth, these GBs meet some obstacles in their market entrance; numerous are presented about their application. What are the obstacles which are preventing green buildings market from expanding and growing? There is a necessity for understanding the obstacles that stop the application of GBs to asset in finding methods for overcoming them. Some studies examined the obstacles delaying utilizing GBs in construction field.

Table 3.7 Barriers for Green Building

Driver no.	Barriers definition	References
1	Absence of alertness and knowledge of GB	Kibert (2008) [10], Ahn et al. (2013) [7], Williams and Dair (2007) [65]
2	Absence of demand by stakeholders and clients	Williams and Dair (2007) [65]
3	Resisting changes from the usage of old-style technologies	Ahn et al. (2013) [7], Hakkinen and Belloni (2011) [48]
4	Uncertaintis and risks in implementing new technologies	Hakkinen and Belloni (2011) [48]
5	The lack of expressed interest from clients	Landman (1999) [64]
6	Unavailability of green buildings suppliers	Lam et al. (2009) [70]
7	Absence of facilities and local institutes for green buildings	Hwang and Tan (2012) [69]
8	Absence of GBs technological training for project	Djokoto et al. (2014) [67]
9	Unavailability of approved green materials and technologies	Aktas (2015) [63]
10	Uneven benefit distribution	Yudelson (2008) [36]
11	Absence of information related to green products	Bond (2011a) [59]
12	Longer implementation time	Hwang and Ng (2013) [68], Lam et al. (2009) [70]
13	High Cost Premium	Ahn et al. (2013) [7], (Yudelson, 2008) [42], Lam et al. (2009) [70]
14	Long payback periods from implementing GBs	Ahn et al. (2013) [7]
15	High rental charges and market prices of GBs caused by GBTs application	Hakkinen and Belloni (2011) [48]
16	Absence of financing methods (e.g., bank loans)	Potbhare et al. (2009)[54], Luthra et al. (2015) [71]
17	Implementing GBs is time-consuming and result in delays in projects and increase the cost	Lam et al. (2009) [70]
18	Absence of regulations and incentives from the government	Zhang and Shen (2012) [66]
19	Inadequate green buildings rating systems and labeling programs available	Aktas (2015) [64]
20	Lack of GB promotion by government	Djokoto et al. (2014) [67]

Table 3.8 Summary of Available Past Studies on Barriers

Cods	Ahn (2013)	Kibert (2008)	Williams (2007)	Hakkinen (2011)	Landman (1999)	Lam et al. (2009)	Hwang (2012)	Djokoto (2014)	Aktas (2015)	Yudelson (2008)	Bond (2011a)	Hwang (2013)	Potbhare (2009)	Luthra (2015)	Zhang (2012)	Frequency
B1	●	●	●													3
B2			●													1
B3	●			●												2
B4				●												1
B5					●											1
B6	●					●				●						3
B7	●															1
B8				●												1
B9													●	●		2
B10						●										1
B11															●	1
B12									●							1
B13								●								1
B14						●										1
B15												●				1
B16								●								1
B17									●							1
B18										●						1
B19											●					1
B20						●	●									2

3.4 Categories Barriers for Green Building

To drive and endorse the plans of sustainable construction in Iraq construction field, it is a requirement to identify the obstacles that obstruct these practices. In this study it is suggested that the barriers of green buildings could be grouped in four key categories:

- Cultural Barriers
- Steering Barriers
- Capacity Barriers
- Financial Barriers

3.4.1 Cultural Barriers

Resisting sustainable buildings happen due to the necessity for procedure changes, that involves awareness of likely risks and unexpected costs [48]. The leaning toward maintaining the present practices and resisting changes in construction field is an extra obstacle to sustainable constructions and designs [7]. The change resistance leads to absence of demand by stakeholders and customers of the construction projects influencing its ultimate supply. One of the most critical obstacles in sustainable constructions and designs is the absence of interest from developers and owners [64]. This obstacle relates to initial cost premium of sustainable buildings and absence of information linked to the advantages of sustainable constructions and designs.Williams and Dair (2007), [65], recognized absence of sustainability measures via stakeholder as the most generally obstacle and specified the absence of demand via client as a usually recognized obstacle. Nevertheless, this could be overcome through the willingness and demand of the client, also the public alertness regarding GBs is considered a significant factor which resulted in high demand (Kibert, 2008) [11]. Because of the inadequate studies, the public are lacking alertness about the advantages of adopting GBs, particularly on matters like the impact of the quality regarding GBs indoor environment on health and productivity[7].Lacking information and studies and on GBs are the main cause of public absence of alertness and knowledge[65].as shown in Table 3.8 there are five cultural barriers.

Table 3.9 Cultural Barriers for sustainable green building

Driver no.	Cultural Barriers	References
1	Absence of alertness and knowledge of GBs	Kibert (2008) [11]. Ahn et al. (2013) [7], Williams and Dair (2007) [65]
2	Absence of demand via stakeholders and clients	Williams and Dair (2007) [65]
3	Resisting change from the usage of old-style technologies	Ahn et al. (2013) [43], Hakkinen and Belloni (2011) [48]
4	Uncertainties and risks involved in implementing new technologies	Hakkinen and Belloni (2011) [48]
5	The lack of expressed interest from clients	Landman (1999) [64]

3.4.2 Steering Barriers

A main feature of construction field is involving many entities ranging from contractors and clients to builders, so an active plan is needed for implementing sustainable constructions, wrong or lacked guidance could suppress sustainable construction while the presence of guidance measures could enhance it. Lacking regulations and incentives from the government are the main barriers of steering, studies suggested that the absence government's incentives and promotions and the increasing cost of maintenance are considered the main barriers to implementation [66]. Regularly, developers do not perceive substantial advantages in GBs and therefore they do not adopt it. Djokoto et al (2014), [67] said lacking support from the government can be defined as main barrier to using and implementing sustainable construction. Information dissemination and green labelling are important government measures for promoting building energy-efficiency/GB. Aktas (2015), [63] suggested that it difficult for the stakeholders to effectively adopt GBs without support or guidance. They are certain that the presence of local rating system may be of help to overcome this issue. In United States there are a lot of green buildings rating systems and labeling programs which offer important information on green buildings to public such as BREAM and LEED.

