STRATEGIES AND POLICY OF GREEN DESIGN IMPLEMENTATION IN BUILDING PROJECTS OF LIBYA

MOHAMED AKREIM

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STRATEGIES AND POLICY OF GREEN DESIGN IMPLEMENTATION IN BUILDING PROJECTS OF LIBYA

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ABSTRACT

STRATEGIES AND POLICY OF GREEN DESIGN IMPLEMENTATION IN BUILDING PROJECTS OF LIBYA

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As to the climatic change, global warming and lack of resources, sustainable or the 'green' design issue has trended into a major measurement in the construction industry. Sustainable projects take not only environmental, but also economic and social factors into consideration. Although there are many studies in literature that focus on taking into account the surrounding environment during the design stages of buildings to reduce their impacts on the environment, unfortunately, there is a big gap between theory and its applications on ground, especially in Libyan building projects. The literature review revealed that there are no studies that evaluate the performance of building projects in Libya, as well as regarding the performance of design teams and policies to mitigate the impact of buildings on the environment. Therefore, it is essential to analyse the situation in Libya considering its built environment, in order to determine the factors that affect the implementation of green design.

The aim of this study is to produce a theoretical framework that focuses on the investigation of motivators and barriers factors that affect the decision-makers and how they affect the implementation of green design in Libyan building projects. The research also aims to determine the role of each of the participants in a project, which are the owner and the design team for the application of green building design in construction projects in Libya. In addition, the study also aims to identify the strategies and policies that are needed to accelerate the green building movement in the Libyan construction sector. The literature review, questionnaire survey and semi-structured interviews were the three main stages of data collection that were employed to achieve the objectives of the study. The data presented in this thesis is mainly

obtained from a comprehensive questionnaire survey developed on the basis of an in-depth literature search. The questionnaire was completed with 74 building experts from Libya who have an interest on this topic or who have involvement in building industry. The Statistical Package for Social Science (SPSS) version 25 was used in the data analysis for both descriptive and inferential statistics and the results are evaluated in detail. In addition, 10 semi-structured interviews were conducted with selected architects and consulting engineers who responded to the final questionnaire survey. The study concludes that the green buildings are unpopular in Libya and are still in their early stages. This is noted by the absence of strategies, policies and regulations that encourage the adoption of green design concept in the building projects of Libya. The findings of this study may help to understand the real needs of developing green buildings in the Libyan construction sector. Finally, recommendations were presented for the government, designers and owners to guide the construction sector towards sustainability.

Keywords: Green Design, Motivators, Barriers, Strategies, Policy, Libyan Building Project.

ÖZ

LİBYA'DAKİ YAPI PROJELERİNE YEŞİL TASARIM UYGULAMA STRATEJİLERİ VE POLİTİKASI

Mohamed AKREIM

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Danışman: Dr. Öğr. Üyesi Özge SÜZER

Aralık 2018

İklim değişikliği, küresel ısınma ve kaynakların tükenmesi sebebiyle, sürdürülebilir veya 'yeşil' tasarım konusu yapım endüstrisinde önemli bir ölçüt haline gelmiştir. Sürdürülebilir projeler yalnızca çevresel değil, ekonomik ve sosyal faktörleri de göz önünde bulundurmaktadırlar. Literatürde, yapıların çevreleri üzerindeki etkilerini azaltmaları için, tasarım sürecinde çevrenin dikkate alınması konusuna odaklanan çokca çalışma bulunmasına rağmen, maalesef özellikle Libya'daki yapı projelerinde, teori ile uygulama arasında büyük bir boşluk bulunmaktadır. Yapılan literatür taraması, yapıların çevresel etkilerini azaltmaya yönelik olarak, Libya'daki yapı projelerinin ve tasarım ekiplerinin performanslarını değerlendiren çalışmaların veya politikaların bulunmadığını ortaya koymuştur. Dolayısıyla, yeşil tasarımın uygulanmasını etkileyecek faktörlerin belirlenmesi adına, Libya'daki durumun, yapılı çevresi bağlamında analiz edilmesi önemlidir.

Bu çalışmanın amacı, Libya'da yapı projelerinde yeşil tasarımın uygulanması bağlamında, karar mercilerini etkileyen *teşvik edici* ve *engelleyici* faktörleri araştırmaktır. Ayrıca bu araştırma, Libya'da yeşil yapıların uygulama projelerinde, yatırımcı ve tasarım ekibinden oluşan katılımcıların rollerini belirlemeyi amaçlamaktadır. Bunlara ek olarak çalışma, Libya'da yeşil yapılaşma akımına ivme kazandırmak için gereken strateji ve politikaları belirlemeyi hedeflemektedir.

Bu çalışmanın hedeflerine ulaşmak için ortaya konan üç ana veri toplama aşaması; literatür taraması, anket uygulaması ve yarı-yapılandırılmış görüşmelerdir. Bu tezde sunulan veriler temel olarak, derinlemesine yapılan literatür araştırmasını baz alarak

oluşturulan kapsamlı anket çalışmasına dayanmaktadır. Anket, yapı endüstrisine dahil olan ve konu ile ilgilenen 74 yapı uzmanı ile tamamlanmıştır. Betimleyici ve çıkarımsal istatistik veri analizleri için Statistical Package for Social Science (SPSS) programı 25 versiyonu kullanılmış ve sonuçlar detaylı şekilde değerlendirilmiştir. Bunların yanı sıra, ankete katılmış olan seçilmiş 10 mimar ve danışman mühendis ile yarı-yapılandırılmış görüşmeler gerçekleştirilmiştir. Bu çalışma, Libya'da yeşil yapıların popüler olmadığı ve halen konu ile ilgili sürecin erken aşamalarında bulunulduğuna kanaat getirmiştir. Bu durum, Libya'da yapı projelerinde yeşil tasarım kavramının benimsenmesini teşvik edecek stratejiler, politikalar ve yönetmeliklerin eksikliği ile kanıtlanmaktadır. Bu çalışmanın bulgularının, Libya'da yapım sektöründe yeşil binaların geliştirilmesi bağlamında, gerçek ihtiyaçları anlamaya yardımcı olacağı düşünülmektedir. Sonuç olarak, yapım endüstrisini sürdürülebilirliğe yönlendirebilmek için; hükümet yetkilileri, tasarımcılar ve yatırımcılar için öneriler sunulmuştur.

Anahtar sözcükler: Yeşil Tasarım, Teşvik Ediciler, Engeller, Stratejiler, Politika, Libya Yapı Projeleri.

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LIST OFABBREVIATIONS

WCED:	The World Commission on Environment and Development.
CIB:	Conseil International du Batiment
USGBC:	United States Green Building Council
GECOL:	General Electric Company of Libya
UNDP:	United Nation Development Program
USEPA:	United States Environmental Protection Agency
WGBC:	World Green Building Council
LEED:	Leadership in Energy and Environmental Design
BREEAM:	Building Research Establishment Environmental Assessment Methodology
CASEE:	Comprehensive Assessment System for Building Environmental Efficiency
GBT:	Green Building Technology
HVAC:	Heating, ventilation, and Air Conditioning
CIDB:	Construction Industry Development Board
BCA:	Building and Construction Authority
CIIGBC:	Confederation of Indian Industry Green Business Centre
GBCN:	Green Building Council of Nigeria
EGBC:	Egyptian Green Building Council
GPRS:	Green Pyramid Rating System
SPSS:	Statistical Package for the Social Sciences
SWOT:	Strength-Weakness-Opportunity-Threat analysis

CHAPTER I
INTRODUCTION

1.1 Overview

Traditionally, construction project performance is measured on the basis of cost, time and quality. Recently, due to climate change, global warming and lack of resources, the environmental issue has turned into a major measurement in the construction industry [1]. Sustainable projects take into consideration economic factors, environmental factors, and social factors. Environmental factors have become more significant among the three factors of sustainability [2].

The term *"Sustainability"* appeared since the realization of global warming. In 1987, the World Commission on Environment and Development (WCED) defined *"Sustainability"* as "meeting the needs of the present without compromising the ability of future generations to meet their own needs". Its purpose is to create a balance between social and economic development with environmental protection, it should be a focal guiding concept of the United Nations, Governments, private institutions, and organizations [3].

The term *"Sustainable Construction"* defined by the Conseil International du Batiment (CIB), in 1994, as "creating and operating a healthy built environment based on resource efficiency and ecological design". Based on this definition, the term *"Green Building"* was defined as "healthy facilities designed and built in a resource-efficient manner, using ecologically based principles", which involves finding the balance between homebuilding and the sustainable environment throughout a building's life cycle [4].

Green building is the result of a design philosophy that concentrate on maximizing the efficiency of resource use, including energy, water and materials, while minimizing building impacts on human health and the environment during the building life cycle, through improved siting, design, construction, and demolition [5].

Green buildings have numerous benefits. These benefits range from the tangible to the intangible. Tangible benefits include reduction of power consumption by 20% - 40% and reduction of potable water consumption by 30% - 40%. On the other hand, intangible benefits include the health and safety of the building's occupants, better comfort and higher productivity for the occupants, and better practices from day one, by having the latest techniques or technologies [6].

Green buildings target to reduce environmental impact by reducing energy use by 30%, water usage by 40%, wastewater by 70% and carbon dioxide emissions by 35%. [7]. Green buildings provide benefits not only from an environmental point of view, but also from economic and social aspects [8]. As for the economic perspective, they provide lower costs in the life cycle of the building. As for the social perspective, it provides improved health, well-being and comfort for its occupants. The green approach provides an opportunity for the construction industry to be part of sustainable development around the world through sustainable building solutions [9].

As any system, stakeholders need something that drives them to act in certain ways; what is called *"Motivators"*. The *Green Building Motivators* refer to both the potential benefits of the green building system itself and the actions taken by others that lead people to apply and adopt the green design concept in building projects. These motivators have an obvious effect on decision makers to adopt and apply the concept of green buildings in practice [10]. Through literature review, it was found that most countries that implemented the concept of green building started by identifying the specific incentives that would motivate their citizens to adopt this concept. Hence, these motivators, together with their efficiencies, and classifications are reviewed in detail, in Chapter 2.

The diffusion of the concept of the green building is hampered by a set of factors called *"Barriers"* [11]. It is necessary to identify barriers to the implementation of green buildings and then to find measures to overcome these potential barriers. [12]. These barriers vary in their impact according to the environmental, economic, and social conditions of countries or regions. Similarly, these barriers, their effects and the ways to overcome them are reviewed in detail in the second chapter.

The design and construction of buildings involve numerous stakeholders with varying backgrounds and scopes, which makes the task more complex. These stakeholders are classified as internal or external, according to their influences or authorities on projects [11]. In this study, the stakeholders who have a significant impact on decision-making for the adoption of green buildings, are considered as; the client, the designer, and the government.

Strategies, policies, and institution's programs and instruments are essentially needed to implement sustainable development concepts [13]. In order to enhance the efficiency of the adoption of green buildings, it is necessary to develop appropriate strategies and policies to take advantage of the green building system features and available motivators, As well as to overcome barriers to the adoption of green buildings [14].

As it is clarified in the next chapter, it is derived from the literature review that, as the motivators and barriers to implement and adopt green buildings differ from one location to another according to the varying environmental, economic and social conditions, the strategies and policies of the application also differ case by case, which brings the necessity to develop specific strategies and policies for each region or country based on their environmental, economic and social characteristics.

The green building industry is very young in Libya. Therefore, the construction sector needs to have a better understanding for the implementation of green design strategies. Interest in green buildings is increasing; while, practical knowledge of green buildings is limited. As of March 2018, there are no studies in the literature which focus on the identification of motivators and barriers for the green buildings in Libya. Therefore, this thesis aims to fill this gap in the literature and to provide a source to help lessen the impact of construction practices in Libya, by the implementation of measures of sustainability.

1.2 Problem statement

As buildings have significant environmental impacts; give more attention to environmental performance in building design has become a priorities [15]. Buildings are responsible for about 40% of resource consumption, 30% of global

energy consumption, and 40% of global waste generation [16]. In addition, buildings are responsible for more than 40% of the world's carbon dioxide emissions [17].

Based on the United States Green Building Council (USGBC), Green building is one of the main manner that globally focused on as a solution to reducing the environmental harm. Green buildings merge design and construction activities to minimize building impact on the environment and occupants through five criteria which are: sustainable site, water efficiency, energy efficiency, internal environment quality, and materials resources [17].

The fast economic development in Libya, has significant impacts on carbon dioxide and other greenhouse gas emissions to the environment [18]. In 2006, Libya was listed as the eleventh country in the world in terms of carbon dioxide emissions per person. Based on the General Electric Company Of Libya (GECOL) annual report, houses are responsible for more than 40% of the overall energy budget [19].

Based on the 2014 United Nation Development Program (UNDP) report, Libya has very little care about climate change and limited efforts compared to its neighbouring countries. Moreover, it is stated that, the extent of Libya’s climate change strategies is constrained to participation in regional and global activities. Currently, Libya has no legislations that are related to the issue of climate change [20].

Although there are many researchers and organizations across the world, that focus on studies regarding reducing the impact of buildings on their surrounding environments, unfortunately, the produced theoretical knowledge often may fail to be efficiently implemented in practice. This failure is also seen in the case of Libya. Furthermore, the awareness of green issues in the construction industry is still low and, as Libya is a developing country, they are seen as new, emerging concepts.

The literature review revealed that there were no studies on Libya related to the evaluation of the performance of building projects, or design teams, or concerning any regulations that were taken to reduce building impacts on the environment. Therefore, it is essential to explore the real situation of the built environment in Libya, to determine the factors that affect the green design performance. Also, more activities are needed to improve designers' knowledge and skills in green design

approaches, to break down the factors that hinder the development of green buildings in the country.

1.3 Objectives of study

The aim of this study is to establish the strategies and policies for implementing green approaches in building projects of Libya, by focusing on the investigation of motivators and barriers, as to the main issue of the study. The research also aims to determine the roles of each of the decision-makers in projects which are; the client, the design team, and the government, for the application of green designs in Libyan construction projects.

Based on the literature review on research methods, it is believed that the triangulation path is suitable to verify the theoretical framework and achieve the objectives of this research. Therefore, this method was adopted for this study. Figure 1.1. shows the theoretical framework of the study which was generated based on the literature review and the main aim of this study. The figure illustrates that there are four main issues regarding the theoretical framework of this study, which are:

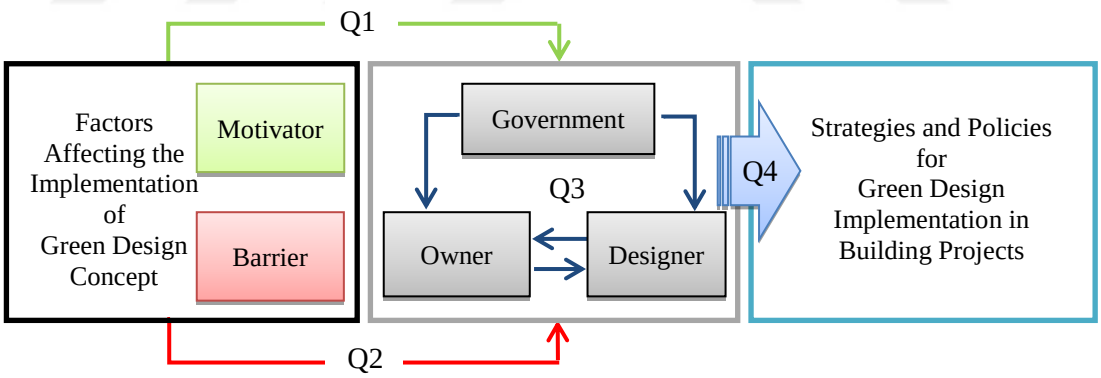

Figure 1.1. Theoretical Framework of the Study

1. The important motivational factors for developing green buildings.
2. The important barriers factors against developing green buildings.
3. The major role players in developing green buildings.
4. The strategies and policies for green design implementation.

The arrows between the issues represent the research questions of this study, which are:

- Q1: What are the major motivators for developing green buildings in Libyan projects?
- Q2: What are the critical barriers against developing green building in Libyan projects?
- Q3: Who plays a major role in developing green building in Libyan projects?
- Q4: What are the important strategies and policies that will facilitate the adoption of green buildings in Libyan projects?

1.4 Justification of the study

Recently, building impact and green building performance are turning out to be highly essential issues in assorted qualities of settings, including education, organizations, and practitioner groups. However, to minimize these impacts in Libya, the extent of the implementation of sustainable applications in building projects, is yet to be explored.