Table 3.10 Steering Barriers for sustainable green building

Driver no.	Steering Barriers	References
1	Lack of government incentives and regulations	Zhang, Shen (2012) [66]
2	Insufficient GB rating systems and labeling programs available	Aktas (2015) [63]
3	Lack of GB promotion by government	Djokoto et al. (2014) [67]

3.4.3 Capacity Barriers

Sustainable buildings could be obstructed through the absence of understanding or ignorance of understanding regarding sustainability. Whereas the designers are confident in their capability for using and accessing knowledge, however, this confidence is obstructed with the emergence of issues related to sustainable buildings. Time and cost are very related in the construction field, because they are important elements for

estimating the success and performance of the project. Long implementations time is considered as an obstacle in the process of GBs [70]. Hwang and Ng (2013), [68] In Singapore, project managers made a study and suggested that the long time needed through the pre-construction is considered as a main obstacle in executing GBs. Bond (2011a) [59] stated that the absence of information and cost are main obstacles related to GBs New Zealand and Australia and there is a necessity from the team to offer better information regarding the tools and products for achieving sustainable constructions. Convincing the developers to utilize GBs is considered a difficult matter when an unequal distribution of benefits between tenants and builders [36]. The developers must bear the high-cost of GBs while occupants get the most of advantages from GBs, like better quality of indoor environment, water and energy savings. Lacking development and research related to the advantages of green technologies and buildings are considered main drivers behind the absence of demand for buildings to go beyond the legislative requirements [69]. New forms of knowledge and competencies are required for installing sustainable materials and technologies, however it was obvious from the studies that not all responsibilities in the field had needed expertise for meeting the challenge. Aktas (2015), [63] suggested that the cost of GBs could be increased when there is lack in supplies for GBs which may result in importing these supplies from abroad. In addition, one main obstacle is the absence of GBs suppliers. Lam et al. (2009), [70] The study suggested that there is lack of trust in suppliers and immaturity of the supplies regarding the green market. When the staff of the projects is not fully trained to deal with GBs, that requires the professionals to be completely familiar with the principles of sustainable construction so as to use it, also, these professionals are required to gather a team that is integrated from conception to inception, the team must have the best information regarding the tools and products for achieving sustainable constructions [67].

Table 3.11 Capacity/Professional Barriers for Sustainable Green Building

Driver no.	Capacity/Professional Barriers	References
1	Unavailability of green buildings suppliers	Lam et al. (2009) [70]
2	Absence of local facilities and institutes for (R&D) of green buildings	Hwang and Tan (2012) [69]
3	Lack of green building technological training for project	Djokoto et al. (2014) [67]

Table 3.11 Capacity/Professional barriers for sustainable green building (cont'd)

4	Unavailability of approved green materials and technologies	Aktas (2015) [63]
5	Uneven benefit distribution	Yudelson (2008) [36]
6	Absence of information related to green products	Bond (2011a) [59]
7	Longer implementation time	Hwang and Ng (2013) [68], Lam et al. (2009) [70]

3.4.4 Financial Barriers

Cost is considered as a significant obstacle towards implementing GBs, in general high cost is the biggest obstacle towards sustainable constructions and designs in the United States [7]. As an example, the cost of compressed wheat board, that is considered a green substitute for plywood, is approximately ten times more than the regular plywood. Additional aspects causing high cost premium of GBs are the cost experienced when searching for green alternatives and in certification of building [36]. Ahn et al. (2013), [7] suggested that the need for lengthy payback periods from applying sustainable technologies and practices is the second obstacle to GBs in United States. Developers or/and investors could be uncertain to invest extra first cost premiums for sustainable plans even that they could lower the future costs in the process of building. High rental charges and market prices related to GBs are barrier to implementing GBs Hakkinen and Belloni (2011), [48] suggest that better energy effectiveness and lower cost of operations are issues which influence the attractiveness and value of the market. Government does not depend on regulation alone, also, there are many local and federal programmers who offer more incentives specifically for owners to adopt GBs. Encouragement and support must be offered from the banks to implement GBs and adopt government-backed strategies for overcoming weakness in supporting GBs. Lack of funding strategies for promoting the implementation of renewable sustainable energy technologies via banks, corporations and industries [54]. Considering GBs may cause delays in the projects [71], because regularly there is a necessity for more time to efficiently include all essential technologies in the green design. Usually, that mean more interaction, communication and involvement between different groups of stakeholders with the necessary experience and knowledge, that may also cause delay in the projects. Lam et al. (2009), [70] suggested that the delays in construction process could increase cost and result in damage

to the stakeholders while time-related clauses in specifications could influence float ownerships and concurrent delays.

Table 3.12 Financial Barriers for sustainable green buildings

Driver no.	Financial Barriers	References
1	High Cost Premium	Ahn et al. (2013) [7], (Yudelson, 2008) [36], Lam et al. (2009) [70]
2	Long payback periods from implementing GBs	Ahn et al. (2013) [7]
3	High rental charges and market prices of GBs caused by GBTs application	Hakkinen and Belloni (2011) [48]
4	Absence of financing methods (e.g., bank loans)	Potbhare et al. (2009)[54], Luthra et al. (2015) [71]
5	High Cost Premium	Ahn et al. (2013) [7], (Yudelson, 2008) [36]

CHAPTER 4

RESEARCH METHODOLOGY AND DATA ACQUISITION

The main goal of this thesis is identifying what is delaying or accelerating green buildings (GBs) in the construction sector in Iraq. Interview and surveys are utilized for obtaining the perception of the industry's professionals. In this chapter we will focus on the subjects related with thesis research methodology, and the way data is acquired and examined**.**

4.1. Research Methodology

The current study has adopted questionnaire and literature review. Figure 4.1 illustrates the research approach. For achieving its objectives, the study work has adopted the following methodology:

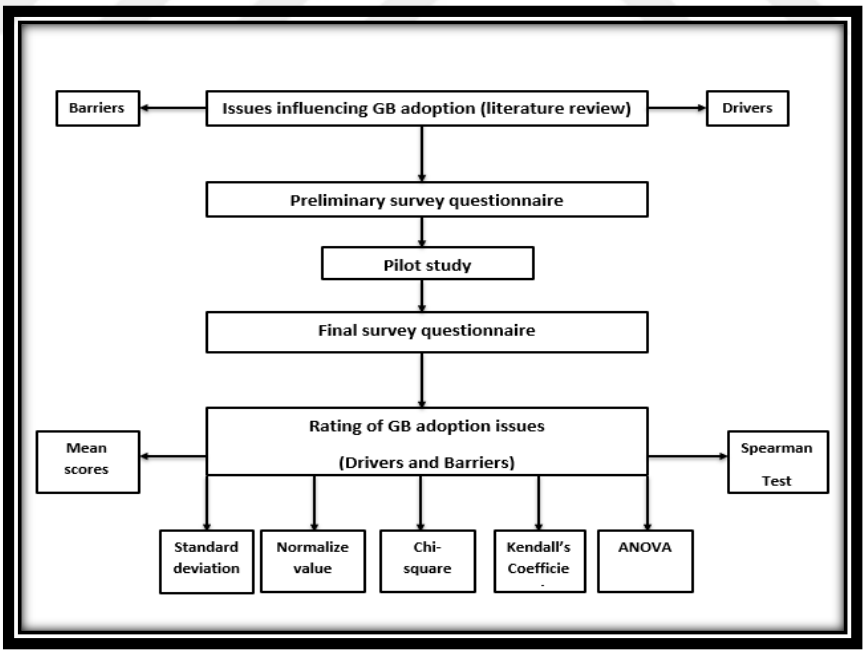


Figure 4.1 Research approach

4.1.1 Questionnaire Development

A comprehensive review is used as a base for the questionnaire survey. The review has been carried out for the purpose of finding the drivers and the obstacles that were recognized in different preceding studies. Lastly, all the recognized drivers are characterized as External, companies, Individual, property and project and all observed barriers are grouped as Cultural, Capacity / Professional, Financial and Steering.