Identification of the current situation of the built environment in Libya helps to determine the approach of design teams and regulations on performance levels, and therefore, provides significant guidelines to both public and private clients, on what they need to consider regarding green buildings. The expected benefits are:

- Identify the design process variables of green building projects, which should be eligible to assist designers and clients to determine key policies in their design processes.
- The research will help to determine design teams' roles for introducing successful green building projects.
- The research will provide a framework for the development of green building designs, by focusing on the stage of design.
- The study could participate to academic organizations, and professional bodies by integrating research findings into the body of knowledge to deliver high-performance design in green building projects.
- The study could contribute to the establishment of a green building assessment tool, adopted for Libyan conditions.

1.5 Scope of the study

The study aims to identify the factors that affect the applications of green buildings in construction projects in Libya, either negatively or positively. The data of this study was obtained from professional architects and engineers, who are working in the built environment consultancy firms, in both governmental and private sectors located only in the capital of Libya, Tripoli.

In order to guarantee the accuracy and reliability of data, the sample size of the questionnaire was kept limited to participants from several firms. Regarding the governmental institutions, only the most important ones related to the design of buildings, preparation of specifications, which also provided consultancy in the field of architecture in Tripoli city were selected. These are:

1. Engineering Consulting Office for Utilities (ECOU).
2. National Consulting Bureau.
3. Organization for Development of Administrative Centers (ODAC).
4. Housing and Infrastructure Board.
5. Cities Development Organization.
6. Centre for Solar Energy Research and Studies (CSERS).
7. Industrial Research Centre / Building Materials Department (IRC).
8. Academics in Higher Education Institutions

As to the private sector, the participants were limited to professionals selected from firms mentioned in *Architecture Firms and Consultant Companies Guide* which was prepared in 2013, by the Libyan Board of Architecture.

1.6 Structure of Thesis

This thesis, as shown in Figure 1.2. includes six chapters. The first chapter presents an introduction to the study. The summary of the remaining chapters is as follows:

The second chapter presents a literature review, starting by addressing the issue of sustainability and green buildings as an introduction to this chapter. Then, an extensive review on the four main issues of the study follows, which are:

1. Motivators for Green Design Implementation
2. Barriers of Green Design Implementation
3. Decision-Makers Effect for Green Design Implementation
4. Strategies and Policies for Green Design Implementation

The third chapter presents the methodology of research that used in this study. The chapter explains the research design, which uses a triangulation method. It also includes the technique used for data collection, the respondents selection, and the tools of statistical analysis that are used during the validation and analysis of the final data.

The fourth chapter presents the results of two different sources of data collection and discusses their effects. The chapter is divided into two parts, namely the results of questionnaire, and interviews survey. Section one presents the results of the final and detailed questionnaire survey, while section two presents the results from the descriptive analysis of the data collected from semi-structured interviews.

The fifth chapter presents the discussion and evaluation the findings of the survey to understand and interpret respondents' views on the formularization of green building strategies in Libya. Critical comments are then made regarding the need for the Libyan Government to formulate a set of green building policies and the tools to be included in these policies.

The sixth chapter presents the comprehensive summary of the research objectives, and the problem statement of the study. This chapter also presents the key conclusions and contributions of the study. Suggested some potential studies, that could be undertake in the future as a result of the study findings.

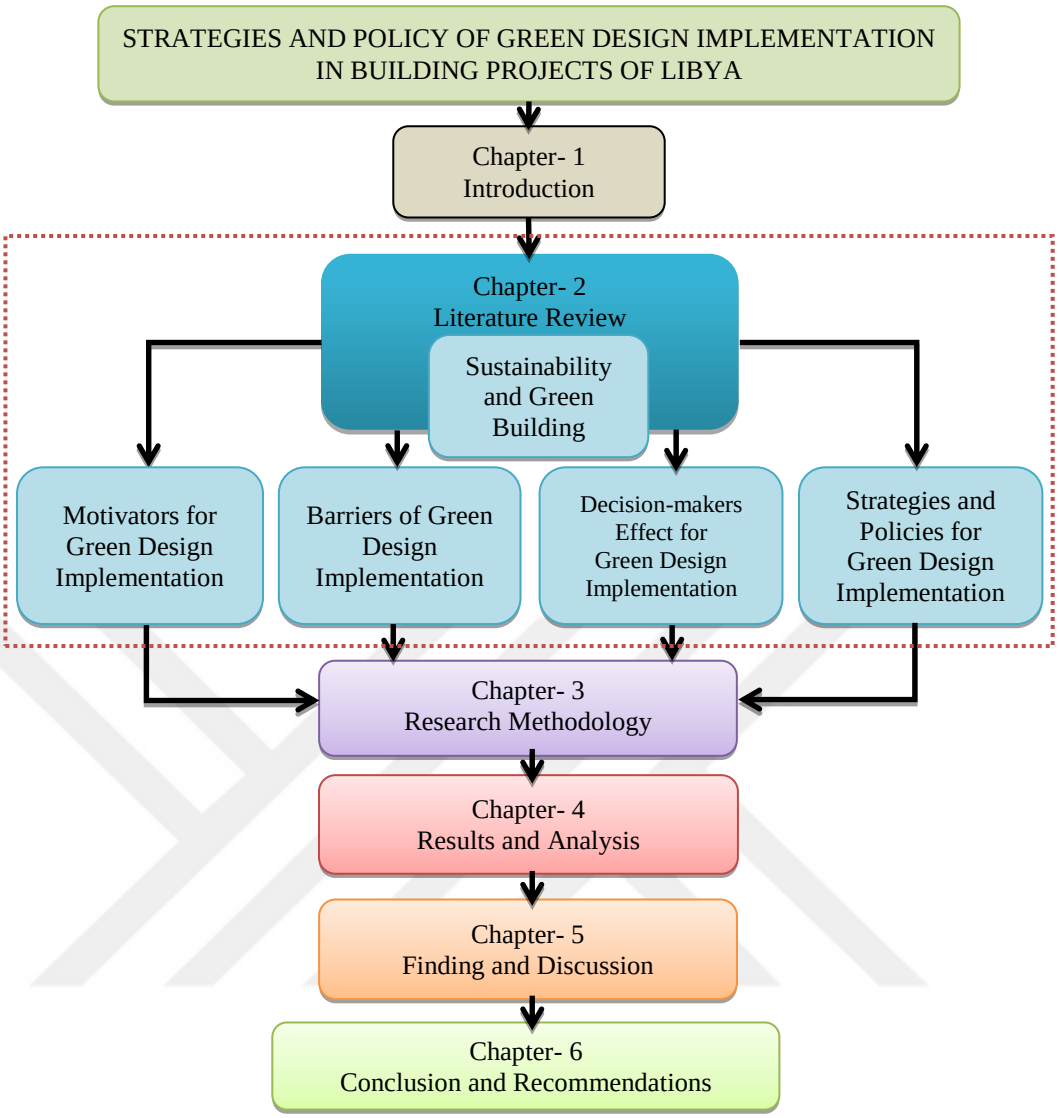

Figure 1.2. Structure of the Thesis

CHAPTER II
LITERATURE REVIEW

Through research in the several search engines (Google Scholar, Academic Search, and Science Direct) and search databases (ResearchGate, ProQuest, and PubMed) to find out the previous studies on topics relevant to this study during the past ten years, a comprehensive literature review was conducted to explore the rising momentum of the green building movement around the globe.

The review of literature in this study is divided into five parts to build up successive understanding of the main issue. In the first part, as an entrance to this chapter, the meaning of green buildings is examined in order to understand the basic philosophy, and concept, as well as the principles, challenges and benefits of green buildings. The second part contains an extensive research of existing studies focusing on the motivators which contribute to the successful implementation of green building projects. The third part contains an extensive research of existing studies focusing on the barriers that hinder the implementation of green building projects. The fourth part provides an overview of the role of decision-makers in the adoption of green building projects. Finally, the fifth part provides an overview of the strategies and policies regarding the adoption and implementation of green building on a global scale.

2.1 Sustainability and Green Buildings

There is an increasing interest in global policies for sustainable development within the building industry. This interest in green buildings is due to the aim of lessening their energy consumptions and greenhouse gas emissions [11]. Building green is one of the most important approaches of sustainable development, and various countries around the world have taken responsibility for implementing this concept in the construction industry [21]. In the 1970s, Nordic countries and the United States began

to improve the concept of sustainable development and to pay attention to energy-efficient buildings [22].

2.1.1 Definition of Green Building

Green building is also known as “a sustainable or high-performance building”. Very often the terms ‘green’, ‘high performance, and ‘sustainable’ are used interchangeably. It should also be noted that the term ‘sustainability’ addresses a broader concept, considering the ecological, social and economic issues of a building [4]. As the term “green buildings” is often used in conjunction with the term “sustainable construction” [23], in this study, to avoid ambiguity, the term “green building” is used as a synonym for “high performance building” that refers to a building designed according to the principles of “sustainable design”. Hence, it refers to a building satisfactory from economic, social and environmental aspects.

According to the United States Environmental Protection Agency [5], green building is the exercise of establishing structures and using procedure that are environmentally responsible and resource efficient during the building life cycle from siting to design, construction, operation, and dismantling. Green building is a result of a design philosophy that concentrate around expanding the effectiveness of resource utilize, including energy, water and materials, while lessening building impacts on human health and the environment during the building's life-cycle.

The United Nations Environment Program (UNEP) defines green building as “buildings that are not only resource efficient but which take measures to improve the health and well-being of occupants, reduce or minimize environmental pollution and waste, use certified environmentally friendly materials and / or incorporate renewable energy system” [24]. World Green Building Council (WGBC) defines green building as “a building that, in its design, construction or operation, reduces or eliminates negative impacts, and can create positive impacts, on our climate and natural environment. Green buildings preserve precious natural resources and improve our quality of life” [25].

ESER Project and Engineering Companies, one of the leading engineering and consultancy companies of Turkey, stated that, in our day, green building designs are one of the most critical matter for the building sector. Buildings have a significant

role in the consumption of natural resources as well as emission of hazardous gases into the environment. Green buildings are the buildings that are designed to minimize the negative impact on the environment and human health [26]. Green buildings merge design and building activities in order to minimize the harmful effect on the environment and occupants, through five main categories, which are: sustainable sites, water efficiency, energy efficiency, interior environmental quality, and material resources [17].

The main environmental impacts of the building are determined at the design stage. The design phase is one of the most significant processes which has the highest effect on the *green* performance of the building [27]. Green design refers to the design of environmentally responsible buildings and allows buildings to operate energy-efficiently over their lifecycles [28]. Green design takes environmental elements into consideration, such as; solar energy, daytime lighting, natural ventilation, low resource consumption, as well as waste recycling. Minimize the destruction of our environment resulting from carbon dioxide emissions from buildings is the main goal of green design [29].

Based on the above mentioned, the term *Green Building* can be defined as a philosophy, and associated project and construction management practices, that seek to create structures which use environmentally responsible processes and consume resources efficiently throughout the life cycle of a building, starting from the design stage, until construction, operation, maintenance, renovation and finally deconstruction.

2.1.2 Principles of Green Buildings

In order to consider a building as *green*, some principles should be included during design, construction and operation phases of the building. These principles are derived from the principles of sustainable construction which were articulated by the Conseil International du Batiment (CIB) in 1994, as seven principles that would be useful in decision-making, which were; Reduce resource consumption; Reuse resources; Use recyclable resources; Protect nature; Eliminate toxics; Apply life-cycle costing; and Focus on quality [4]. These principles apply over the whole life cycle of building as shown in the Figure 2.1.

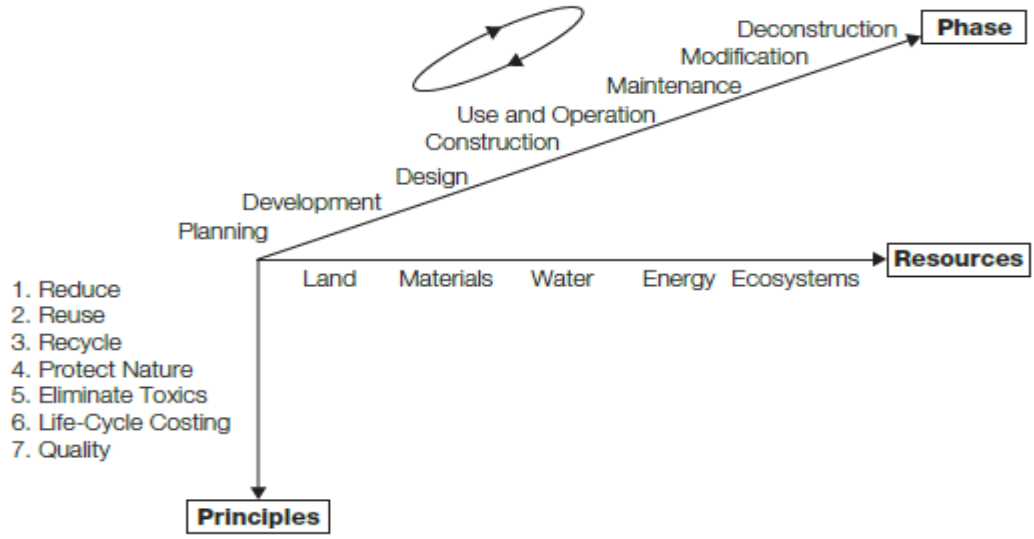

Figure 2.1. Framework for sustainable construction developed in 1994 by CIB Task Group (source: Kibert, 2012)

Yudelson [17] in his book 'Green Building A to Z'; and Alam, and Haque [30], in their study; *'Fundamental Principles of Green Building and Sustainable Site Design'*, summarize the key principles of green building design as:

- Sustainable Site Design
- Water Quality and Conservation
- Energy and Environment
- Materials and Resources
- Indoor Environmental Quality

The literature review revealed that most commonly used green building assessment tools around the world, i.e., Leadership Energy Efficiency Development (LEED), Building Research Establishment Environmental Assessment Methodology (BREEAM), Green Star, and Comprehensive Assessment System for Building Environmental Efficiency (CASEE), use these principles as five main criteria for green building assessments with little change [31, 32].

2.1.3 Benefits of Green Buildings

The benefits of green building are classified under sustainable building dimensions, which are environmental, economic, and social parameters, that is due the fact that green buildings are projects built on the principles of sustainable development [33].

Potential benefits of green buildings include environmental, economic, and social benefits, but with different levels of importance depending on the environmental, economic and social conditions of the location of the building.

2.1.3.1 Environmental benefits

Prevent harmful impacts on the environment is the main objective of green buildings through the; innovative use of natural resources, waste minimization and environmental preservation [34]. In their studies on green construction; [35-38], emphasized that the environmental benefits of green buildings include;

- Protect biodiversity and ecosystems
- Natural resources conservation
- Water losses reduction
- Air and water quality improvement

2.1.3.2 Economic benefits

The economic benefits of green buildings relates to the monetary gains generated by green building projects and the benefits that the public and government gain from the success of the project [39]. Most of published relevant studies conducted over the past ten years, including; Feltes, [40]; Turner, [41]; Yudelson, [42]; Buys and Hurbissoon, [43]; Gundogan, [44]; McGraw-Hill, [45]; USGBC, [28]; and EPA, [46], confirmed that the major economic benefits of green buildings are:

- Operating costs reduction
- Creating, expanding, and shaping markets for green product and services
- Occupant productivity improvement
- Life-cycle economic performance optimization

2.1.4 Social benefits

The social benefits of green building projects may be either, psychological when occupants naturally attracted as a result of their environmental beliefs, or can be physical (material) when occupants enjoy tangible benefits such as health, comfort and productivity gains [33]. According to studies found in literature, social benefits can be summarized as follows:

- Enhancing the health and comfort of occupant
- Increasing aesthetic qualities
- Minimizing pressure on the infrastructure
- Improving of life quality

2.2 Motivators for Implementing Green Design

As in any system, stakeholders need something that drive them to act in certain ways; this is what called *"Motivators"*. The term *"motivators"* in the field of green architecture is considered as any factor that encourages the decision-makers in the construction industry, including project owners, designers (architects and engineers), and governmental authorities, to adopt and apply green building concepts in projects. These motivators may be caused by the characteristics and advantages of the green buildings, or may be through decisions or actions taken by others that may lead and motivate people to apply this system [47].

The "*Green Building Motivators"* indicate to the potential benefits of the green building system and to the actions taken by others that lead people to apply and adopt the green building concept. These motivators have an obvious effect on decision-makers to adopt and implement the green building concept practically [10].

In order to increase the decision-maker's choices towards green building projects, they need to be motivated. Several studies have indicated that the motivation of stakeholders may increase the successful implementation of green building projects [33]. An overview of these motivators is fundamental in order to understand how green buildings can be more popular and successful [47].