4.1.2 Field Survey

It includes preparing closed questionnaire forms in the light of results obtained from Previous Studies, distributing these forms among two steps the first step among a group of five experts to examined the questionnaire and corrected the errors while at the same time answering the questionnaire and the second step among individuals of the research sample to answer the questions based on 1-5 Likert scale, collecting these forms, analyzing the results statically, and then discussing the results obtained from the statistical analysis, and deriving the relative conclusions. The aim of this questionnaire is the determination of the most important Drivers & Barriers and Finally, recommendations have been suggested for the purpose of steering the construction sector towards GBs and sustainability.

4.1.3 Questionnaire Format

As a methodical approach regarding gathering data, the approach of surveying which is related to the questionnaire is a common method in soliciting professional opinions on the problems that influence adopting different innovations in the researches of construction managing [4]. Particularly, in the sustainable green building's sources also, survey is a popular approach for examining the problems that influence adopting sustainable innovations, [55], [57]. a questionnaire has been constructed for soliciting professional opinions from the Iraqi professionals in civil, architectural and environmental engineering. The questionnaire was made up of 3 parts. The first one is concerned with the information of the respondents include 5 questions (1&2 Optional). The second part is about the drivers divided into four categories about Sustainable green buildings in Iraq. The third part is about barriers divided into four categories that prevent adopting green building guidelines in Iraq. the experts have been requested for rating the value of drivers and barriers with the use of 5-point Likert-scale (1- very low, 2- low, 3-

medium, 4- high, 5- very high). The 5-point Likert scale has been chosen, due to the fact that it provides unambiguous outcomes, which are easily interpreted [72]. Appendix A includes the questionnaire.

4.2 Collection of Data and Analysis

Before conducting the survey, an initial research (pilot study) among a group of five experts has been held for testing the relevance and comprehensiveness the survey. It has been finalized according to feedbacks from this initial study. The questionnaire has been sent out by e-mail and by hand for University professors and specialists in this field including (civil engineers , architects and environmental engineers). All of the questionnaires have been sent to specialists, attaching a Word document and a weblink (for allowing on-line answers), and requesting these specialists to pass on this questionnaire to other specialists or to their co-workers. One of the main obstacles encountered in publishing the questionnaire is the lack of knowledge about the subject, in some cases, the expert does not accept the idea of receiving the questionnaire due to lack of time and Fear to answer the subject because it is a new subject and lack of information on it, in some occasions it has reached the point where some college professors ask for amounts of money to answer questionnaires. More than 150 questionnaires have been sent out. 100 questionnaires returned from the exports [55% Respondents from Civil Engineering, 28% Respondents from architecture Engineering and 17% from Environmental Engineering] see Figure 4.2. The English-Arabic version of the questionnaire was used to facilitate and speed up the process of answering questions. The ranking method of mean score in IBM SPSS was commonly utilized in earlier researches on GB for ranking and determining the main drivers and barriers among numerous individual drivers [43]. There are studies expounding certain details concerning the approach as wells as its mathematical background [72], [73]. Regarding the present research, the approach of the mean score is utilized for prioritizing obstacles, Drivers along with their categories see Tables 4.1-4.4, as viewed by specialists. In which more than one factor happen to be of identical mean scores, higher rank has been assigned to the factor which has the lowest standard deviation (SD) [74]. Identifying the crucial drivers in the twenty six GBs adoption drivers as well as identifying the crucial barriers in twenty adoption barriers is achieved via calculating the normalized values of mean scores [75]. Prior to statistical analyses, Kendall's concordance analysis has been

implemented for checking if the specialists have been reliable or not as regard to ranking different elements related to the survey questionnaire [76]. Kendall's coefficient of concordance (Kendall's W) is a non-parametric test that apply a coefficient index to determine the general agreement among sets of rankings [77]. From (0 to +1) is the possible values for the Kendall's W, as the value +1 means "complete agreement" and the value of 0 means "no agreement" in the group on the ranking of a specific set of factors. About the current study, Kendall's W, W barriers and W drivers have been 0. 0.478 and 0.329, respectively Table 4.1 and Table 4.2. It is suggested that, as (N>7), N can be defined as the number of factors ranked in all the cases, and with large value of the sample size (>20), the importance regarding an identified W must be decided via denoting the estimated distribution of Chi-square (X2) with N − 1 degrees of freedom (df). In this study, X2 drivers= 943.884, df=25; X2 barriers= 685.066, df = 19. All of them have a possibility of incidence under $p < 0.001$, signifying that the experts have a decent understanding concerning the rankings of the drivers and for encouraging the implementation of GBs. Finally, the normalized values of the mean scores were then calculated to identify the critical drivers and barriers [75].

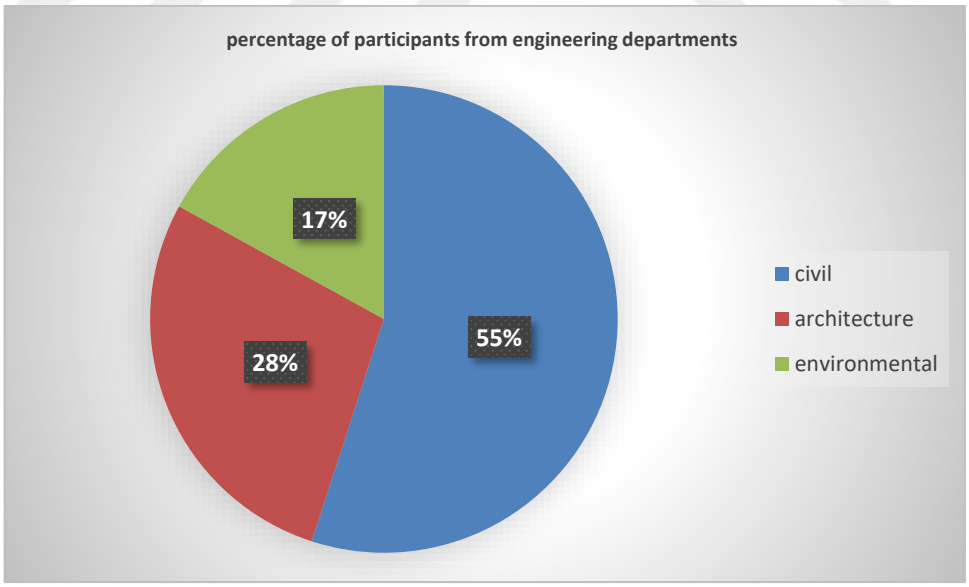


Figure 4.2 The percentage of participants in the survey

Table 4.1 Ranking of Drivers Use The Mean and Std. Deviation Method

Code	Drivers	Mean	Std. Deviation	Rank	Normalized value
X12	Energy conservation	4.19	.84918	1	1
X11	Environmental protection	4.18	.84543	2	0.99
X13	Water conservation	4.11	1.06263	3	0.96
X2	Development government legislation	4.02	1.05390	4	0.91
X4	Increase knowledge and awareness, and information	3.92	.93937	5	0.87
X1	Adoption of incentive programmers (incentive schemes)	3.8	.82878	6	0.81
X10	Resource conservation	3.74	1.01125	7	0.78
X18	Waste reduction (materials and construction wastes)	3.66	.93441	8	0.74
X20	Provide Competent team members	3.62	.92965	9	0.72
X25	Significant savings in the operational costs	3.58	1.06534	10	0.70
X24	Providing integrated design approaches	3.56	1.01822	11	0.69
X6	Demand from clients/tenants	3.41	.97540	12	0.62
X16	Achieve high building quality	3.24	1.06477	13	0.54
X3	Increase education and training	3.04	.99412	14	0.44
X14	Reduced whole lifecycle costs	3.01	1.01995	15	0.43
X7	Green building rating systems available (LEED, BREAM…etc.)	2.67	1.02548	16	0.26
X19	Improved project constructability	2.62	.95113	17	0.24
X15	Increased property values	2.58	1.05582	18	0.22
X22	New kinds of partnerships and project stakeholders	2.44	1.08544	19	0.15
X5	Promotion and communication	2.41	.81767	20	0.144
X8	Self- identify	2.36	1.13280	21	0.12