There are numerous factors that can affect the decision to follow green design in building projects. In this section, a systematic review of the literature will be provided to identify; what the important motivators for the adoption of green buildings among construction stakeholders are; how literature categorized these motivators; and what the efficiency of these green building motivators are, in order to provide worthy information to decision makers in the building industry, i.e. governments, designers, and owners of projects regarding what motivate people to help further promote green buildings.

2.2.1 Identification of Green Building Motivators

To find ways to implement green buildings, first it is important to identify potential motivation factors [48]. Identifying motivators for the adoption of green buildings was the first objective of this study. To achieve this objective, an online search were conducted in famous search engines and databases, which started in February, 2017, to find out the previous studies on topics relevant to the motivators for green buildings during the last ten years, by using the keywords; *green building motivators*, *green building incentives*, *green building drivers* [49].

After reviewing the content of 70 published research studies related to the mentioned keywords, which were obtained from the famous search engines and downloaded in the EndNote program, it was found that some of them just noted the existence and importance of motivators without mentioning what they are or giving details, and thus, did not give an adequate answer to the main research problem of defining the important motivators for the adoption of green buildings. Therefore, only the studies which actually clearly defined what the green building motivators were, were selected. It was seen that, based on this criterion only 40 studies remained, which were journal articles, conference papers, theses, and reports, conducted during the period of 2008 – 2017 from different countries of the world, including developed and developing countries. Figure 2.2. shows the number of these studies by year of publication, while, Table 2.1. shows the distribution of these selected studies according to their country and publication type.

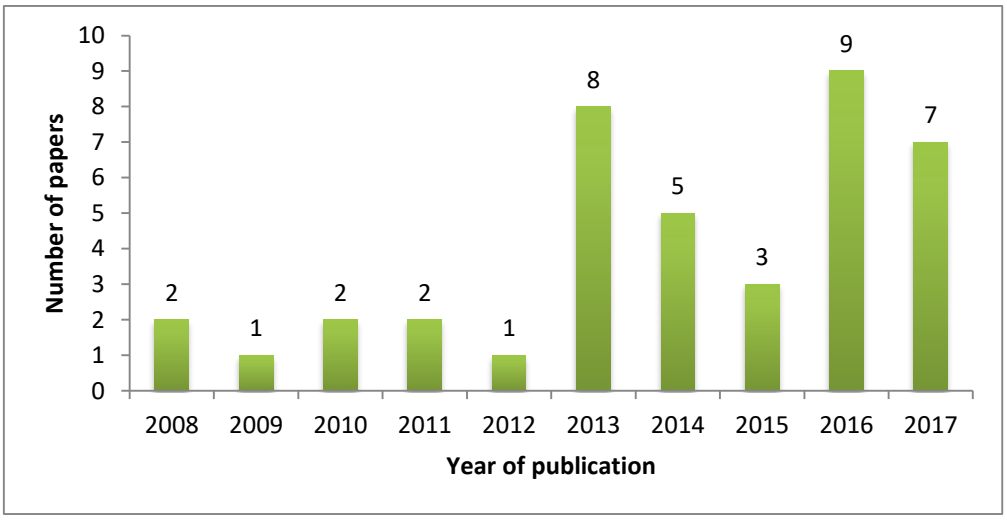

Figure 2.2. Numbers of the 40 selected studies by their year of publications

As examples, a sample of these selected studies that identified the green building motivators from different countries, will be presented in this section based only on their chronological order (Sequential organizing) starting from the beginning of 2008 and ending to the middle of 2017.

Table 2.1. Distribution of the 40 selected studies regarding to the green building motivators according to their country and publication type. (produced by the author).

Countries	Type of Publication				Quota
	Journal articles	Conference papers	Theses	Reports	
USA	[48] [50], [51]			[41], [45], [52]	6
New Zealand	[53]				1
Australia	[54], [55], [49], [56],	[57]			5
Finland	[58]				1
Italy	[59]				1
Turkey			[44]		1
R-Korea	[60]				1
China	[61] [47]				2
Hong Kong	[62] [63]				2
Singapore	[64]				1
Malaysia	[65], [37], [66],, [67]	[68], [69], [70]			7
Sri Lanka	[71]				1
India	[72]				1
Nigeria	[73] [74]		[33]		3
South Africa	[75]				1
Saudi Arabia	[76]				1
UAE	[77]				1
Kuwait	[23]				1
Oman	[78]				1
Palestine	[21]	[79]			2
Total	30	5	2	3	40

Starting in 2008, Turner Construction Company conducted a study to understand the views of executives involved with commercial real estate about green buildings. It surveyed 754 executives on green building issues through an online questionnaire. The surveyed executives represented a broad spectrum of organizations involved with facilities including developers, owners of rental buildings, brokers, and other firms providing real estate services, architects, engineering, and construction firms, and corporate owner occupants and tenants. The study reported that green buildings have better performance in the; 'Lower energy costs', 'Lower overall operating costs', 'Lower total life cycle costs', 'Building value', 'A higher asking rents', 'Greater return on investment', 'Higher occupancy rates', 'Improving the health and well-being of the population', and 'Increase employee productivity' [41]. They are considered as advantages of green buildings and they act as motivators for stakeholders to adopt this approach.

In 2009, a study entitled "The market for green building in developed Asian cities—the perspectives of building designers" was conducted in Hong Kong and Singapore which had the aim to explore the favourable factors and the obstacles that affect market participants in green building investment. A questionnaire survey covering building designers in Hong Kong and Singapore was used to collect the needed data. This study presents; 'Lower operation cost', 'Higher building quality', 'Lower lifetime cost', 'Higher return on investment', 'Help to transform the market', 'Increase staff productivity and retention', 'Enhanced marketability', and 'Reduced liability and risk' as the main business reasons that make the green buildings more attractive in both Hong Kong and Singapore. [62].

Sandy Bond [57], in his study "Best of the Best in Green Design: Drivers and Barriers to Sustainable Development in Australia", identifies research results conducted in Australia in 2009, in order to identify the stakeholders' motivations and experiences gained from proven examples of best practices in sustainable development. The study concluded that; 'Sustainability as a core policy', 'Zero net emissions as a target', 'Reducing the city's water consumption', 'Reduce environmental impact', 'Social responsibility', and 'economic viability', were the main drivers for sustainable development in Australia. The study also concluded that the demand for

environmental sustainable development was driven either by the tenant, owner / investor, or the government [57].

Nurul Sakina, and Mokhtar Azizi, in 2011, reviewed more than 20 past research studies from different countries including; United States, Germany, Switzerland, and New Zealand, to list and discuss the drivers of implementing green buildings. The study concluded that the; 'The implementation of new government policies', 'Higher benefits in return and more economical to operate', and 'The increase in the quality of awareness' are the main three drivers for growing trend of green buildings [80].

The result of a study conducted in Turkey by Handan Gundogan in 2012, aimed to answer the question "what are the greatest motivators and barriers to green building movement in the Turkish construction market" through a questionnaire survey, shows that the; 'Innovation in the construction sector', 'Improved quality of life', 'Occupant health and well-being', and 'Improved productivity' was specified as the top motivators to the movement of green buildings in the Turkish construction market [44].

McGraw-Hill Construction Research and Analytics in 2012, conducted a study about world green building trends among the worldwide architects, engineers, contractors, owners, consultants, manufacturers and suppliers to identify the triggers and obstacles related to the adoption of green buildings. In this study, data were collected from 62 countries including developed, and developing countries, through an online survey during August and October 2012. The study found that the; 'Client demand', 'Market demand', 'Lower operating costs', 'Branding/Public relations', and 'Right thing to do' are the most important drivers to increase the numbers of green buildings [45].

Nazirah Abidin and Ayishatul Powmya [78], discusses the drivers to motivate development specialists to take an interest in executing a green concept into their construction projects and investigate the impression of these experts on the future standpoint of green concept in Oman. This study reveals insight into the status of green development in Oman to empower facilitate suggestions be made to enhance and advance more extensive application later on. Through surveys, the study found that; 'A good way to protect the environment', 'Company cares for the society and the environment', 'A safe way to avoid infringement of laws and regulations', 'Useful for

the company image' and 'The possibility of saving money while operating the building in the long term' were the top five motivator factors out of a total of 13 have been identified as potential reasons for encouraging the acceptance and application of the concept of green buildings in Oman [78].

In 2015, David Nduka and Olabode Ogunsanmi conducted a study in Nigeria to compare the perceptions of stakeholders about the factors that determine the possibility of adopting the principles of green buildings in construction projects and also to know the limitations in the implementation of green building principles. Through a questionnaire conducted on 150 respondents who were eco-friendly building professionals in Nigeria, the study concluded that the most important factors determining the possibility of the adoption of green buildings are; 'Conservation of the environment and resources', 'Site sustainability', 'Energy conservation', 'Maintenance and building operation', 'Occupant health and safety', 'Water conservation' and ' Recycling and waste reduction' [81].

The results of a global survey conducted by Dodge Data & Analytics in 2015 at 69 countries included some of Arabic countries (Algeria, Bahrain, Egypt, Iraq, Jordan, Lebanon, Morocco, Palestine, Qatar, Saudi Arabia, and United Arab Emirates), showed that 'Client demand' which was consistently an important motivator for the previous two studies conducted in 2008 and 2012, takes a significant jump in 2015 as one of the top motivators for green building implementations for the future, and are followed by; 'Environmental Regulations', 'Market demands', 'Right Thing to Do', and 'Lower Operating Cost' respectively [52].

The latest research, which have been selected among the previous studies, was a research study conducted in 2017 by Amos Darko, Albert Chan, Ernest Ameyaw, Bao He, and Ayokunle Olanipekun, to investigate the major drivers for adopting green building technologies. A questionnaire survey with 33 green building experts from the United States was carried out. The study identified 12 drivers for green building adoption, which are; 'Reduced whole lifecycle costs', 'Greater energy efficiency', 'Greater water efficiency', 'Improved occupants' health, comfort, and satisfaction', 'Improved productivity', 'Reduced environmental impact', 'Better indoor environmental quality', 'Company image', 'Better workplace environment', 'Thermal comfort', 'High rental returns', and 'Increased building value' [51].

After a detailed review of the literature, 24 motivators were identified for the adoption of green buildings. Table 2.2. lists these motivators derived from reviewing the selected studies. As to Table 2.2. it can be stated that; 'Providing lower annual energy cost', 'Protection of the environment and ecosystem', 'Providing lower operation, maintenance, and repair cost', 'Providing lower water and wastewater cost', and 'Providing improved comfort, health, and well-being of occupants' are the top five motivators for green building adoption, regarding its frequency in the selected studies.

2.2.2 Categorisation of Green Building Motivators

In order to comprehensively understand the green building motivators and their level of effectiveness in the implementation of green building development, it is essential to classify these motivators and to differentiate them [47]. Half of the 40 selected studies just identified these motivators without any classification, while the remainder of these studies classified the green building motivators in different ways.

The motivators were classified by Turner Construction [41], on a *financial* and *non-financial* basis, while, Diyana and Abidin [68], and Abidin and Powmya [78] classified them on a *financial , knowledge, business*, and *ethical* basis. On the other hand, Olubunmi et al. [49], Olanipekun [55], and GIZ and ODI, [72] classified the motivators as *external*, and *internal* motivators.

However, the studies of; Su Ang and Sara Wilkinson [54]; Häkkinen and Belloni [58]; Handan Gundogan [44]; McGraw-Hill Construction [45]; Waidyasekara and Fernando [71]; Naim H. Rustom [21]; Usman and Gidado [76]; Dodge Data & Analytics [52]; Mohamed Ghazali et al. [70]; and Durdyev et al. [82] which make up the largest proportion of the 40 selected studies (22.5%), classified green building motivators as *environmental, economic*, and *social* motivators, followed by (10%) which classified them as *external*, and *internal* motivators.

Based on this fact, in this study, it was decided to classify the green building motivators under three main categories; which are: environmental, economic, and social motivators. Table 2.3. illustrates these classifications from the point of view of the authors of the 40 selected studies.

Table 2.2. The potential motivators derived from reviewing the selected studies. (produced by the author)

Label	Green Building Motivators	References
M1	Protection of the environment and ecosystem	[63], [57], [48], [71], [60], [64], [78], [21], [81], [47], [77], [51]
M2	Control of climate change.	[57], [44], [71], [60], [21], [59]
M3	Compatibility with environmental regulations	[45], [64], [52], [61], [47]
M4	Increasing indoor air quality	[71], [50], [47], [51]
M5	Recycling and waste reduction	[63], [44], [71], [81], [47], [82]
M6	Improve reusable and recycle building elements	[63]
M7	Increasing building quality and value	[62], [44], [45], [76], [52], [47], [69]
M8	Providing lower operation, maintenance, and repair cost	[41], [62], [44], [45], [68], [64], [73], [81], [52], [67], [47]
M9	Providing lower building life-cycle cost	[41], [63], [73], [67], [47], [51]
M10	Providing a good opportunity for investment returns	[41], [62], [53], [44], [65], [64], [47], [69], [51]
M11	Increasing occupant productivity	[41], [62], [64], [47], [51]
M12	Increasing occupancy rate	[41], [47]
M13	Increasing rental and sale value	[41], [62], [65], [64], [76]
M14	Providing lower annual energy cost	[41], [63], [44], [48], [71], [64], [75], [21], [81], [59], [61], [67], [72], [47], [77]
M15	Providing lower water and wastewater cost	[57], [44], [48], [71], [21], [81], [61], [67], [47], [51]
M16	Giving a good reputation for marketers	[62], [45], [65], [64], [51]
M17	Availability of more financing channels	[65], [78]
M18	Increase in demand of clients/tenants	[45], [76], [52], [49], [72], [47]
M19	Product and material innovation and/or certification	[73], [47]
M20	Providing improved comfort, health, and well-being of occupants	[41], [64], [81], [76], [52], [49], [47], [51]
M21	Satisfaction from doing the right thing	[45], [78], [73], [52]
M22	Government regulations and policies	[53], [48] [60], [78], [75], [61], [72], [47]
M23	Moral imperative or social conscience	[57], [68], [64], [47], [77], [51]
M24	Creating of better future opportunities	[64], [72]

Table 2.3. Categorization approach of the 40 selected studies on green building motivators, (produced by the author)

Categorization Approach	Studies		
	References	**Number**	**%**
• Financial • Non-financial	[41]	1	2.5
• External • Internal	[49], [55], [72], [33]	4	10.0
• Environmental • Economic • Social/Cultural	[54], [58], [44], [45], [71], [21], [76], [52], [70]	9	22.5
• Stakeholder • Responsibility • Techniques • Feedback	[63]	1	2.5
• Financial • Knowledge • Business • Ethical	[68], [78]	2	5.0
• Enhanced value • Costs/Savings • Sustainability • Legislation	[64]	1	2.5
• Pressure • Benefits	[61]	1	2.5
• External • Property-level • Corporate-level • Project-level • Individual-level	[47]	1	2.5
Without categorization	[62], [53], [57], [48] [65], [60], [37], [73], [75], [66], [23], [81], [59], [50], [67], [56], [77], [69], [51], [79]	20	50.0
Total		40	100

2.2.2.1 Environmental Motivators

Environmental motivators include; environmental protection, climate change, recycling and waste minimization. Tarja Hakkinen and Kaisa Belloni [58] stated that according to the draft of ISO 21929 (2010a), climate change, deterioration of the ecosystem, and depletion of resources are considered as the main environmental reasons to motivate building stakeholders for the adoption of green building concept in their projects [58].

Handan Gundogan [44], pointed out in her study that, in Turkey 'Reducing negative impacts of buildings on environment' was the primary motivation for the implementation of green buildings, followed by 'Reduce the use of natural

resources', 'Climate change control', and 'Water and air quality improvement' respectively.

McGraw-Hill Construction, in its report 'World Green Building Trends: Business Benefits Driving New and Retrofit Market Opportunities in Over 60 Countries' [45], showed that the 'Lower greenhouse gas emission' is considered the second significant environmental motivation for European and Australian respondents, while, the 'Natural resource conservation' is considered as the second significant environmental motivation in South Africa and Singapore [45].

Waidyasekara and Fernando listed in their study; *'Benefits of Adopting Green Concept for Construction of Buildings in Sri Lanka'*, the top five environmental beneficial factors as; 'Lower potable water use', 'Better air quality inside the facility', 'Reduced energy use', 'Lower fossil fuel use', and 'Protection of ecological resources' respectively [71].

Naim H. Rustom [21], believes that 'Increased material efficiency by reducing the material demand of non-renewable goods', 'Reduced material intensity via substitution technologies', 'Enhanced material recyclability', 'Reduced and controlled use and dispersion of toxic materials', 'Reduced energy required for transforming goods and supplying services', 'Supporting the instruments of international conventions and agreements', 'Maximizing the sustainable use of biological and renewable resources', and 'Considering the impact of planned projects on air, soil, water, flora, and fauna' are the major environmental motivators for adopting green buildings.

Dodge Data & Analytics [52], reported that 'Reduce the consumption of energy' still the top environmental cause of green building by 66% of all respondents, followed by 'Protecting natural resources' which was ranked second globally, with 37%, and 'Reducing water consumption' was third, with 31%.

2.2.2.2 Economic Motivators

According to Tarja Hakkinen and Kaisa Belloni [58], promoting the adoption of sustainable building concepts rely on economic factors such as: 'Useful operational

costs for sustainable buildings', 'Improved productivity of buildings' occupants', and 'Benefits for the national economy in the long term'.

Handan Gundogan in 2012, identified 'Lower annual energy cost', 'Lower annual water cost', and 'Increased profitability of company with improved productivity' as the main economic motivators for green building development and construction [44].

A survey that was conducted in 2012 by McGraw-Hill Construction, points out that 'Client demand', 'Market demand' and 'Lower operating cost' constitute the major economic motivators for the implementation of green buildings [45].

Based on the study conducted in Sri Lanka in 2013 by Waidyasekara and Fernando, most respondents think that 'Lower cost of energy', is the most effective economic motivator in adopting green buildings in Sri Lanka. It was identified that 'Lower cost of annual electricity', 'Reducing the annual cost of water and sanitation', 'Reducing the annual cost of fuel', and 'Reducing the cost of waste disposal' are the next top four economic motivators according to the respondents. It is obvious that most of the economic motivators are based on long term benefits, where they are achievable within two years of constructing the building [71].

Naim H. Rustom [21], points out that 'Consider costs of life cycle', 'Internalizing external costs', 'Consider alternatives to funding mechanisms', 'Develop the suitable economic tools to encourage sustainable consumption', and 'Considering the economic impact on local structures' were the top five economic motivators for adoption of green design in building construction.

Usman and Gidado [76], observed in their study '*An Assessment of the Factors Affecting Green Building Technology (GBT) Adoption*', that the economic and financial benefits of green buildings include: 'Higher rents', 'Higher sales prices', 'Lower cost of occupancy', 'Greater tenant demand', 'Human capital savings', and 'Building value insurance'.

The results of a global survey conducted at 69 countries by Dodge Data & Analytics in 2015, showed that the 'client demand' which was consistently an important motivator for the previous two studies conducted in 2008 and 2012, takes a significant jump in 2015 as one of the top motivators for green building implementations for the

future, and are followed by ‘Market demands’, and ‘Lower operating cost’ respectively [52].

Mohamed Ghazali et al. [70], stated that, economic motivators, including; ‘long-term cost of money compensation’, ‘High market demand’, ‘Cost saving in energy use’, ‘Financial incentives and tax exemption’, ‘Full life cycle design’, ‘Reducing cost of water consumption cost’, ‘Low cost of waste disposal’, ‘High return on investment’, and ‘Minimum maintenance and repair cost’ are the main motivation for developers to push the development of green buildings not only in Malaysia but also in other countries around the world. By determining the economic motivators, the developer can obtain benefits of green buildings not only for them but also for humanity and the environment [70].

2.2.2.3 Social Motivators

The motivators; ‘Improved quality of life’, ‘Well-being of occupants’, and ‘Better occupant health’, are considered as the most important social factors for the adoption of green buildings, as stated by Gündoğan [44], McGraw-Hill [45], Waidyasekara and Fernando [71], and Dodge Data and Analytics [52]. On the other hand, Hakkinen and Belloni [58], and Usman and Gidado [76] identified ‘Health’, ‘Satisfaction’, ‘Equity’, and ‘Cultural value’ as the majority of social motivators for the implementation of green buildings.

Moreover, Rustom [21], observed that ‘Involving stakeholders in order to enhance the participatory approach’, ‘Promote participation of the public’, ‘Advance the improvement of suitable institutional frameworks’, ‘Thinking about the effect on the current social framework’, and ‘Evaluating the effect on well-being and the life quality’ are the main important social motivators to implement the concept of green buildings.

Based on the above-mentioned literature review, and as to the approach of classifying the green building motivators into three categories as environmental, economic, and social, adopted by this study, the 24 potential motivators, which were identified from reviewing the 40 selected studies, were classified under these three categories as shown in Table 2.4.

Table 2.4. The Potential Motivators for the Adoption of Green Buildings

Label	Categorized	Motivators
M1	Environmental	Protection of the environment and ecosystem
M2		Control of climate change.
M3		Compatibility with environmental regulations
M4		Increasing indoor air quality
M5		Recycling and waste reduction
M6		Improve reusable and recycle building elements
M7	Economic	Increasing building quality and value
M8		Providing lower operation, maintenance, and repair cost
M9		Providing lower building life-cycle cost
M10		Providing a good opportunity for investment returns
M11		Increasing occupant productivity
M12		Increasing occupancy rate
M13		Increasing rental and sale value
M14		Providing lower annual energy cost
M15		Providing lower water and wastewater cost
M16		Giving a good reputation for marketers
M17		Availability of more financing channels
M18		Increase in demand of clients
M19		Having a good market for green buildings in Libya
M20	Social	Providing improved comfort, health, and well-being of occupants
M21		Satisfaction from doing the right thing
M22		Government regulations and policies
M23		Moral imperative or social conscience
M24		Creating of better future opportunities

2.2.3 Efficiency of Green Building Motivators

The efficiency of green building motivators varies from country (or region) to another, depending on the environmental, economic, and social conditions. Through a global survey conducted by Dodge Data and Analytics in 2015, it was found that;

‘Client demands’ ranked first in the list of top five motivators to increase levels of green buildings in UK and US, while it ranked the last in India and Colombia. On the other hand, it was found that ‘Environmental regulations’ has topped the list in UK, Singapore, and Australia, while tailed the list in Poland, Germany, and Saudi Arabia [52].

As a result of a survey conducted in Malaysia, among a number of stakeholders, the majority of respondents stated that legislations and policies have a higher influence than other motivators [66]. Unlike the result obtained from other countries, the reason ‘Satisfaction from doing the right thing’ is a key social motivator driving the implementation of green buildings in South Africa [45].

As to the situation in Turkey, based on Gundogan’s study conducted in 2012, ‘Lower annual water cost’, ‘Lower annual energy cost’, and ‘Increased profitability of company with improved productivity’ were the top three important motivators for green building development, while, the ‘Government support’ listed at the end of the list of potential motivators [44].

Abidin, and Powmya [78] discusses the drivers to motivate development specialists to take an interest in executing a green concept into their building projects and investigate the impression of these experts on the future standpoint of the green approach in Oman. Through surveys, the study found that ‘A good method to save the environment’, ‘Company cares for the society and the environment’, and ‘A safe method to avoid encroachment of laws and regulations’, were identified as the top effective motivators of green building adoption in Oman [78].

It is noticeable from the above mentioned that the green building motivators differ in terms of efficiency from country to another. The motivators related to the economic aspects such as; reducing costs, saving money, and increasing profits, play a major role in motivating the stakeholders to adopt the green building in some countries such as US, Turkey, China, and Saudi Arabia [41, 44, 45, 47, 52, 62, 64, 67, 68, 73, 81]. On the other hand it found that the environmental and social aspects, such as; protection of the environment and ecosystem, control of climate change, waste reduction, and improving the quality of life, have played a key role in other countries such as Malaysia, Singapore, Oman, and South Africa [21, 50, 57, 59, 60, 71, 76, 78].

2.3 Barriers of Green Design Implementation

The term *"barriers"* in this study is considered as any challenges and obstacles that hinder the decision-makers in the construction industry for the adoption of the concept of green design in building projects. The implementation of green design in building projects faces challenges and barriers. As green building practices in capital projects are influenced by a set of hindrances and barriers to their implementation, it is important to investigate the main barriers for green design in the built environment [48]. The process of designing green buildings faces numerous obstacles. Hence, the reduction of these obstacles will encourage green design practices in the built environment [81].

It is necessary to understand and address the main barriers and risks associated with implementing green building practices in order to manage them and accelerate the expansion of green building projects [23]. Understanding the barriers to the development of green buildings will help discover approaches to encourage the green building market [62]. There is a need for a better understanding of the barriers to the implementation of green buildings to help find ways and means to overcome them. The discovery of these barriers is necessary, and only then can the corresponding solutions be effectively planned. [83]

Understanding green building barriers helps promote the practice of green buildings. Many academic articles discussed green building barriers, and in-depth research was undertaken to analyse these barriers in different countries [84]. Adoption of green building practices has not been easy in many regions of the world. Numerous researchers have published studies that summarize barriers, which hinder the successful adoption of green buildings in different countries [85].

This section, through a systematic review of the literature, explores the major barriers, challenges or obstacles (hereinafter referred to as barriers) related to green building projects. The barriers will be discussed in detail to identify; what the critical barriers hindering the adoption of green buildings among construction stakeholders are; how literature categorized these barriers; and what the efficiency of these green building barriers are, in order to obtain significant data for decision-makers in the building

industry, in particular, governments, designers, and owners of projects regarding what inhibiting people to help further promote green buildings.

2.3.1 Identification of Green Building Barriers

Despite this growing interest in green buildings, there are still many barriers to green building policies. As these barriers create a lack of efficiency, their identification is as important as their possible solutions, since they can enhance the implementation of green buildings [86].

In order to support and lead the sustainable design agenda within the construction industry, barriers to such practices must be identified first. Given the virtues and growing interest in sustainable construction, all stakeholders in the construction industry must identify barriers for implementation, and subsequently develop actions to overcome these potential barriers (Djokoto, Dadzie, & Ohemeng-Ababio, 2014). Identifying the factors associated with the low-performance of buildings can provide great input to deliver high performing green buildings and help to develop solutions to the issue of poor performance [87].

There are three steps the government should take to develop a green concept in the building industry by identifying barriers against the development of green buildings in the country. The first step is identifying barriers that hinder green building development, second is analysing these barriers, and finally the third step is developing new strategies or modifying current ones to remove these barriers [88].

Identifying the barriers against the adoption of green buildings was the second objective of this study. To achieve this objective, online searches were conducted in famous search engines and databases started in February, 2017, to find out the previous studies on topics relevant to the barriers against green buildings during the last ten years, using *"green building barriers, green building obstacles, green building challenges"* as keywords.

The same steps to reach the first objective have been taken. After reviewing and filtering the downloaded studies related to green building barriers, only 38 studies which actually clearly defined what were the green building barriers and gave an adequate answer to the main research problem of identifying the critical barriers for

the adoption of green buildings during the period from 2008 to 2017 were finally selected. Figure 2.3. shows the number of these studies by year of publication.

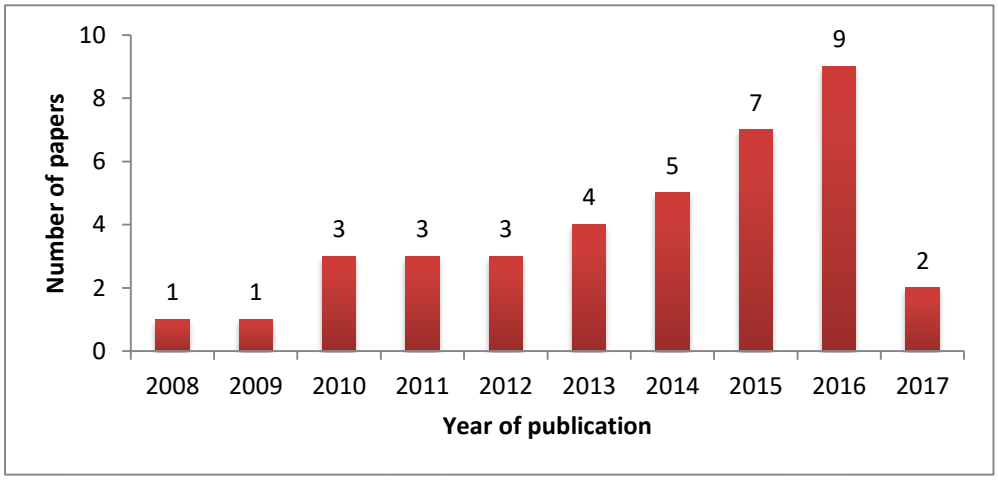

Figure 2.3. Number of the 38 selected studies by year of publication

The 38 selected studies was diverse from different countries of the world including developed and developing countries, as well as Western and Eastern countries. It included countries from all six continents of the world (USA, New Zealand, Ireland, Australia, Finland, Brazil, Turkey, R-Korea, China, Hong Kong, Singapore, Malaysia, Indonesia, India, Nigeria, Ghana, South Africa, Saudi Arabia, Kuwait, Palestine) to cover most of world's societies. Table 2.5. shows the distribution of these selected studies according to their country and publication type.

A sample of these selected studies that identified the green building barriers will be presented in this section based on their chronological order starting from the beginning of 2008 and ending to the middle of 2017.

Table 2.5. Distribution of the 38 selected studies regarding to the green building barriers according to their country and publication type. (produced by the author).

Countries	**Type of Publication**				**Quota**
	Journal articles	Conference papers	Theses	Reports	
USA	[48], [86], [85], [51]	[89]		[41], [45], [52]	8
New Zealand	[80]				1

Ireland	[90]				1
Australia		[57]			1
Finland	[58]				1
Brazil	[91]				1
Turkey			[44]		1
R-Korea	[60]				1
China	[92]				1
Hong Kong	[62] [93]				2
Singapore	[94], [95]				2
Malaysia	[96], [88], [66], [87]				4
Indonesia	[97], [83]				2
India	[72]				1
Nigeria	[73], [81]				2
Ghana	[98], [12]		[84]		3
South Africa	[99]		[100]		2
Saudi Arabia	[101]				1
Kuwait	[23]				1
Palestine	[21]	[79]			2
Total	29	3	3	3	38

Through an online questionnaire conducted in 2008 by Turner Construction Company to assess a series of problems that may lead to discouraging adoption of green buildings, it found that; ‘Cost and documentation for certification’, ‘Higher cost of the construction’, ‘The required payback period is long’, and ‘Awareness of the benefits of green buildings is lacking’, were presented as an extremely significant barriers to green buildings [41].

The overall results of a study conducted in Hong Kong and Singapore, in 2009, related to the barriers that hinder the green building market show that the perceptions of architects in both cities are very similar to these barriers, and they agree that; ‘Consider high costs in advance’, ‘Education lack’, ‘Lack of tax incentives’, and ‘Awareness lack’ are the undeniable barriers that should arouse attention [62].

Nessa Winston [90], outlined the barriers to achieving sustainable housing and regeneration in Dublin as; 'Lack of common view for green housing', 'Inadequate building systems', 'Non-compliance with existing regulations', 'Knowledge and experience in green construction methods are limited', 'Negative impression of high density housing', 'Low quality designs', 'Negative attitudes towards social mix', 'Focus on demolition', 'Failed to recognize the need for social renewal', and 'Resources Limited' [90].

In 2011, Tarja Hakkinen and Kaisa Belloni, used a web-based questionnaire, interviews, and case studies to identify the most important barriers to the application of green building in Finland. The study found that; 'Steering mechanisms', 'Economics', 'Lack of customer understanding', 'Process of tendering, timing, and collaboration', 'Knowledge support', 'Availability of tools and tools' are the actual barriers to the adoption of green buildings. The study concluded that green buildings is not hindered by the lack of technologies and valuation methods, but suffers from the organizational and procedural difficulties involved in adopting new methods [58].

In Turkey, based on a research study prepared by Handan Gundogan under the title "Motivators and Barriers for Green Building Construction Market in Turkey" to identify the greatest barriers and motivators to the green building movement in the Turkish construction market, from the point of view of respondents, the questionnaire found that; 'High cost of technology and materials', 'Lack of insurance policies', 'Initial high cost', 'Lack of experience', and 'Difficulty of finding green material' are the main barriers for achieving green building practices in Turkey. The study concluded that the construction sector avoids green buildings due to; the contracting and tender process focus on low cost and less time rather than building performance; lack of government incentives to encourage green building; and the building regulations do not urge on a higher level of design of the building [44].

The study, conducted by McGraw Hill Construction [45], through a global survey covered 62 countries around the world, concluded that 'High of initial costs' was the top barrier to the adoption of green buildings, followed by 'Lack of government support', 'Challenge between capital expenditures and savings in operating costs', then 'Lack of public awareness' [45].