Table 4.1 Ranking of Drivers Use the Mean and Std. Deviation Method (cont'd)

X17	Reduced on-site worker health and safety risks	2.31	1.12542	22	0.09
X9	Moral imperative or social conscience	2.19	1.15203	23	0..03
X23	Ensure project cost certainty	2.17	.96457	24	0.028
X21	Decreased construction time	2.16	.98186	25	0.024
X26	Reduced labor demand and construction cost	2.11	1.00398	26	0.00

Kendall's W 0.478(a)

Chi-square 943.884

df =25

a- Kendall's Coefficient of Concordance test on the drivers among the experts.

b- Normalized value = (mean - minimum mean)/ (maximum mean - minimum mean) and the normalized value indicates that the barrier is a critical driver (normalized value must be greater than 0.50)

Table 4.2 Ranking categories of drivers

Categories	Mean	Rank
External drivers	3.14285	2
Individual-level drivers	3.09090	4
Property-level drivers	3.85714	1
Project-level drivers	2.4	3

Table 4.3 Ranking of Barriers Use The Mean and Std. Deviation Method

Code	Barriers	Mean	Std. Deviation	Rank	Normalized value
B13	Lack of GB promotion by government	4.32	.91982	1	1
Bb11	Absence of regulations and incentives from the government	4.09	.80522	2	0.89
B19	Absence of information related to green products	4.07	1.09411	3	0.88
B9	Absence of financing methods (e.g., bank loans)	4.05	.98857	4	0.87
B17	Unavailability of approved green materials and technologies	4	1.18918	5	0.84
B3	Resisting changes from the usage of old-style technologies	3.95	1.02863	6	0.82
B6	High Cost Premium	3.88	.89081	7	0.79
B1	Absence of alertness and knowledge of GB	3.66	.97670	8	0.68
B15	Absence of facilities and local institutes for (R&D) of green buildings	3.44	1.02809	9	0.58
B5	The lack of expressed interest from clients	3.4	1.09175	`10	0.56
B2	Absence of demand by stakeholders and clients	3.35	.96792	11	0.54
B4	Uncertainties and risks in implementing new technologies	3.2	1.18918	12	0.46
B8	High rental charges and market prices of GBs caused by GBTs application	3.16	1.04175	13	0.45
B12	Insufficient GB rating systems and labeling programs available	3.02	1.13689	14	0.38

Table 4.3 Ranking of Barriers Use The Mean and Std. Deviation Method (cont'd)

B7	Long payback periods from adopting GB	2.5	1.02000	15	0.13
B14	Unavailability of GB suppliers	2.49	.99995	16	0.132
B16	Absence of GBs technological training for project	2.3	1.05887	17	0.04
B10	Adoption of GB is time consuming and causes project delay and increase the cost	2.25	.94682	18	0.018
B18	Unequal Distribution of Benefits	2.24	.75371	19	0.014
B20	Longer implementation time	2.21	1.05692	20	0.00
Kendall's W 0.361(a) Chi-square 685.066 df 19					

a- Kendall's Coefficient of Concordance test on the barriers among the experts.
b- Normalized value= (mean - minimum mean)/ (maximum mean - minimum mean); The normalized value indicates that the barrier is a critical barrier (normalized value must be equal or greater than 0.50).

Table 4.4 Ranking Categories of Barriers

Categories	Mean	Rank
Cultural Barriers	3.512	2
Capacity/Professional Barriers	2.965	4
Financial Barriers	3.168	3
Steering Barriers	3.81	1

4.3 Survey Findings and Discussion

4.3.1 Ranking of Drivers

In spite of the fact that there are some barriers in implementing GB, there are still many reasons for stakeholders to implement GB. From the survey results when the specialists have been demanded to assess the criticality of 26 drivers for implementing GB in Iraq. These results have been displayed in the Table 4.1 The significance levels from Normalized value express that 13 drivers are critical drivers. also, the mean scores of all the drivers are above 3.0. There is a general suggestion taken from these results, which is the considered factors in this study are of high importance in urging the implementation of GB in the construction industry in Iraq. From the survey results the (energy conservation, mean=4.19, Normalized value=1) is ranked first, which mean that the decreased CO 2 emissions along with the energy savings, has been the major cause leading to implementing GBs, these results are in agreement with the earlier studies related to sustainable construction drivers via ("Ahn et al.2013"),[7] in the US, and ("Manoliadis et al.2006"),[43] in Greece, also, these results are in agreement with ("Brotman.2016"),[78], who suggested that the costs for energy are the main cause leading to implementing GBs. In various advanced nations, energy efficiency is considered of high importance. In the United States, the Department of Energy, which might be abbreviated to (DOE) is considered one of the most recognized government agencies for ensuring the security and the wealth of the nation via encountering the energy challenges, the nuclear and environmental challenges via technological and scientific transformation resolutions [79]. This study proposes that the stakeholders should place value on applying GBs, as it assists them to achieve efficient buildings of high energy. Nowadays, stake-holders are attempting to find approaches for reducing their costs for energy and identifying that the innovative solutions might decrease using energy by 25-40 percent. After energy conservation, (Environmental protection, mean=4.18, Normalized value=0.99) has taken second place by ranking from experts as the main drivers to implement GB, the possibilities of practicing GB in guaranteeing that buildings added by stakeholders the inventory are efficiently designed and less energy-consuming, thereby, helping in the reduction of the impacts of buildings on the environment. That protecting the environment is one of the important issues that promote the implementation of GB. It has been stated that reduced influence on the environment provides a motivation for stakeholders to implement GB [6]. The findings of this research give evidence