Djokoto et al. [73], investigated the possible barriers for sustainable construction in the Ghanaian construction industry Through a survey of randomly chosen experts in the construction industry in Ghana. The factors identified as key barriers for sustainable construction are; 'Demand for sustainable buildings are limited', 'No strategy to encourage sustainable building', 'High of initial costs', 'Lack of public awareness', and 'Absence of government support' .

Ibrahim Mosly [101], conducted a study to explore barriers for the expansion and adoption of green buildings in Saudi Arabia. Through a series of interviews with various industry experts, the study concludes with 14 green building barriers slowing the development of green buildings in Saudi Arabia. The most important ones are; 'Absence of government support', 'Absence of skilled workers', 'shortage of information and awareness', 'Lack of funding and support from the private sector', 'Unavailability of incentives', and 'Resistance-to-change culture'.

In Singapore, Hwang et al. [95], identify critical factors affecting the productivity of green building projects by assessing likelihood, impact and critical factors with comparisons with traditional projects by performed a questionnaire with 32 professionals with experience in green building projects, and an interview with three experts in green buildings were also performed. The results of the study show that; 'Workers' experience', 'Workers' skills', 'Technology', 'Design changes', 'Planning and works' sequence' are the five most critical factors affecting the productivity of green building projects.

Sabboubeh and Farrell [79], stated that the main barrier towards green buildings in Palestine is the political situation, followed by the 'Lack of strategic planning', 'Lack of demand by clients', 'Availability of sustainable materials', 'Lack of awareness of sustainable construction', 'Lack of technology implementation', 'Time barrier', while it was surprising that the cost was the last barrier. These barriers were found as a result of the survey conducted among professionals working in jobs related to the field of architecture in Palestine [79].

As a result of the deep review of the literature with regard to the barriers for the implementation of green buildings, there are many barriers identified by numerous researchers in previous studies, of which 24 barriers can be derived as possible

barriers against the adoption of green buildings. Table 2.6. lists these barriers derived from reviewing the 38 selected studies.

It is clear from Table 2.6. that the 'Lack of awareness in the society', 'Higher initial project cost', 'Unsupportive government policies and regulations', 'Lack of knowledge', and 'Lack of experience of consultants and contractors' topped the list of the possible barriers for green building adoption. While the 'Difficulty of applying changes in late design stages', 'Hardness of the local climatic conditions', 'High cost of green building certification', 'Having low electricity prices', and 'Having low water prices' tailed this list in terms of its frequency in the selected studies.

2.3.1 Categorisation of Green Building Barriers

Some of the studies that identified barriers for green building adoption, begin by categorizing these barriers under certain related groups [101].

Although more than half (55.26%) of the 38 selected studies did not classify barriers for the adoption of green buildings, the remaining of these studies classified these barriers into groups in different ways. Table 2.7. illustrates these classifications from the point of view of the authors of the 38 selected studies. Some of these studies (4 studies) have classified these barriers as they relate to stakeholders [58, 94-96], others (3 studies) have rated them in terms of their impact on each stage of the building i.e. design stage, construction stage, and operation stage [80, 85, 93].

Xie Xiaohuan [84], in his thesis entitled '*Integrated Design for Green Building in China: the obstacles and the way forward*', identified and analyzed twelve barriers for green building design and categorized them into two aspects i.e. *technical* and *non-technical* barriers.

Table 2.6. The potential barriers derived from reviewing the selected studies. (produced by the author)

Label	Green Building Barriers	References
B1	Lack of environmental concerns	[73], [101], [97], [83]
B2	Lack of accurate environmental data	[88], [98], [101], [93], [85], [51]
B3	Lack of green materials in the local market	[81], [94], [12], [95], [83], [79]
B4	Hardness of the local climatic conditions	[95]
B5	High cost of green building certification	[41]
B6	Very long payback time for investment returns	[41], [44], [48], [81], [12], [85]
B7	Higher initial project cost	[62], [89], [57], [58], [100], [44], [99], [60], [48], [45], [91], [73], [101], [81], [92], [52]
B8	Higher financial risk	[44], [60], [88], [98], [12], [76], [85], [51]
B9	Having low electricity prices	[101]
B10	Having low water prices	[101]
B11	Higher green material costs	[57], [100], [44], [99], [48], [81]
B12	Higher green technology system cost	[89], [57], [100], [44], [99], [88], [73], [98], [66], [94], [85], [83], [51]
B13	Having a short-term budget perception instead of long-term	[48], [81]
B14	Lack of demand of client	[88], [98], [12], [79]
B15	Lack of demand in the market	[88], [45], [73], [98], [12], [85], [52], [51]
B16	No financial incentives from the government	[62], [96], [80], [21], [98], [101], [12], [86], [85], [79]
B17	The difficulty of applying changes in late design stages	[94], [95]
B18	Lack of awareness in the society	[41], [62], [96], [45], [48], [91], [73], [98], [101], [81], [84], [12], [86], [85], [97], [72], [52], [83], [51], [79]
B19	Lack of knowledge	[90], [58], [88], [48], [21], [98], [66], [81], [12], [92], [85], [97], [72], [83], [51]
B20	Lack of experience of consultants and contractors	[90], [57], [80], [100], [44], [99], [88], [45], [73], [21], [66], [85], [52], [51],
B21	Limited experience and skills of construction workers	[44], [91], [98], [101], [94], [12], [93], [95], [85], [51]
B22	Lack of funding and support of the private sector initiatives	[96], [21], [12]
B23	Unsupportive government policies	[90], [89], [80], [88], [45], [98], [66], [101], [12], [86], [92], [85], [97], [72], [52], [51],
B24	Absence of an official green building body	[44], [91], [101], [12]

While Handan Gundogan [44], in her thesis entitled '*Motivators and Barriers for Green Building Construction Market in Turkey*', explored thirty four barriers for a green building market, then categorized these barriers into four sections as, *economic*, *educational/awareness*, *organizational*, and *market* barriers. From another point of view, Djokoto et al. [98], stated that the barriers of green buildings can be classified into four classes which are; *cultural*, *financial*, *steering*, and *professional* barriers.

It is noted from the Table 2.7. that there was no consensus, majority or tendency to specifically classifying the barriers for green building implementation and that each study classified these barriers according to the author's view of these barriers and their effects. Based on that, this study decided to classify the green building barriers under three main categories; which are: environmental, economic, and social barriers.

2.3.1.1 Environmental barriers

The barriers; 'Lack of environmental concerns', 'Lack of accurate environmental data', 'Lack of green materials in the local market', and 'Hardness of the local climatic conditions', are considered as the most important environmental barriers for the adoption of green buildings.

The lack of attention to the environment or the so-called lack of environmental awareness, whether by the people or the government, is one of the most barriers to the application of green building [73, 83, 97, 101]. Ibrahim Mosly, in his study *'Barriers to the Diffusion and Adoption of Green Buildings in Saudi Arabia'*, confirmed that; there is an absence of attention on environment in Saudi Arabia, this represents a barrier to the implementation of green buildings.

The design of green buildings requires accurate information and data on the environmental characteristics (Topographic and Geographical) of the project location and surrounding environment, currently and future forecasts. The barrier 'Lack of accurate environmental data' pointed out by various researchers as a crucial barrier to the green building adoption [51, 85, 88, 93, 98, 101]. Darko et al. [51], through a questionnaire survey carried out with 33 green building experts from the United States, ranked 'Lack of accurate environmental data' as the 7^{th} out of 26 barriers to adoption green building.

Table 2.7. Categorization approach of the 38 selected studies on green building barriers, (produced by the author)

Categorization Approach	Studies		
	References	**Number**	**%**
• Financial • Cultural • Capacity • Steering	[21], [98], [12], [23]	4	10.52
• Technical • Nontechnical	[84]	1	2.63
• Stakeholders on project	[58], [96], [94], [95]	4	10.52
• Building stages	[80] [93], [85]	3	7.89
• Economic • Awareness • Organizational • Market	[44]	1	2.63
• Financial • Governmental • Technical • Cultural and market	[101], [87]	2	5.26
• Financial • Organizational	[91]	1	2.63
• Project • Manpower • Technical • Management • External	[86]	1	2.63
Without categorization	[41], [62], [90], [89], [57], [100], [99], [60], [88], [45], [48], [73], [66], [81], [92], [97], [72], [52], [83], [51], [79]	21	55.26
Total		38	100

The choice of building materials for green building projects have always been the most difficult task facing the designers of the project [4]. From the survey results conducted in Nigeria by David Nduka and Olabode Ogunsanmi [81], 'Too hard to find materials for green building', ranked eighth in the list of twenty barriers. Other researchers have pointed to this barrier in their studies, including: [12, 79, 83, 94, 95].

2.3.1.2 Economic barriers

In the context of green buildings, economic barriers appear in several forms. Costs, including; 'Higher initial project cost', 'Higher green technology system cost', 'Higher green material costs' are a crucial economic barrier to adopting green buildings [44, 48, 57, 81, 99, 100]. In addition, Chan et al. [85], cited in their study,

'Barriers Affecting the Adoption of Green Building Technologies', what mentioned in USGBC (2003), that use of green building technologies and features, can increase the initial cost of the building projects from 2% to 7%. As cited in the same study, what mentioned in Tagaza and Wilson (2004), that the overall cost of the green building project could increase by 1% to 25% compared to traditional building projects. Another issue related to the cost is 'High cost of green building certification' which rated as very significant barrier by more than half (54%) of the executives whose involved in the survey conducted in 2008 by Turner Construction Company [41].

Investors in construction sector, always prefer to recover their capital as shorter time as possible, this is a barrier to the expansion of investment in green buildings as it takes very long payback time for investment returns [12, 41, 44, 48, 81, 85]. 'Higher financial risk' is also an economic barrier to the adoption of green buildings, due to fear of high investment costs of green buildings compared to traditional buildings resulting from unexpected costs [12, 44, 51, 60, 85, 88, 98].

In some countries, especially developing countries, many subsidies are provided to electricity and water utilities to reduce their prices to the public as government subsidies to citizens. This led to a decrease in the price of electricity and water, resulting in an disinterest in the consumption of water and electricity by the majority of the public. Thus, these government subsidies created two additional barriers to the application of green buildings which are; 'Having low electricity prices', and 'Having low water prices' [101].

Other economic barriers which were mentioned in the selected studies included:

- 'Having a short-term budget perception instead of long-term' [48, 81]
- 'Lack of demand of client' [12, 79, 88, 98]
- 'Lack of demand in the market' [12, 45, 51, 52, 73, 85, 88, 98]
- 'No financial incentives from the government' [12, 21, 62, 79, 80, 85, 86, 96, 98, 101]
- 'The difficulty of applying changes in late design stages' [94, 95]

2.3.1.3 Social barriers

The market is influenced by the culture of society and therefore accepts some products and rejects others. For example, resistance to change makes it difficult for innovative products and systems, such as green building concept, to achieve market penetration [101].

Lack of awareness about the importance and benefits of green buildings among stakeholders ,even from the decision-makers, was mentioned in 20 of the 38 selected studies. This barrier has ranked first in some studies, not only at the level of social barriers but at all barriers in general,[72, 73, 81, 84, 86, 96, 97]. While it identified as second or third barrier to green building implementation in other studies [41, 48, 58, 62, 83].

In their studies on identifying barriers to the application of the green design concept in construction projects, [12, 21, 48, 51, 58, 66, 72, 81, 83, 85, 88, 90, 92, 97, 98], identified lack of knowledge about green buildings as one of the major factors hindering the implementation of green building practices in the construction industry. This lack of awareness and knowledge can be caused by the lack of expressed interest from clients [48]

Lack of experience and skills, both consultants and workers, is one of the biggest barrier facing the construction industry in general and in the application of green building concept in particular. In other words, there are not enough technical experts and qualified builders to build green buildings, this is reflected in planning, design and construction [72]. The result of both studies, Shaikha AlSanad [23], and Albert Chan et al. [85], concluded that the lack of skilled professionals limits the implementation of green buildings. As most construction professionals suffer from a lack of green building practices.

From another point of view, Dodge Data and Analysis report '*Green Building Trends 2016*', showed that although the lack of green building professionals has been identified as one of the barriers to increasing green building activity, its influence has declined 25 points from 46% in 2008 to 21% in 2015 based on opinion of survey respondents. This decline may indicate a global trend towards more expertise in green building techniques. [52]

Governments play very important roles in the promotion or reduction of green buildings. They are able to develop a number of regulations and decisions that obliged, or encourage the public to green building adoption. Thus, the lack or absence of a government policy framework for adopting green design concept in building projects, is a barrier to the development of green buildings [88, 101]. The government should introduce standards for the green building implementation to increase the level of awareness and encourage stakeholders in the building industry [23]. It is necessary to replace rules and regulations with new rules that support the development of green buildings [21].

'Lack of funding and support of the private sector initiatives' identified as a social barrier from some studies [12, 21, 96]. Low investment and participation from the public and private companies to increase the diffusion of green building, creates a barrier for building practitioners more effectively in design and construction [96]

The absence of a governmental or civil body that adopts the green building application in terms of setting specifications and requirements, as well as monitoring and evaluation, is considered a barrier to the diffusion of the concept of green building and its applications among the stakeholders.

Most of the developed countries that have become pioneers in green construction, such as the United States, most of Western Europe countries, and Japan, as well as developing countries that are making significant progress in adopting this concept, as Malaysia and Singapore, have started by creating and forming a board (*Green Building Councils*) and labelling programs (*Green Building Rating Systems*) that adopt and provide technical and sometimes financial support to the public in order to expand the implementation of green buildings [12, 44, 91, 101].

Based on the above-mentioned, the 24 potential barriers that hinder the adoption of green buildings, which were identified from reviewing the 38 selected studies, were arranged under three classifications including; environmental, economic, and social barriers as shown in Table 2.8.

Table 2.8. The Potential Barriers Hinder to Adopt the Green Building

Label	Categorized	Barriers
B1	Environmental	Lack of environmental concerns
B2		Lack of accurate environmental data
B3		Lack of green materials in the local market
B4		Hardness of the local climatic conditions
B5	Economic	High cost of green building certification
B6		Very long payback time for investment returns
B7		Higher initial project cost
B8		Higher financial risk
B9		Having low electricity prices
B10		Having low water prices
B11		Higher green material costs
B12		Higher green technology system cost
B13		Having a short-term budget perception instead of long-term
B14		Lack of demand of client
B15		Lack of demand in the market
B16		No financial incentives from the government
B17		The difficulty of applying changes in late design stages
B18	Social	Lack of awareness in the society
B19		Lack of knowledge
B20		Lack of experience of consultants and contractors
B21		Limited experience and skills of construction workers
B22		Lack of funding and support of the private sector initiatives
B23		Unsupportive government policies and regulations
B24		Absence of an official green building body

2.3.2 Efficiency of Green Building Barriers

In contrast to motivators leading to increased levels of green buildings practice, there is much less variation in the barriers that prevent the green buildings adoption among the different countries of the world [45]. The result of global survey conducted by Dodg Data and Analytics [52], pointed out that some barriers have greater weight in some countries. This disparity in the ranked of the barriers to green building adoption from one country to another may be due to disparity in the environmental, economic and social conditions of these countries.

In general, based on the above, 'Higher initial/capital project cost', 'Lack of awareness/knowledge in the society', and 'Lack of government policies/incentives support' are the top three barriers in nearly most of the 38 selected studies, respectively, as shown in Table 2.9.

Table 2.9. Frequency of mention of the top three barriers in the 38 selected studies, (produced by the author)

The top three barriers	Frequency of mention in the selected studies			Total
	as a first barrier	as a second barrier	as a third barrier	
Higher initial/capital project cost	17	3	4	24
Lack of awareness/knowledge in the society	6	4	7	17
Lack of government policies/incentives support'	4	10	0	14

2.4 Effects of Decision-Makers on the Implementation of Green Buildings

Decision-making in the building industry is a differentiating between limitless alternatives of designs and the right decision depends on the amount of available information and the data analysed. Decisions are made on various aspects of building designs and usually include the choice of design objectives, principles and corresponding design strategies [102].

Magent et al. [103], developed a model that illustrates the decision making process, as shown in Figure 2.4, the model represents the nature of decision making in design where options are narrowed through analysis and information to a point where one is selected. The ambiguity in the decision-making process represented by the cone's diameter. The ambiguity is considerable when new design options are presented for consideration. Ambiguity can be shrinked by gathering information and analysing numerous options.

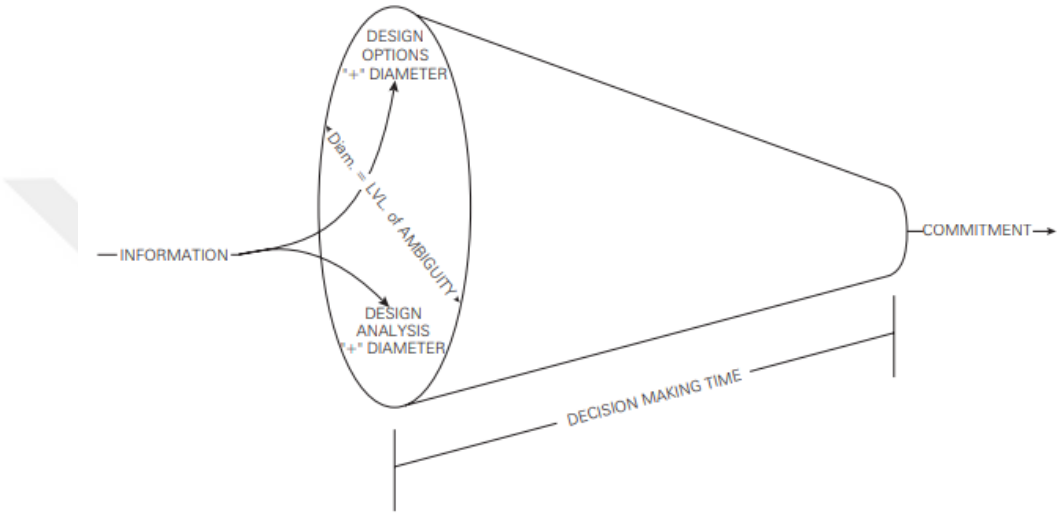

Figure 2.4. Design decision mode (source: Berardi, 2013)

The success of construction projects is closely linked to stakeholders in the project. Therefore, in building projects, stakeholders have been specified as substantial for a project to be successful [104]. The design and construction of buildings, in general, includes many stakeholders with different backgrounds and scopes, making the task more complex [11].

In order to determine the impact of decision-makers on green building adoption and the role of each of them in deciding on the implementation of this concept, it is necessary to firstly define who are the stakeholders of the building industry and what their role is. Identification of key stakeholders or stakeholder analysis provides a useful tool for stakeholder understanding, community or organizational needs to reduce the risks involved in green building development [47]. What will be presented in this section is finally, identifying the key actors of the stakeholders in the decision-making process for the adoption of green design in construction projects.

In general, stakeholders are individuals or groups that may affect or be affected by the achievement of the objectives of the project or institution and they are classified as internal or external stakeholders based on their relation to the project [105]. In this study, only stakeholders who can affect the decision-making process for the adoption of green buildings are considered. The main stakeholders of the building sector with their foci and objectives are reported by Umberto Berardi in his book '*Moving to Sustainable Buildings: Paths to Adopt Green Innovations in Developed Countries'* as shows in Table 2.10. Stakeholders were divided into four categories, including; Client, Design, Construction, and Public side which correlate with the various aspects of the project [11].

Table 2.10. Stakeholders of building sector with their foci and objectives (source: Berardi, 2013)

Category	Foci	Stakeholders	Objectives
Client Side	Building Value	User	Usability, energy consumption, internal comfort
		Owner	Reliability, quality, economy
		Financier	Successful completion, time, quality
Design Side	Technical Functionality	Architect	Quality, reliability of owner needs, aesthetics
		Consultant Engineer	Specific functionality according to the specialization
Construction Side	Economic and Successful Construction	Project Manager	Stakeholder integration, resources coordination
		General Contractor	Quality, profit and workmanship
		Subcontractor	Work in construction
		Product Manufacturer	Sale of subcomponents and material products
Public Side	Social equity	Neighbor & Citizens	Local conservation, minimization of project disturbance
		Local Government	Local development
		Regional Government	Healthy environment, local conservation
		National Government	Healthy environment, energy saving, climate change
		Non-Governmental Organizations	Emission of carbon dioxide, energy saving, climate change

It is clear from the table that the objectives of each stakeholder, even within the same category, are different. Therefore, their interests and powers differ.

Key stakeholders play important roles in adopting green design in the context of the building industry by taking responsibility for minimizing the negative impacts of buildings on the environment and society, while maximizing their economic contribution [42]. In building projects decisions are made in a complex context where the influence of stakeholders is given through a combination of power and level of interest which changes over time. Stakeholder power refers to their actual ability to influence the project, while interest indicates their desire to influence. Stakeholders with greater power and interest are seen to have influence greater than stakeholders with less power or interest [105]. At each stage of the construction process, actors or stakeholders are taken in or out [106]. Figure 2.5. shows the three-dimensional matrix of Power, Interest, and Time for project's stakeholders from Beradi's perspective.

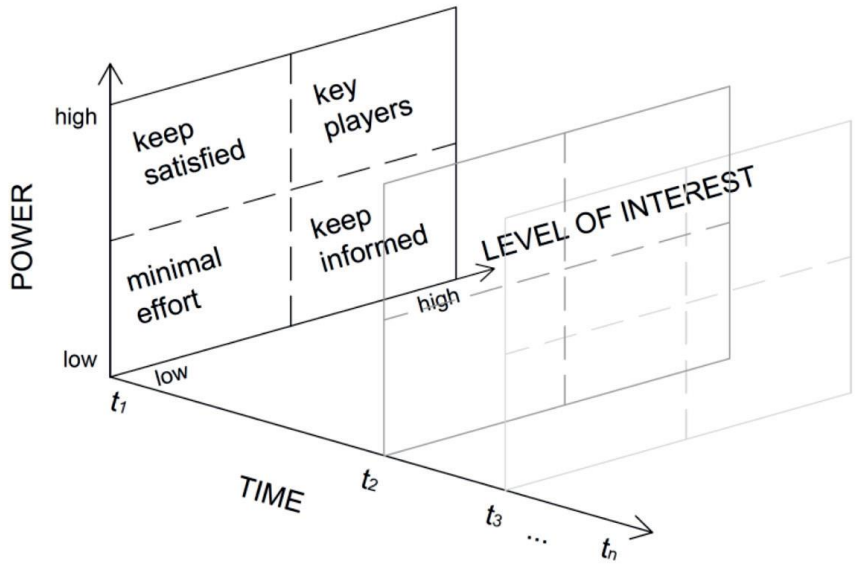

Figure 2.5. The three-dimensional matrix of Power, Interest, and Time for project's stakeholders (source: Berardi, 2013)

From the figure given above, it is clear that who have high power and high interest are the key players in the decision-making process and that these key players may change from one stage to another of the project implementation stages.

In building projects, decision-making in the initial stage greatly influences the aesthetics of the building, its functions, environmental load, cost and other sustainable

performance measures throughout its life cycle [102]. The design stage is the most influential phase of the green building adoption. In order to successfully support the green building concept, should be paid particular attention to the design phase in which potential design options are created and selected as best solutions. The design phases of the building are the most important times for making decisions about sustainability characteristics [102]. Therefore, particular attention needs to be paid at the early design stage to achieve high performance of green buildings [107]. Not all stakeholders can influence the progress and results of a building project. Stakeholders who can exercise influence are referred to as "actors" [106]. Accordingly, this study will focus on identifying the major role players of decision-making, to adoption the green building concept, at design stage of project, among main stakeholders i.e. Government, Owner/Client, and Designer/Design Team.

2.4.1 Role of decision-makers in the adoption of green building projects

Identifying the major role players in developing green buildings was the third objective of this study. To achieve this objective, an extensive and comprehensive review of key stakeholders of building projects at the design stage was conducted among famous search engines using the "*key stakeholders of building projects*, *green building stakeholders*, and *green building decision-makers"* as keywords to find out the previous studies on topics relevant to the decision-makers of green building adoption.

2.4.1.1 Role of Owner/Client

The building project initially creates an idea by the owner or client, then develops from stage to another until it becomes a reality. Therefore, the owner/client is the first member in the list of project's stakeholder and always topped the list.

In the building projects, the meaning of the owner is used interchangeably with the client [108]. Project owners are financiers who build projects, and who consider the facility to be primarily a strategic asset. Krane et al. [109], used the term "project owner" as defined by Eckland (2001): the owner of the project endure the rights of the owner and the responsibilities of the owner of the project. The project owner is that who endure the risks related to the cost and expected value of the project. The owner of the project is the owner of the project's authority through its financing, therefore he

is the owner who must be satisfied and its basic business requirements will be enhanced through project implementation [109].

The client whether a company, a public body or a private individual acting as promoter or developer is usually the primary player in any building project due to its strategic and operational responsibilities. These responsibilities usually appears by identifying the needs and requirements of the project, i.e. scope, scope, character, design and general budget of the project [105].

Elforgani and Rahmat [107], stated that the owner's performance is critical because decisions taken will affect the overall performance of the project. To manage the design process in effective way, owner representatives must have a broad knowledge of building, leadership and organizational skills. The owner is the principle individual to give data on the work mission, goal and setting of the authoritative structure and in addition the general goal of the project. During the early stage of the design process, the owner has an active involvement. As project participants, owners of projects report on their goal and take major decisions regarding to the adoption of green building projects. Project owners play a leading role as well as push green building projects more than other project participants [110].

Yang et al. [111], found that the risks related to internal stakeholders, such as client, have a higher impact in the process of green building development. Internal stakeholders, such as the client, contractor, consultant and end user, play more important roles in green buildings than external stakeholders. The very important role of project owner in green building projects are integrate project participants and introduce green intent in the early stage of project designing [112].

Olanipekun et al. [112], undertaken a systematic literature of review of 47 scientific publications on project implementation of green building projects to identify indicators of owner commitment. The study concludes that there are nine important indicators of owner commitment that can affect performance of project such as cost, time, quality and sustainability metrics, thus ensuring implementation of green building projects successfully.. The three top of these indicators were:

- Provide a vision statement on why green building projects are being developed by project owners is the most important indicator

- Facilitating the integration of project participants and introducing green intention early are very important indicators
- Support from senior management, education of project team participants, and commissioning separate experts are important indicators

Owners of building projects are important project's stakeholders involved in the implement green building projects. With their commitment, they can ensure the successful implementation of green building projects. The project owner's vision statement contains the goals, and scope of green building requirements by the project owner. The objectives of the project owners are the reason why they decided to adopt green building projects [112].

It is clear from the above that the owner, whether an individual or a body, is the one who bears the burden and financial responsibility among the stakeholders, therefore he either earn profits in the event of success of the project or incurred losses in case of failure of the project. This gives the owner/client the right and the authority of the decision-making that lead to take decision whether to accept or refuse the design concept of the project, especially that bear new or unique visions and ideas (innovative concepts) such as green building projects.

2.4.1.2 Role of Designer/Design Team

After creating the idea of the project through the imagination of the owner, it will be displayed by the design team which include architects, engineers and consultants, who will transform these ideas into reality through numbers, lines, maps and drawings which reflect the shape and method of implementation of these ideas. The design team is thus considered as the second member, directly following the owner, in the list of project’s stakeholders.

Delivery of the green building project requires the project team to be formed in advance. The key project team members must be recognized from the start of the project and therefore initiate actions to create an integrated design solution [113]. In integrated design, design team including architects, engineers and consultants deal with owner/client needs and requirements, aesthetics, shape, function, facilities, safety

and maintenance issues of the proposed building, including the facility's program and construction plans and details of construction [105].

As a result of Elforgani & Rahmat [113] study, it indicates that the commitment of design team members will help to produce building designs with green characteristics. The level of commitment of members of design team to green building design is related to owner/client commitment and is also related to the budget and time frame assigned by the owner. Design teams will implement more green design principles if they found a commitment from the owner/client.

Generating, selecting and integrating alternatives to form a single design proposal are primarily responsibility of design team, led by architects. As a key stakeholder, the architect plays a key role in the promotion and development of high performance buildings. It is expected that it will assist other stakeholders in identifying, recognizing, and selecting solutions with various information. For example, Heating, ventilation, and Air Conditioning (HVAC) engineers help designers to determine the most suitable ventilation system for a project [102]. To build a high-performance green building, the ability of the design team to understand and apply the concept of environmental design is the key. Designers should often use their best judgment when making decisions among the many available alternatives [4].

Berardi [11], in his book '*Moving to Sustainable Buildings:: Paths to Adopt Green Innovations in Developed Countries*', cited both (Andreu & Oreszczyn, 2004) and (Cooke et al., 2007), that design team (architects, engineers, and consultants) often have a strong interest in adopting green buildings because they usually have the awareness and knowledge to evaluate them. However, their ability to impose options is restricted. They have a key role in advising the client on potential sustainable options but limited authority over the final decision.

The architect, as a first designer in the design team of building project, are important stakeholders in the growth of green buildings, because they are the main decision makers to specified the types of materials that be used in building construct. In addition, architect have a substantial role in educating owner/client and recommending them to using green building materials [47].

From the above-mentioned literature review, it can be concluded that for good design performance in terms of green building requirements, an effective design team is vital. It is also concluded that, despite the great interest of the design team in green or sustainable design, its power and influence in decision-making is constrained by both the financial power of the owner and the legislative power of the government.

2.4.1.3 Role of Government

The status of the government in construction projects may appear as the owner of the project through one of its ministries or institutions. It may appear as legislators and supervisor of implement these legislation, regulations or laws. Therefore it has an active and critical role to the success or failure of the implementation of construction projects in general and green building projects in particular. The government is a kind of stakeholder with unique interests [105]. The government has a leading role in promoting the spread and development of the concept of green buildings [49].

The local government is one of the key stakeholders in any project, since it has the capacity to allow construction and has a major impact on the typological and technological choices in the building. The local government has enough power to influence the adoption of green technologies via applying stringent energy performance standards and creating conditions which encourage green technologies implementation. Thus, its power over decision-making processes, especially at the initial stage, is very high. [11].

AlSanad [23], stated that if the government imposes environmental and green building standards in the construction industry, this probably will accelerate its implementation. She revealed through the survey conducted in Kuwait that the majority of respondents agreed that government involvement was needful to ensure the adoption of green building practices in Kuwait, and the majority of stakeholders believe that green building cannot be strengthened unless the government commits to doing so. The government can review existing standards or introduce new regulations, and launch appropriate guidelines to implement green practices to ensure a sustainable approach as a step to promote the green building concept.

In Malaysia, the government is primarily responsible for the development of green buildings through the Construction Industry Development Board (CIDB) [37]. Based

on the results of a survey conducted across the country by Milad Samari et al. [88], government play a major role in the green buildings development in Malaysia. The development of green buildings in Singapore is largely due to government efforts as the development of green buildings in Singapore was the responsibility of the Building and Construction Authority (BCA) [94, 95].

In Australia, the government has played a key role in the development of green building projects. The government appears as a leader in minimizing the environmental impacts of its buildings and operations. The government's position is the source of motivation for green building in Australia. [33].

As a result of the survey conducted in the United States by Yong Ahn et al. [48], identified the government officials as a third most important stakeholders who have ability to improve and apply sustainability strategies to motivate green design in the building industry [48].

Government in UK has a vital role in the adoption of green design. The government developed several initiatives in order to promote the development of green building practices in the UK, included:

- Established the Building Research Establishment Environmental Assessment Method (BREEAM) in 1990
- Established the sustainable communities plan (SCP) in 2003
- Established the Zero Carbon Homes (ZCH) standard in 2006
- Established the Code for Sustainable Homes (CSH) in 2007
- Established the Green Deal is a retrofit initiative in 2012

These government policy initiatives have made green building practices a commitment in the UK construction industry. This commitment produce a powerful claim for green building products and services in the UK [33].

The Chinese government is quite effective for green building development in the country and has a vital role through the implementation of a number of catalytic interventions, which led to accelerated growth of green buildings and has made many developers and entrepreneurs develop and adopt green design conception in building projects of China [33].

In India, the Indian government is constantly updating policies and laws that support the transition to a more environmentally friendly world. numerous of new laws and programs have been checked out to improve efficiency in the construction sector and reduce energy losses through its governmental and semi-governmental organizations i.e. Bureau of Energy Efficiency (BEE), Ministry of environment and Forests (MoEF), Confederation of Indian Industry Green Business Centre (CIIGBC), and The Energy and Research Institution (TERI). These stakeholders are the most important in India due to these actions; Policy advocacy, Consultation, Green buildings and products, and Setting standards [114].

It could be argued that the government, especially local governments, have a distinctive and effective role cannot be ignored as being the only one of the stakeholders have the right and full power in the enactment the legislation and laws, whether mandatory or motivational, to implement plans, programs and projects.