concerning the fact that the third main driver behind adopting GB is (Water conservation, mean=4.11, Normalized value=0.96), which coincided with the findings of (Zhang (2011),[80], GB like the technology of permeable surface depending on the installed appliances, irrigation practices, etc. water reusing and water-saving appliances decrease the impact on the quality of water for gaining water efficiency. The forth driver in this study is (Development Government legislation mean=4.02, Normalized value=0.91), The interviews and survey which examined the drivers to green existing and new buildings in Singapore suggested that all respondents were certain about the significance of the polices and legislations of the government to promote green buildings [45], this came in accordance with the study of (Russo and Bernstein 2013),[46], that suggested that the actions of the government, particularly the regulations concerned with environment impacted the adoption level of GB. In Malaysia, (Khoshnava et al. 2014), [81], implemented a survey between many stake-holders, involving manufacturers, suppliers, consultants and customers for identifying the main elements for adopting sustainable and green buildings in the construction field related to industrial construction system, the results of the survey were that (58.3%) of respondents specified that the effect of policies and legislations has been higher than the other drivers. The fifth driver is (Development Knowledge and awareness, and information mean=3.92, Normalized value=0.87), The researchers highlighted the importance of increasing knowledge and awareness in the course of shifting the behavior and attitude stake-holders towards adopting GBs. identified that communication strategies, such as television programs and generic marketing have considerable urged using wood as a sustainable solution for GBs in United Kingdom [6]. To penetrate the market more effectively in GBs, it is necessary to rise the environmental and knowledge alertness for all stake-holders, and particularly for improved disseminating for the information along with the demand. The six driver is (Incentive schemes, mean=3.8. Normalized value=3.81), Incentive plans are considered as standard for promoting GBs and increase the enthusiasm of stake-holders for meeting high standards [82]. The financial incentives and host in the market are very important in the process of enhancing implementing GBs, due to the advantages it offers to stake-holders that are implementing GBs. The efforts and additional costs needed for including GBs in projects of stake-holders are compensated via the incentives offered by the financial institutions and local governments. The results offered by this study implies that simulating the demands of GBs could be done via incentives, allowances and associated tax credits. from the results the seventh diver is (Resource conservation, mean=3.74,

Normalized value=3.81), They believe the probability of maintaining limited resources increased the popularity of GB. according to the finding of this study resources (Manoliadis, Tsolas, and Nakou 2006), [43], Reduce the consumption of resources in green buildings less than other non-green buildings because it uses an integrated design method that reduces waste of. Being ranked through the specialists, other highly-ranked motivations and have significant Normalized value for involving in adopting GBs consist of: (Waste reduction (materials and construction wastes), (Provide Competent team members), (significant savings in the operational costs), (Providing integrated design approaches), (Improve the well-being of employees), (Development of company policies),(improving occupants' productivity),(Demand from clients/tenants),(improving indoor environmental quality),(achieve high building quality),and the last critical driver is (Competitive advantage, mean=3.23, Normalized value=0.53).

The first not critical driver from the results is (increase education and training, mean=3.04, Normalized value=0.44) this result Contradicts with the results of some researchers who see it as a major driver of green construction like (Potbhare et al 2009),[54] GBs education along with the training champions might assist in building the knowledge of stakeholders on the current marker of GBs, benefits and system performance might spur implementing GBs. Education via improved flow of communication and information is highly important to the level of awareness and knowledge of public and customers in order to understand the benefits of green building [51]. As a result of this driver is not very contradictory, because it ranks 14 among 26 drivers, because there is a priority on this driver due to the fact that the rate of education in Iraq is very high, only lack of experience in the field of green construction. On the contrary, respondents disagree that (ensure project cost certainty), (Decreased time of construction), (reduced costs for construction and labor demands), are the project-level drivers behind the Iraqi green building market, they occupy the last three drivers. Generally, the climatic conditions, locations to implement various GB levels, the type of the building are all construct the base for assessing the costs related with GBs. Actually, there is no solid evident that the cost of adopting GBs is less than traditional buildings. According to several studies, the GBs might increase the initial capital cost. Apart from, ("Langdon 2004"), [83], suggested that various projects might implement sustainable design with small supplemental funding or within their budget. ("Yudelson 2008"), [36], suggested that relations with the public could deliver money benefits like acquiring

approvals from the government or decreasing resident disapproval to projects for private developers. Concerning the decreased time of construction, ("Kats et al. 2003"), [57] suggested that increased cost modelling and architectural design time are caused by integrating sustainable construction applications into projects.

4.3.2 Ranking of Barriers

There still are limitations that face the success and popularity of adopting GB in Iraq. From the survey results when the specialists have been asked to assess the criticality regarding 20 barriers that prevent for implementing GB in Iraq. In Table 4.3, a summarization of the survey's results will be presented. The significance levels from Normalized value indicate that 11 barriers are critical barriers. also, the mean scores of all the drivers are above 3.0. The results of the study conclude that (the governmental lack of promoting GB, mean=4.32. Normalized value=1) and (lack of government incentives and regulations, mean=4.09, Normalized value=0.89) As the two most important, there is research that matches these results like ("Chan et al. 2009"),[77] and ("Zhang et al. 2010"),[80], suggest that the support offered by the government is not enough, this support comes in terms of accelerating GBs through incentives and policy implementations. Stakeholders want to see the direct intervention of the advocates and policy makers in the GBs market as additional efficient incentives for supporting implementing GB. Efficient incentives can encourage market stakeholders in pursuing GB. On the other hand, in the case where stakeholders are not capable of receiving efficient support of the government, it would be hard to bear the more expenses of GB. Although lack of government support appears to be an obstacle to the development of green buildings, government incentives, policies and standards are an efficient means of encouraging adopting GBs. As one of the most significant barriers for the implementation of GB in Iraq (Absence of information related to green products, mean=4.07, Normalized value= 0.88) was the third barrier, was considered as the most critical barriers, this high rank coincides with the results of a previous study by (Hwang and Tan. 2012), [69] There is still no sufficient amount of information about green product and sustainable systems of constructions, which may be implemented in GB. Lack of information and studies about GBs is the main reason for the general absence of vigilance and knowledge. Also, Bond (2011a) [59] stated that the absence of information and cost are main obstacles related to GBs New Zealand and Australia and there is a necessity from the team to offer

better information regarding the tools and products for achieving sustainable constructions.

As a critical obstacle to adopting green buildings in Iraq (absence of financing approach (for example, loans from banks), normalized value =0.78, mean=4.05) took the 4th position, these results indicate that the financial/economic issues are vital for developing and implementing green buildings in Iraq. As an obstacle in implementing green buildings, is very much associated to the barrier (normalized value=0.79, mean=3.88, High Cost Premium) has been ranked 7th position in this study.

It is crucial to implementing green buildings due to the fact that in the case of lacking financial foundation, stake-holders and companies might not have the ability to use and purchase expensive green buildings. For the purpose of overcoming the absence of funding systems, financial institution and banks should offer some financial support, such as grants and soft loans for implementing green buildings. Another approach for promoting green buildings is the learning for other nations experience. Banks in Hong Kong offer loans without complications for financing projects adopting GBs [84].

Using the financing schemes of PPPs in GBs might offer a chance to handle the deficiency of a barrier to financing systems. The 5th barrier has been (absence of appropriate green technologies and materials, normalized value=0.84, mean=4), some difficulties have been encountered in finding and researching green technologies and materials, like (Turbines, solar cells content, recycling, and so on), this was due to the fact that green materials are considered more costly than standard materials.

For overcoming this difficulty, an attempt is made to find other materials, also the diversity and production of local materials must be improved to decrease the cost of green materials. The 6th obstacle preventing adopting GBs has been (refusal to go along with the change from using old-style technologies, normalized value=0.82, mean=3.95), refusing to utilize the modern technologies, as they might involve unexpected costs, risks, difficult application, requiring integration, operation and change in the building.

Naturally, individuals are unwilling to change, this could be mainly accurate in the construction field in which liability is considered as a critical issue [85]. Opposition from the public and the stake-holders could cause harm to the success of adopting GBs. The industry of construction is distinguished via the quite slow innovation rates. The industry of construction in the United States is usually recognized to be an innovation laggard,

because of its diversity and size, and small investments in demonstration and research [86].