As a result of what has been review in this section, that owner/client, designer/design team and government, have high importance and high influence. They have an active role in the decision-making process to adopt green design in building projects with varying levels depending on their degree of power and interest.

2.5 Strategies and Policies for Green Design Implementation

To implement sustainable development concepts, strategies, policies, and institution's programs and instruments, are essentially important requirements [13]. It is necessary to develop appropriate strategies and policies to take advantage of the green building system features and available motivators, as well as to overcome barriers that hinder the adoption of green buildings, in order to enhance the efficiency of the adoption of green buildings [14]. To be adopted successfully and widely, different strategies and policies are needed take advantage of motivators and overcome barriers for the adoption of green buildings [51].

The development of strategies and policies to accelerate green building is the fourth and main goal of this study. It is considered the dependent variable of this study, which follows both independent variables namely, *motivators* and *barriers*, as shown in the theoretical framework of the study in Figure 1.1.

2.5.1 Identification of the strategies and policies for the adoption of green buildings

As it is found from the literature review in section 2 and section 3 of this chapter, the motivators and barriers to implement and adopt green buildings differ from one country to another according to the varying environmental, economic and social conditions. The strategies and policies of the application also differ case by case. This led to the need of review of the literature with regard to the strategies and policies to apply the concept of green design in building projects, in order to identify and summarize the important strategies and policies that will facilitate the adoption of green buildings. Hence, to be used as a guide in the empirical part of this study.

There are a number of studies focusing on the strategies and policies that promote the adoption of green buildings. 44 of these researches which in fact clearly define what important strategies and policies have been applied or recommended as a solution to facilitate the widespread adoption of green buildings from different countries and during the past ten years, were selected and downloaded via various search engines. Figure 2.6. shows the number of these studies by year of publication.

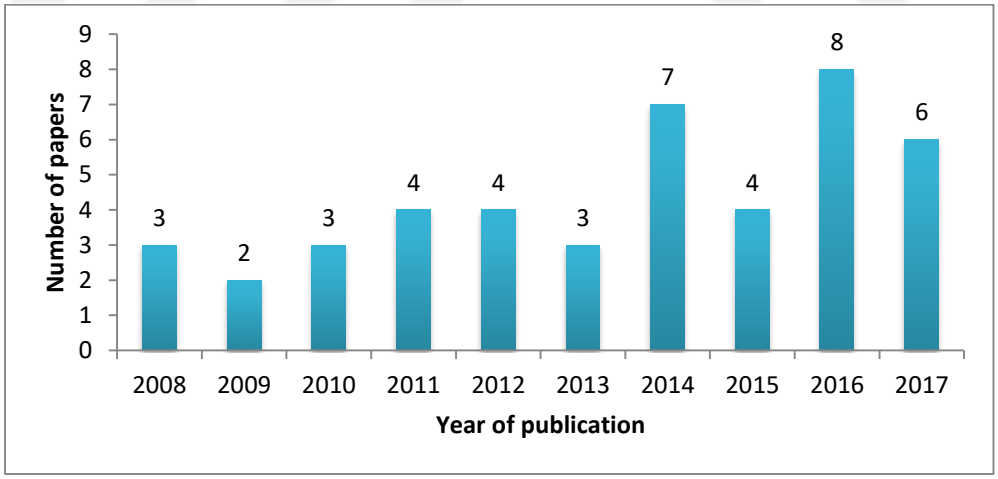

Figure 2.6. Number of the 44 selected studies by year of publication

The 44 selected studies were diverse from different countries of the world including developed and developing countries. Table 2.11. shows the distribution of these selected studies according to their country and publication type. A sample of these selected studies that identified the green building strategies and policies will be presented in this section, as to lessons learned, to provide insight from different

countries that are in the process of developing, or developed, their own green building program over the past 10 years from the beginning of 2008 to the middle of 2017.

Table 2.11. Distribution of the 44 selected studies regarding to the strategies and policies for green design implementation, (produced by the author).

Countries	Type of Publication				Quota
	Journal articles	Conference papers	Theses	Reports	
USA	[115], [116], [48], [51]				4
Germany	[117]				1
Sweden			[118]		1
Australia	[1], [49]	[57]		[24]	4
Finland	[58]				1
Turkey		[119]	[44]		2
R-Korea	[60]				1
China	[120], [121], [122], [123]				4
Hong Kong	[62]		[22]		2
Singapore		[124]			1
Taiwan	[125]				1
Malaysia	[65], [126]	[69]			3
Indonesia	[97]				1
India			[114]	[72]	2
Nigeria	[73], [74]				2
South Africa	[99]		[100]		2
Saudi Arabia	[127], [101]				2
Kuwait	[23]				1
Iraq	[128]				1
Oman	[78]				1
Palestine			[21]		1
Egypt	[129]				1
Global	[67], [87], [14], [112]			[130]	5
Total	31	4	6	3	44

Starting with the United States as the leading country for the application of the green building concept, Janak [115], concluded in his master thesis which studied three of the most prominent state-run green building programs, namely, New York, California, and Minnesota's programs as successful ones. They have relied mainly on following policies:

- The states has passed green building legislation
- The states have an executive order from the governor regarding green buildings
- The states has modified existing building codes to facilitate green buildings
- The states has tax incentives in place to encourage green buildings
- Grant programs, loans or other direct financing opportunities for green buildings are available

The study also concluded that the executive orders take a top-down approach to implementing green buildings for government building projects, and it appears that a top-down approach leads to a faster-growing program than an upward approach.

In addition, Darko et al. [51], based on analysing the professional views of green building experts from the US, identified that the; 'financial incentives and further market-based incentives', 'availability of better information on cost and benefits of green building', 'green labelling and information dissemination', 'mandatory green building codes and regulations', 'a strengthened green building technology research and education, and communication of new technologies', and 'educational programs for developers, contractors, and policy makers related to green building' are the six most important strategies to promote the adoption of green building among construction stakeholders in USA, respectively.

In Germany, as Europe's green leader, Buehler et al. [117], stated that all government levels in Germany, over the past 40 years, have reorganized policies to promote environmentally sustainable growth. Sustainability policies in Germany have been implemented for the first time on a small scale and were expanded in stages over time. This strategy called '*staged implementation'*, it is allow policy makers to experiment and the public to test a realistic example of the proposed program. Then, successful programs will be expanded while unsuccessful programs will be corrected and developed. In addition, Germany has succeeded in raising sustainability by using a range of tools, including below base rate mortgages, grants, tax breaks, budgetary allowances and soft loans [72].

In Australia, Bond [57], stated that since the founding of Green Building Council of Australia (GBCA) in 2003, there has been great interest in environmental sustainable development. This led the way in creating some of the most innovative and sophisticated green buildings that now exist in Australia. The study, based on the interviewers suggestions, recommended a set of government initiatives that would promote the spread of sustainable construction which were:

- Changes to the Australian Building Code
- Mandatory reporting on energy efficiency
- Increase the cost of energy to serve as an incentive for conservation
- Provide financial incentives for building owners to upgrade to a higher environmentally sustainable level
- Legislation against energy use

In Turkey, the result of Handan Gündoğan's thesis shows that from the viewpoint of survey respondents, the construction sector avoids green buildings because of three main reasons, which are; inadequate contracting and tender procedures to the green building principles, not enough government incentives to encourage green buildings, and regulations not urging a higher level of design and construction. This can be solved through education, government support, and research in green buildings, by adopting the following policies:

- Government should give support by financial incentive mechanisms
- Mandatory regulations may be effective
- Raised the level of awareness of the public about green buildings
- Creating education programs about green design in the academic programs of Engineering and architecture faculties
- More research and development on green buildings is essential especially by professionals of architects, and engineers

According to her opinion, the building industry should be forced to adopt and construct green buildings in terms of sustainability. In this case, green buildings will spread widely in most of the world including Turkey [44].

In China, green buildings have been progressively applied. In May 2006, China developed a long-term and medium-term strategic plan including green building. In October 2006, green buildings were clearly laid out in the outline of China's 11th

Five-Year Plan. In 2013, the Ministry of Housing, Urban and Rural Development (MOHURD) and the National Development and Reform Commission (NDRC) of China developed a plan of action on green buildings, aiming to achieve 20% of the new buildings up to the level of green building [123].

Qian Shi [120], identified that, green building implementation strategies in China should be as follows:

- The government should improve strategies and policies regarding to the green building adoption
- Should be customized the green building evaluation standard
- Should be established the basic database in advance
- Should be developed a large number of specialists in green buildings

Zhang et al. [121], mentioned that, to promote the task of sustainable development in China, there are many organizational strategies to be considered, as described follows:

- Government intervention and green development policies and their effects
- Strategies for creating awareness of green buildings
- Strategies to minimize the municipal service taxes for green building
- Involvement of stakeholders during the design stage of project
- A proactive strategy for educational programs for green building

In Malaysia, all government institutions support green buildings by providing many types of incentives and policy implementation. Energy and atmosphere, water efficiency, materials and resources are important elements in the concept of green buildings. Therefore, these three green criteria should be taken into account to developing the model of property tax incentive, including exemption from property tax, reduction of property tax, and tax credit real estate, and can be applied as strategies for the development of green buildings in Malaysia [65].

Furthermore, Bohari et al. [126], confirmed that the green approach in Malaysia concentrates on minimize carbon growth, conservation of energy and the green technology uses, including the construction industry. Malaysia's five-year development plan, NGTP, the National Energy Policy (NEP) and the National Climate Change Policy (NPCCC) play an important role in leading the building industry towards the agenda of sustainability. By following the top-down methods,

including launching diverse policies and initiatives, the Malaysian Government aims to guide the industry to become more sustainable in the completion of its projects. The study identified various green policies developed and introduced from the Malaysian government, which were; introducing ISO / EMS, unified laws for unified construction on environmental conservation, green technology, green procurement, green labeling, green building assessment tools, and waste management.

Moreover, Yang et al. [69], emphasize that green buildings need specific coverage to meet their new risk needs and new industry losses, which must be carefully identified, measured and priced. This has provided a new opportunity for the insurance industry to create green insurance for green buildings. This strategy is a very effective way to encourage more people to pay attention to investing in green buildings.

Regarding India, according to the case studies undertaken by Gesellschaft für Internationale Zusammenarbeit and the Overseas Development Institute [72], government of India has many political initiatives in the form of voluntary systems and plans in order to popularization green building practices and energy efficiency. The report summarized the possible policy action to promote green building in India in seven points as follows:

- Integrate sustainability into the state's internal regulations in buildings
- Performance-related incentives for compliance with laws and codes
- Provide standards for green building materials
- Integrate sustainability into all professional curricula
- Skills development and certify professional staff and service providers
- Local government tax concessions for green buildings
- Coordination between banks and refinancing bodies

In South Africa, Hankinson [100], discussed the factors affecting the implementation of sustainable design in KwaZulu-Natal, South Africa. The study established some solutions to sustainable design, provided by participants and similar studies, included:

- Improve sustainable design knowledge
- Support government policy and implement regulations
- Improved knowledge and scope of products and materials
- Utilize rating tools
- Educate the client

In their study on green building practice in Nigeria, Dahiru et al. [73], concluded that the green building is not currently practiced and is needed, there is no enabling environment in a legislation or laws format regarding the practice of green building. Based on the study results, they recommended some strategies that may promote green building implementation included:

- Government and professional bodies should enlighten the public through continuous professional development
- The Government should encourage the practice of green building by requesting the Environmental Management Plan from contractors as part of the tender documents
- The government, in cooperation with professional bodies in industry and private individuals, should establish a construction bank
- Designers must adopt a more integrated approach to designing and estimating the basics of green buildings
- Building materials manufacturers should use life cycle considerations as a basis for product development and should cooperate with designers in the development of environmentally friendly building materials
- The government should set an example by building green buildings for public buildings and providing incentives for those who want to build green buildings

Moreover, Nduka and Sotunbo [74], also conducted a study in Nigeria to investigate a professional construction conception on awareness of green building classification systems and accrued interest in building projects in Nigeria. The study found that the full establishment of Green Building Council of Nigeria (GBCN) is the way to encourage investors and practitioners in the built environment in adoption green building practices.

In Saudi Arabia, Alrashed and Asifa [127], conducted a survey with relevant professionals to investigate prospects for green buildings in Saudi Arabia. The results of the survey indicated that, building industry professionals have not yet realized the importance of sustainability in their practices. The study suggested options to promote the application of sustainable buildings in Saudi Arabia, which are:

- Improve building codes and standards
- Initiate major sustainable building projects
- Support the research in the discipline of green buildings
- Train people in the building sector through workshops and seminars
- Offer both undergraduate and postgraduate degrees in the discipline of green design
- Offer incentives for those who use sustainable design solutions
- Establish an information center to support the use of green design
- Develop comprehensive rating tools for green buildings

In this context, Mosly [101], conducted a study on green building in Saudi Arabia. The study added, to the above study, some recommendations that could help quicken the green building growth in Saudi Arabia, including:

- Redesigned all the governmental building projects as a green buildings
- Review the government subsidies of electricity and water
- Sharing, over social media, successful practices of green buildings

With regard to the policy of applying the concept of green building in Kuwait, based on the results of AlSanad [23] study, that public awareness of the concepts of green buildings is low and more efforts are needed to raise awareness to quicken the adoption and implementation the conception of green building in Kuwait. The study concluded that to promote the green concept in building industry in Kuwait, the government should be:

- Reconsider the current standards or introduce new regulations
- Launch appropriate guidelines to implement green practices to ensure sustainable methods adoption
- Cooperate with the private sector to ensure that the standards and rules are applied in an appropriate

In their study on green building in Oman, Abidin and Powmya [78], suggested recommendations to promote and encourage green building adoption and implementation in Oman. These recommendations included the following:

- Governmental support
- Improve knowledge and awareness
- Private and professional initiatives

In Egypt, Elfiky [129], highlighted that there are important steps have been taken by Egyptian government towards green buildings, summarized as follows:

- Establish an Egyptian Standards And Codes
- Establish an Egyptian Unified Building Law
- Establish an Egyptian Green Building Council (EGBC)
- Developed a national green building rating system called the Green Pyramid Rating System (GPRS)

The above mentioned study, concluded with some recommendations considered as a way to apply green building rules. These included the following:

- Providing incentives in the form of grants, priority for loans, and credit against taxes
- Establishment of an advisory board to assist and encourage the public
- Enforcing the green law of all state-owned buildings and then state-funded construction then for the private sector
- Enforcing contractors and building material product for environmental license (ISO 14000) and quality certificate (ISO 9002)
- Enforcement of minimum requirements, as rating systems do

Globally, Chan et al. [14], conducted a study to identify important strategies to promote the adoption of green buildings in the construction industry through a comprehensive literature review and presentation in an international questionnaire to assess the value of these promotion strategies. The study identified twelve promotion strategies to adopt green buildings, which are:

- Financial incentives for adopters of green buildings
- Mandatory government policies and regulations
- Green rating and labeling
- Improve the application of current green building policies
- Low-cost loans and government support
- Creating public environmental awareness
- More publicity through the media
- Educational programs for developers, contractors, and policy makers
- Availability of better information on benefits of green buildings

- Effective / proactive green building promotion teams / local authorities
- Availability of institutional framework for effective implementation
- Promoting green building research and communication

After the above-mentioned, through and extensive review of the literature on green building strategies and policies, a list of ten proposed strategies to promote green design adoption in the construction industry were developed, for achieving the objectives of this thesis study. These proposed strategies are provided in Table 2.12.

Table 2.12. The important strategies to accelerate green building implementation (Produced by the author)

Label	Strategies
ST1	Establishing sustainability as the core policy
ST2	Raising awareness towards green building and the environment in educational curriculum
ST3	Development and use of green building rating systems as assessment tools
ST4	Development and use of economic incentives
ST5	Modification of governmental building projects into green buildings
ST6	Implementing property tax incentives for green buildings
ST7	Sharing successful experiences related to green buildings through social media
ST8	Encouraging green building research
ST9	Establishment of an official green building body
ST10	Promotion of the construction materials industry to depend on local resources

The literature review that has been compiled and presented, summarize previous studies on green design adoption in the building industry in different countries around the world. Most of the previous studies have focused more on motivators, barriers, the role of decision makers and green building adoption strategies in general. As such, most of the results and suggestions of these studies are general for green buildings, which require validation as regards their application to the adoption of green buildings. Therefore, conducting research focusing specifically on the adoption of green buildings, in order to validate the results of literature review in this context, deserves attention.