These subjects could clarify why resisting the change is crucial obstacle. An exciting discovery is that Participants didn't observe (implementing GBs increase the costs, cause delays in the project and consume much time, mean=2.25) has been ranked 18, that didn't happen with the past studies, it has been anticipated that the time might receive higher criticality barriers which prevents implementing GBs. The reason for this for example due to the fact that the majority of GBT were yet to be completed so implementing them would cause problems which result in the project to be delayed [68]. Also, more time is required for efficiently integrating all the needed technologies in green design.

4.3.3 Differences In Perceptions Between The Civil and Others Engineering for Adoption GB Drivers.

In this case it was used two tests as shown as follows:

1-Spearman's Rank Correlation (Rs): this test has been implemented for measuring the level of accordance between the civil Engineering group and others (architecture and Environmental Engineering group) in their ranking behavior [77].

The correlation results indicate the calculated (Rs) for the drivers is= 0.947 with a considerable level of 0.000, this signifies considerable correlation and consensus between the two groups. For example, as shown in Table 4.5, both (Water conservation) and (Development Government legislation) ranked 3 and 4, respectively, they have the same ranked in both groups.

$$Rs=1-\frac{6\cdot\sum d\text{^}2}{n(n^2-1} \quad (4.1)$$

n = number of rank drivers

d = deference between ranks

$$Rs=1-\frac{6\cdot 94}{26(676-1)}$$

Rs= 0.967

Table 4.5 Calculating Spearman's Rank Correlation for GB Drivers Between Civil and Others Engineering

Code	Rating Means		Ranks		d= (rank civil-rank others)	D^2
	Civil	Others	Civil	Others		
X12	4.2182	4.1556	1	2	-1	1
X11	4.2	4.2	2	1	1	1
X13	4.1455	4.0667	3	3	0	0
X2	4.0727	3.9556	4	4	0	0
X4	3.9636	3.8667	5	6	-1	1
X10	3.8182	3.7556	6	8	-2	4
X25	3.7273	3.4	7	11	-4	16
X1	3.7091	3.9111	8	5	3	9
X18	3.6727	3.6889	9	9	0	0
X20	3.6364	3.6	10	10	0	0
X6	3.4545	3.3556	11	12	-1	1
X24	3.3636	3.8	12	7	5	25
X16	3.2182	3.2222	13	13	0	0
X3	3.0727	3	14	15	-1	1
X14	2.9273	3.1111	15	14	1	1
X7	2.7091	2.8	16	16	0	0
X19	2.6727	2.5556	17	18	-1	1
X15	2.5636	2.6	18	17	1	1
X22	2.4909	2.3778	19	21	-2	4
X8	2.3818	2.4222	20	19	1	1
X17	2.3273	2.2889	21	23	-2	4
X5	2.2909	2.4	22	20	2	4

Table 4.5 Calculating Spearman's Rank Correlation for GB Drivers Between Civil and Others Engineering (cont'd)

X23	2.2	2.1333	23	26	-3	9
X21	2.0909	2.2444	24	24	0	0
X9	2.0727	2.3333	25	22	3	9
X26	2.0182	2.2222	26	25	1	1
					Sum=0	94

2-Analysis of Variance (ANOVA): this test has been implemented for determining if the differences in mean scores are from 2 respondent groups. ANOVA can be defined as a common approach utilized for comparing mean scores from 2 or more groups [87]. according to SPSS ANOVA test the significance values of 26 drivers=0. 837, was greater than 0.05 as shown in Table 4.6, so these results signify that there has been no considerable difference in the perception of criticality regarding these obstacles from civil and others engineering fields.

Table 4.6 The ANOVA Test for Derivers Between Groups

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	12.500	50	.250	.500	.837
Within Groups	.500	1	.500		
Total	13.000	51			

4.3.4 Differences In Perceptions Between The Civil and Others Engineering for Adoption GB Barriers.

1-Spearman's Rank Correlation (Rs) test was also adopted to measure the level of agreement between the civil Engineering group and others (architecture and Environmental Engineering group) in their ranking behavior [77].

The correlation results indicate the calculated (Rs) for the barriers is= 0.914 with a significance level of 0.000, This indicates significant consensus and correlation between the two groups. For example, as shown in Table 4.7, both (Lack of GB promotion by government) and (lack of government incentives and regulations) ranked 1 and 3, respectively, they have the same ranked in both groups.

$$Rs=1-\frac{6\cdot 114}{20(400-1)} \quad (4.1)$$

Rs= 0.914

n = number of rank drivers

d = deference between ranks

Table 4.7 Calculating Spearman's Rank Correlation for GB Barriers Between Civil and Others Engineering.

Code	Rating mean		Ranks		d= (rank civil-rank others)	D^2
	Civil	Others	Civil	Others		
B13	4.4545	4.1333	1	1	0	0
B19	4.4	3.6889	2	7	-5	25
B11	4.2182	3.9111	3	3	0	0
B9	4.1818	3.8667	4	5	-1	1
B17	4.0727	3.8889	5	4	1	1
B3	4.0545	3.8	6	6	0	0
B6	3.8545	4.0222	7	2	5	25
B1	3.8364	3.4	8	8	0	0
B15	3.7818	3.0889	9	13	-4	16
B5	3.4909	3.3778	`10	9	1	1
B2	3.3455	3.2889	11	10	1	1

Table 4.7 Calculating Spearman's Rank Correlation for GB Barriers Between Civil and Others Engineering. (cont'd)

B4	3.1636	3.2444	12	11	1	1
B8	3.1455	3.1556	13	12	1	1
B12	3.0364	2.9778	14	14	0	0
B14	2.6	2.3778	15	17	-2	4
B16	2.3091	2.2667	16	18	-2	4
B18	2.2909	2.1778	17	20	-3	9
B7	2.2909	2.7111	18	15	3	9
B20	2.2105	2.2	19	19	0	0
B10	2.0909	2.4667	20	16	4	16
					Sum=0	Sum=114

2-Analysis of Variance (ANOVA) test was performed to determine whether the differences in mean scores from two respondent groups. ANOVA is a widely used method that is suitable for comparing the mean scores from tow or more groups [87]. according to SPSS ANOVA test the significance values of 20 barriers =0.553, was greater than 0.05 as shown in table (4.8).so the result indicates that there were no statistically significant differences in the perceptions of the criticality of these barriers from civil and others engineering.

Table 4.8 The ANOVA Test for Barriers Between Groups

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.194	1	.194	.359	.553
Within Groups	20.515	38	.540		
Total	20.709	39			

4.4 Provide Solutions and Recommendations

recommendations are suggested in order to guide the construction sector towards sustainability and to overcome GB barriers.

1- Solutions for Government

In this study the development Government legislation has been classified as an important factor to help improve the green building market. And the Lack of GB promotion by government, deficiency regulations and incentives from the government as the major 2 obstacles preventing the implementation of GBs in Iraq. Government are highly important in providing regulations and incentives for organization to implement GBs in their projects. Governments could accelerate the adaptation of GBs through the below-mentioned list of initiatives [54], ([64], [88]:

- Provide tax benefits and subsidies to adopters and stakeholders.
- All the buildings of the government must be obliged to adopt a level of green certificate.
- Applying laws and regulations for green building.
- Offering funding and research to non-governmental organizations and environmental groups.
- A flexibility could be applied on regulations related to water, recycling and energy.
- Buildings which have adopted and achieved high standard levels of GBs could have some policies of tax reduction.

2- Solutions for Absence of Information

- The main sources of information to raise the awareness for adopting GBs in Iraq are print media, television programs and radio, other important sources could be internet, workshops, seminars and education [54].

- Some examples of development are offering valid information on benefits and cost of GBs, offering information regarding the guidelines of GBs and indicating GB projects in nations who have adopted the guidelines of GBs.

3- Solutions for lack of Financing Mechanism

- For the purpose of overcoming the absence of barrier funding systems, financial institutions and banks should offer financial support, such as grants and soft loans for adopting GBs.
- Using PPPs financing systems in the field of GBs might offer a chance to handle the lack of barrier to financing systems [89].
- The needed incentive should be formed via delivering tax benefits, in this case the whole costs of energy in the nation will considerably decrease in the future.

4- Solutions for unavailability of approved green materials

- To overcome this difficulty, alternative materials are sought, and the production and diversity of local materials must be increased for the purpose of reducing the cost of green materials.

5- Solutions for Lack of Knowledge and Awareness of GB

- Education through a better flow of communications and information is highly important on the level of awareness and knowledge of public and customers so as to understand the benefits of adopting GBs. communication strategies, such as television programs and generic marketing, have motivated using wood as sustainable solution for GBs in the United Kingdom construction [6].
- Seminars and workshops are major sources of information to offer awareness regarding GBs [54].

CHAPTER 5

RESULTS AND DISCUSSION

5.1 Conclusıon

It has been expected that adopting GB in constructions will keep growing. This paper researches the main issues that influence adopting GB from the point of view of the Iraqi GB experts. Therefore, taking under consideration the small number of empirical researches on problems that influence adopting GB, this research adds a contribution to the literature by pointing out the main problems for Iraqi GB market stakeholders. It has been concluded that numerous problems impact and determine implementing GB. Many different agents and limitation of adopting GB have been determined and detected with the use of a set of research approaches, such as literature reviews and a questionnaire survey.

The problems that influence adopting GB have been analyzed in detail with the use of ranking approach, thereby ensuring a clear comprehension about the main problems that should be addressed in implementing GBs promotion attempts. This research has studied twenty six drivers and twenty barriers from the point of view of experts in Iraq. Concerning GB adoption drivers, the top five drivers:

- Energy conservation
- Environmental protection
- Water conservation
- Development Government legislation
- Development Knowledge, awareness and information

This study proposes that the stakeholders should place value on applying GBs, as it assists them to achieve efficient buildings of high energy. Nowadays, stakeholders are attempting to find approaches for reducing their costs for energy and identifying that the innovative solutions might decrease using energy by 25-40 percent.

The protecting the environment is one of the important issues that promote the implementation of GB. the possibilities of practicing GB in guaranteeing that buildings added by stakeholders the inventory are efficiently designed and less energy-consuming, thereby, helping in the reduction of the impacts of buildings on the environment.

Green Buildings like the technology of permeable surface depending on the installed appliances, irrigation practices, water reusing and water-saving appliances decrease the impact on the quality of water for gaining water efficiency.

All respondents were certain about the significance of the policies and legislations of the government to promote green buildings.the support offered by the government is not enough and it is must devlopment, this support comes in terms of accelerating Green Buildings adoptions through incentives and policy implementations.

The most critical barrier being:

- Lack of GB promotion by government
- Lack of regulations and incentives by the government
- Deficiency of Green Product Information
- Absence of financing mechanism
- Absence of approved green materials and technologies

The findings of this research show a consensus in rankings among the experts of GB, as it has been confirmed via the Kendall's concordance coefficient.

A flexibility could be applied on regulations related to water, recycling and energy.Whereas the recognized limitations have been highlighted in this research as limitations inhibiting GB implementing, the majority of those limitations could be offset or otherwise overcome via benefitting from the identified drivers.

Research, education and support offered by the government could eliminate most of these obstacles. Stakeholders and banks must realize the value and benefits of GBs to create a shift in the market demand.

In addition, the results of the respondents were compared between civil engineers and other engineers. Spearman's test has been implemented for measuring the level of accordance between the civil Engineering group and others, both the drivers and barriers results indicate a considerable correlations and consensus between the two groups. the ANOVA test has been implemented for determining if the differences in mean scores are from tow respondent groups. Barriers and drivers result there have been no statistically considerable differences in the perceptions. The results of this study are expected to be contributing in information that is useful for policy-making in the industry of constructions and in future implementations of GB. The results play a role in deepening the understanding concerning the main problems influencing implementations of GB. The findings are relevant for the Iraqi GB market, and could as well be applied for policy makers in some of the other countries. In addition to that, foreign parties attempt developing GB and therefore utilize GB in Iraq could gain experience from the opinions of local experts on GB.

5.2 Future Researches

There are some issues of this research warranting the attention of future researches. Firstly, even though the size of the sample size sufficient for conducting statistical analyzing, it’s taken under consideration that it’s still a rather small sample. Future researches are required for employing a bigger sample, in order to see if the findings would be different from the results that were reported in this study, and to take a comprehensive picture of the driving factors and factors that prevent implementation green buildings. Secondly, future researchers could utilize more Other methods can be used in statistical analysis for other results.

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APPENDIX-A

DRIVERS AND BARRIERS IN IRAQ

YILDIZ TECHNICAL UNIVERSITY

CIVIL ENGINEERING FACULTY/ CIVIL ENGINEERING DEPARTMENT

A research project is being carried out by the Department of Civil Engineering at Yildiz Technical University on the subject of (Identify Drivers & Barriers for Adopting Sustainable Green Buildings in Iraq). The aim of this study is the determination of the most important Drivers & Barriers and suggestion solutions for this.

This questionnaire consists of three parts. The first part about the information of the respondents include 5 questions (1&2 Optional). The second part is about the drivers about Sustainable green building guidelines in Iraq. The third part is about barriers that prevent adopting green building guidelines in Iraq. This questionnaire will be completed in approximately 15 minutes. We are aware that this study can be performed with your participation and we appreciate your efforts. Thank you very much for participation in this study and your valuable contribution. You can ask your questions about the questionnaire by sending emails to (Mustafa_Alazawi9@yahoo.com)

يجري تنفيذ مشروع بحثي من قبل قسم الهندسة المدنية في جامعة يلدز للتكنولوجيا حول موضوع "تحديد الدوافع والعقبات لاعتماد المباني الخضراء المستدامة في العراق". الهدف من هذه الدراسة هو تحديد أهم الدوافع والحواجز لتبني الابنية المستدامة الخضراء واقتراح حلول لذلك.

يتكون هذا الاستبيان من ثلاثة أجزاء. الجزء الأول عن معلومات المستفتيين يشمل 5 أسئلة (1 & 2 اختياري). الجزء الثاني هو حول دوافع المبادئ التوجيهية للبناء الأخضر في العراق. الجزء الثالث هو عن الحواجز التي تمنع اعتماد المبادئ التوجيهية للبناء الأخضر في العراق. سيتم الانتهاء من هذا الاستبيان في حوالي 15 دقيقة. نحن ندرك أنه يمكن إجراء هذه الدراسة بمشاركتك ونقدر جهودك. شكراً جزيلاً لكم على المشاركة في هذه الدراسة وعلى مساهمتكم القيمة. يمكنك طرح أسئلتك حول الاستبيان عن طريق إرسال رسائل البريد الإلكتروني إلى (Mustafa_Alazawi9@yahoo.com)

Part 1: Demographic Information: Please answer the questions about yourself.

1. Name (Optional):
   _____

2. Email Address (Optional):
   _____

3. Professional Affiliation (Choose one or more of the following options)

   - ☐ Civil Engineer
   - ☐ Architect Engineer
   - ☐ Environment Engineer
   - ☐ Sustainable Building Consultant
   - ☐ Others: _____

4. Education of the respondent
   _____

5. Name & Address of your Organization:
   _____

Notes: GB= Green buildings
GBT=Green buildings technology

Email to receive answers: Mustafa_Alazawi9@yahoo.com

Part 2: What are the drivers that adopting green building guidelines in Iraq? based on 1-5 Likert scale. Please perform this evaluation by considering the importance of these Drivers. (1- very low, 2- low, 3- medium, 4- high, 5- very high)

Drivers for green buildings	1	2	3	4	5
1-**External drivers** الدوافع الخارجية					
Adoption of incentive programmes (incentive schemes) اعتماد برامج الحوافز					
Government legislation تشريعات الحكومة					
Education and training التعليم والتدريب					
Knowledge and awareness, and information المعرفة والوعي والمعلومات					
Promotion and communication تعزيز والاتصالات					
Demand from clients/tenants الطلب من العملاء / المستأجرين					
Green building rating systems available (LEED, BREEM…etc.) نظم تصنيف المباني الخضراء					
Comment:					
Marketing benefits (Marketing / branding motive) فوائد التسويق (الدافع التسويقي / العلامة التجارية					
Comment:					
2- **Individual-level drivers** الدوافع على المستوى الفردي					
Self identify to improve professional identity by doing ‘high quality work’ or ‘very nice job’ التحديد الذاتي لتحسين الهوية المهنية من خلال القيام بـ "عمل بجودة عالية" أو "عمل جيد جدًا"					

Moral imperative or social conscience حتمية أخلاقية أو ضمير اجتماعي					
Comment:					
3- P**roperty-level drivers** الدوافع على مستوى الممتلكات					
Resource conservation الحفاظ على الموارد					
Environmental protection حماية البيئة					
Energy conservation الحفاظ على الطاقة					
Water conservation المحافظة على المياه					
Reduced whole lifecycle costs خفض تكاليف دورة حياة كاملة					
Increased property values زيادة قيم العقارات					
Achieve high building quality تحقيق جودة بناء عالية					
Comment:					
4- P**roject-level drivers** الدوافع على مستوى المشروع					
Reduced on-site worker health and safety risks تخفيض مخاطر الصحة والسلامة للعمال في الموقع					
Waste reduction (materials and construction wastes) تقليل النفايات (المواد ومخلفات البناء)					
Improved project constructability تحسين بناء المشروع					
Provide Competent team members أعضاء فريق مختص					
Decreased construction time تقليل وقت الانشاء					
New kinds of partnerships and project stakeholders أنواع جديدة من الشراكات وأصحاب المصلحة في المشروع					

Ensure project cost certainty زيادة المصداقية وعدم الشك في وقت الانشاء					
Providing integrated design approaches توفير مناهج التصميم المتكاملة					
Significant savings in the operational costs وفورات كبيرة في تكاليف التشغيل					
Reduced labour demand and construction cost انخفاض الطلب على العمالة وتكلفة البناء					

Part 3: What are the barriers that prevent adopting green building guidelines in Iraq? based on 1-5 Likert scale. Please perform this evaluation by considering the importance of these barriers. (1- very low, 2- low, 3- medium, 4- high, 5- very high)

Barriers for green building عوائق البناء الاخضر	1	2	3	4	5
1-Cultural Barriers الحواجز الثقافية					
Absence of knowledge and awareness of GBT نقص المعرفة والوعي لتكنلوجيات البناء الاخضر					
Absence of demand by clients and stakeholder نقص الطلب من قبل العملاء وأصحاب المصلحة					
Resistance to change from the use of traditional technologies مقاومة التغيير من استخدام التقنيات التقليدية					
Risks and uncertainties involved in adopting new technologies المخاطر والشكوك التي ينطوي عليها اعتماد تكنولوجيات جديدة					
Absence of expressed interest from clients عدم الاهتمام المعلن من العملاء					
Comment:					

2-Financial Barriers الحواجز المالية					
High Cost Premium عالية التكلفة					
Long payback periods from adopting GBT فترات استرداد طويلة من اعتماد تكنلوجيات البناء الاخضر					
High market prices and rental charges of green buildings resulting from GBT application ارتفاع أسعار السوق ورسوم استئجار المباني الخضراء الناتجة عن تطبيق تكنلوجيات البناء الاخضر					
Absence of financing mechanism (e.g., bank loans) نقص آلية التمويل (على سبيل المثال القروض المصرفية) ،					
Adoption of GBTs is time consuming and causes project delay and increase the cost هو مضيعة للوقت ويسبب تأخير المشروع اعتماد وزيادة التكلفة					
Comment:					
3-Steering Barriers حواجز التوجيه					
Absence of government incentives and regulations عدم وجود الحوافز واللوائح الحكومية					
Insufficient GB rating systems and labeling programs available عدم توفر انظمة تقيم البناء الاخضر وبرامج وضع العلامات المتاحة					
Absence of GB promotion by government عدم وجود تعزيز البناء الاخضر من قبل الحكومة					
Comment:					

4-Capacity/Professional Barriers حواجز القدرة/المهنية					
Unavailability of GBTs suppliers عدم توفر موردي تكنلوجيات البناء الاخضر					
Absence of local institutes and facilities for research and development of GB عدم وجود معاهد ومرافق محلية للبحث والتطوير					
Absence of green building technological training for project عدم وجود تدريب تكنولوجي على المباني الخضراء للمشروع					
Uavailability of approved green materials and technologies عدم توافر المواد والتقنيات الخضراء المعتمدة					
Unequal Distribution of Benefits التوزيع غير المتكافئ للمزايا					
Absence of Green Product Information نقص معلومات المنتجات الخضراء					
Longer implementation time وقت تنفيذ أطول					
Comment:					

CURRICULUM VITAE

PERSONAL INFORMATION

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EDUCATION

Degree	Department	University	Date of Graduation
High School	Al - Kindi High School		1/6/2010
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WORK EXPERIENCE

Year	Corporation/Institute	Enrollment
2015	ayadi alkhayr company	10/2/2015
2015	Subcontractor/private sector	1/7/2015

PUBLISHMENTS

Papers

1-Alazawi, M.J., Gürgün, A.P.,(2018). " Identify Drivers and Barriers for Adopting Green Buildings in Iraq and discussion for the top ranks" Arid International Journal for Science and Technology,DOI Number/Link