CHAPTER III
RESEARCH METHODOLOGY

This chapter presents the research methodology used in this study. The chapter explains the research design of the study, which uses a combination of two research philosophies, i.e. integrating the quantitative and qualitative research approach which is called the "Triangulation Technique". It also includes the methods used to collect data, respondents selection, study limitations, and statistical analysis tools used for validation and analysis of final data.

The study used two main sources of data collection: primary and secondary data. Primary data sources were collected from surveys and semi-structured interviews, while secondary data collection sources were textbooks, journal articles, websites, conference papers and official reports.

To achieve the study aims, three main phases of data collection were employed; the first phase was a comprehensive literature review, questionnaire survey was the second phase, while the third phase involved semi-structured interviews.

This chapter contain three main sections including; research design, population identification, and data collection methodology. The key targets of this chapter are:

1. Explanation of the data collection process
2. Explanation of the sample survey identification
3. Description of the technique used for analyzing the statistical data

3.1 Research Design

The research design involves the determination of the method and tools of data collection and how they will be analysed, in order to obtain scientific and convincing answers to the research questions. Research design is a guiding system of researcher to collect the appropriate data, then analyses the data and interprets it as a logical

model of the guide that allows the researcher to; make a hypothesis regarding the causal relationships between the variables being researched, or put a questions regarding the research objectives. Depending on the nature of the study, whether exploratory, descriptive or incidental, the research framework is constructed.

This study explores the motivator and barrier factors, which affect the green design adoption in building projects of Libya in order to establish the policies and strategies for implementing the green design in building projects of Libya. To achieve this objective, qualitative and quantitative approaches are applied. While the qualitative method is based on conducted interviews used for social or human-related phenomena, the quantitative method is used to confirm the pre-established theories by statistical data [131]. Therefore, combining both research approaches into social sciences can lead to strong and valid results of the research because the qualitative method may complement quantitative results, which will increase real and reliable results.

This study is primarily designed on the basis of the methodology adopted by most of the previous studies that conducted research in the built environment field. From the literature review on research methods, the researcher believes that the triangulation approach is suitable for validating the theoretical framework and achieving the objectives of this research. Therefore, the mentioned approach was adopted for the study. Two main sources of data collection were used in this study, which are primary and secondary data. While primary data sources were collected from the questionnaire survey, and semi-structured interviews, the secondary data sources were gathered from textbooks, journal articles, web sites, conference papers and official reports. For achieving the study objectives, three main phases of data collection were adopted, including;

- Literature review
- Questionnaire survey
- Semi-structured interviews

The first phase was the literature review, which refer to the secondary data collection through a comprehensive literature review. The area of green design concept, motivators for green buildings, barriers for green buildings, the role of decision

makers and the strategies to adopt the green design concept, were the main focus areas of the literature review. The second phase of data collection was the questionnaire survey, including both pilot and final questionnaire. While the pilot questionnaire was conducted to ascertain whether the questionnaire model is clear and feasible or not, the final questionnaire was conducted to obtain the required data for analysis.

The qualitative method of in-depth semi-structured interview was adopted as the final phase of data collection; the submission of detailed questions to selected experts via email and social media were used in order to gather the required detailed data.

All the collected data were validated and analysed utilizing quantitative statistical analysis package software (SPSS) Version 25. Descriptive Statistics Analysis, Univariate Analysis of Variance, and a one-Sample t Test were conducted to describe and measure the level of variables . Figure 3.1. illustrates the research design of this study.

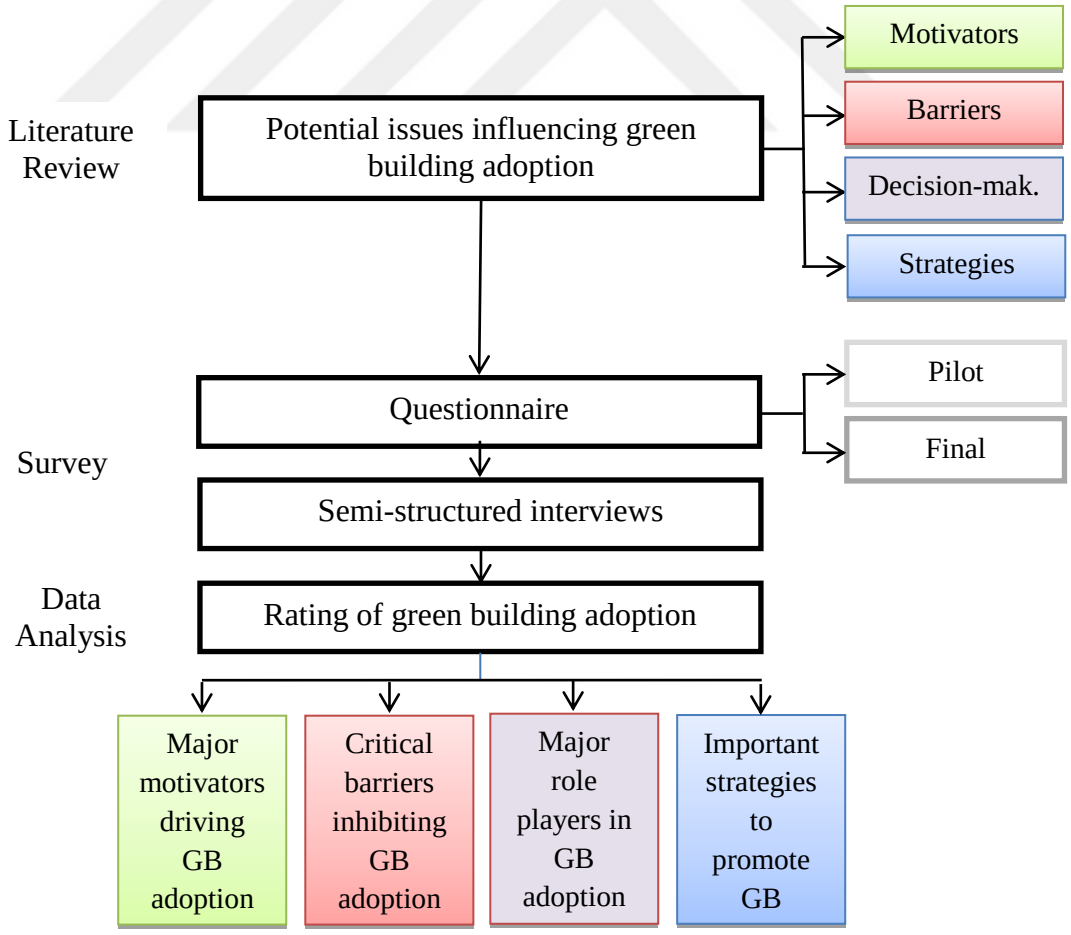

Figure 3.1. Research study design

3.2 Literature Review

Literature review was the first stage of data collection. The literature was thoroughly reviewed covering all areas related to the research problem, which were retrieved from many types of materials that included published studies used in the literature review survey in the specific field of study. From exploring the literature review, the problem of the research, the influencing variables and the dominant variables were determined accurately.

The literature review provides the researcher with the background of green building design, green building motivators, and green building barriers. The literature also helps the researcher to identify decision makers in green building projects and green building strategies and policies. From this phase, the potential variables of the study were determined. Verification of these variables is achieved and confirmed through the next phases of data collection in the questionnaire survey and semi-structured interviews.

3.3 Questionnaire Survey

The questionnaire survey is usually used in research either as to why participants conduct or behave in relation to the situation or to require participants to evaluate their agreement or disagree with the reasons why they act or act with regard to the situation [132]. In the green building literature, questionnaire survey has been a popular technique to explore the issues influencing the adoption of green design concept in construction projects [51]. The best method to understand the motivators and barriers of green design can be achieved by learning from the direct practitioners of green design [44], [47]. Thus, a questionnaire survey was used as a quantitative research approach to collect the required data for this study.

3.3.1 Questionnaire Design

The questionnaire, as displayed in Appendix A, was designed based on the theoretical framework and aim of the study. The questionnaire included three sections. The first section was constructed based on questions regarding the personal information and experience of the respondent.

The second section was arranged to comprehend respondent's perceptions considering the decision-makers role, as well as the motivators, and barriers for adopting the green design concept in Libyan building projects. The motivators were encoded as M1-M24, described, and presented in a table (see Table 2.4), and this also applies to the barriers where they were encoded as B1-B24, described, and presented in a separate table (see Table 2.8).

The last section consisted of a list of potential strategies to promote the adoption of green design concept in building projects. These potential strategies were encoded as S1-S12, described, and presented in a separate table (see Table 2.12). In addition, this section was made out of open-ended questions where the respondents could compose their comments and their recommendations for implementing the green design concept.

In second and third sections of the questionnaire, the participants were asked the extent to which they agree or disagree to the given motivators, barriers, and strategies to be applied in Libya. The variables were ranked on a four-point Likert scale that ranged from 1, as 'definitely does not affect'; to 4, as 'definitely affects'. By using the four-point Likert scale, participants were given the ease to decide on their point of view. A "neutral" option was not offered in the questionnaire to assert a forced choice method to answer the corresponding questions, thus obtain specific and explicit answers [83].

To ensure access to the required information, the researcher followed effective strategies of design of questionnaire,, in order to increase the rate of response. The questions of the questionnaire are designed to be short, obvious, and plain as possible as, and were well-coordinated on five pieces of A4-size paper.

At the end of the questionnaire form, the researcher provided an area for respondents to write down their names and addresses if they were interested in receiving the results of the final survey for free as well as an invitation to write any comments in the allocated space, that to encourage and enhance the questionnaire survey return rate.

3.3.2 Target Respondents and Sample Selection

It is very important to identify a research group that reflects the real picture of the study. Since this research focuses on the adoption of green design concept in building projects, the appropriate professions were determined as architects and engineers. Therefore, the respondents of this study are comprised of professional architects, structural engineers, mechanical engineers and electrical engineers who are working in the construction industry, including consultancy firms in both governmental and private sectors.

As the survey was aimed at the Libyan building industry, the first step was to contact institutions and organizations related to the construction industry for permission to distribute the questionnaire to some of its employees. The current political situation of Libya, which leaded to existence of two separate governments and deterioration of the security situation, had limited the survey only within the capital Tripoli. The voluntary technique used in the population sample was relative, and the survey was a sample within a sample. Of the institutions and organizations initially contacted, only a few selected had agreed to participate. In total eight governmental institutions, which played an important role in the development plans and programs of the state and involved in the design works of major projects, agreed to provide their assistance in distributing the survey. These institutions were:

1. Engineering Consulting Office for Utilities (ECOU).
2. National Consulting Bureau.
3. Organization for Development of Administrative Centers (ODAC).
4. Housing and Infrastructure Board.
5. Cities Development Organization.
6. Centre for Solar Energy Research and Studies (CSERS).
7. Industrial Research Centre / Building Materials Department (IRC).
8. Academics in Higher Education Institutions

In addition, for private sector participation, a sample of architects and engineers was chosen from some of engineering and consulting offices in Tripoli city, which included:

1. Private Architecture Firms
2. Private Consulting Companies

These local stakeholders were considered to be appropriate for this survey as they had practical experience in the construction sector of Libya. For further information about the selected governmental institutions, see Appendix B.

3.3.3 The Pilot Questionnaire

The pilot survey is a copy and test of a main study that helps point out any problems linked with the study tools, such as the questionnaire. This view was supported by many researchers who stated that conducting a pilot survey before the actual survey has many benefits such as testing the suitability of the search method used and revealing any weaknesses, deficiencies, uncertainty, or inexactness of meaning, or other problems that need to be corrected before distributing the actual questionnaire. Prior to the final questionnaire survey, a pilot survey was conducted to test the comprehensiveness and relevance of the questionnaire as well as to ascertain whether the questionnaire model is clear and feasible or not, and to avoid any ambiguous words and sentences. A group consisting of one person from each of the selected organizations was adopted as a sample for conducting the pilot questionnaire. Therefore, electronic copies were sent via personal email account, to ten specialists in the field of building design in Libya belonging to the selected organizations during the period from 10/04/2017 to 20/04/2017. Based on feedbacks from the pilot study, the questionnaire was finalized.

3.3.4 The Final Questionnaire

After making the necessary modifications to the questionnaire form, based on the observations received from the pilot questionnaire, the final version of the questionnaire form was approved by the 'Çankaya University Ethics Committee', and a report was received about it on 11 of May 2017, as displayed in Appendix C.

To avoid non-response situations due to the frequent interruptions of electricity and the Internet services in Libya as well as to raise the interest of the participants, hardcopies of the final questionnaire form, on A4 white plain paper, were distributed manually, with the help of some friends, to the target population during the period of the business days of the week started on 02 of July 2017. By the end of Thursday's work 06 of July 2017, one hundred and fifty hard copies of the final version of the questionnaire were completely distributed by the same percentage to the target population which mentioned earlier. Three weeks later, by the end of the working day

on Thursday 27 of July 2017, 96 replies (64%) of all questionnaires distributed had been received.

After a careful review, the responses were classified as follows; the total number of distributed questionnaire forms were 150 copies (100%), the total returned were 96 respondents (64%), the total rejected were 22 respondents (14.66%), and 74 replies were found to be worthy for analysis the required data, and giving a good final rate of response of about 49.33%, which is acceptable for the study of social sciences. The details are shown in the Table 3.1. Some of the questionnaires were rejected because of;

- ✓ Some of them were returned empty,
- ✓ Some respondents did not follow the instructions mentioned, and some parts of the questionnaire were incompletely answer.

Table 3.1. Distribution of respondents to the target population

Institutions/Organizations		Distributed	Returned	Rejected	Accepted	
					Quantity	%
Governmental institutions	Engineering Consulting Office for Utilities	15	10	3	7	46.66
	National Consulting Bureau.	15	6	3	3	20.00
	Organization for Development of Administrative Centres	15	14	2	12	80.00
	Housing and Infrastructure Board.	15	8	3	5	33.33
	Cities Development Organization.	15	7	1	6	40.00
	Centre for Solar Energy Research and Studies	15	10	2	8	66.66
	Industrial Research Centre / building materials department	15	3	2	1	6.66
	Academics in Higher Education Institutions	15	11	0	11	73.33
Non-Government Organizations	Private Architecture Firms	15	13	4	9	60.00
	Private Consultant Companies	15	14	2	12	80.00
Total		150	96	22	74	49.33
%		100	64.00	14.66	49.33	

The size of the sample from 20 to 30 is appropriate to enable internalization in exploratory studies. Low response rates are typical in studies involving construction practitioners [78]. The result of the survey is biased and low value if the response ratio is less than 30-40% [74].

The sample size of 74 respondents, and response ratio of 49.33%, compares favorably with the past similar green building related studies. The sample size of the survey of Gündoğan [44], was 64 respondents. Abidin and Powmya [78], although they adopted a snowball sampling style to gain more response, only 67 responses of 200 questionnaires (33%) were obtained for analysis. Dahiru et al. [73], adopted only 40 respondents out of 50 participants and used for analysis.

All collected data were analyzed using quantitative statistical analysis package software (SPSS) Version 25. 'Descriptive Statistics Analysis', and 'Univariate Analysis of Variance' were conducted to describe the demographic variables and also to test perception of green building tendency, while 'A one-sample t Test' was conducted to measure the level of importance of variables. The results of these analyses and tests will be presented in details in the next chapter.

3.4 Semi-Structured Interviews

The semi-structured interview approach is the most widely used research technique in qualitative approaches, aimed at exploring the perceptions of people interviewed in their surroundings [133].

Semi-structured interviews were employed as a final phase of data collection for this study in order to obtain more professional and detailed data. Semi-structured interviews have many advantages such as getting complete answers to all questions with flexibility in rewriting the questions based on aims of study. In addition, the application of this method allows interviewers to engage more complex questions that are difficult to express through the questionnaire form.

The semi-structured interview is closer to a qualitative research approach, it was conducted in order to extract additional data that will improve the quantitative data obtained through the questionnaire survey. Semi-structured interviews can help explain some of the ambiguous answers obtained from the questionnaire. The

interview aims to validate the data obtained in the questionnaire survey. Semi-structured interview was conducted given the limited local knowledge and technical know-how related to green building technologies, as well as the lack of literature in the implementation of such projects in the Libyan construction industry.

3.4.1 Participants of the Semi-Structured Interviews

As the objective of the interview is to obtain more detailed data, and in order for these data to be impartial and neutral, it was recommended that the participants of the semi-structured interviews should be selected among the target population mentioned earlier, which had participated in the final questionnaire. Therefore, ten experts were asked via personal emails, which obtained from their replies of final questionnaire, to participate in a personal interview. The participants were selected based on their responses to the questionnaire and according to their years of experience in the construction industry and the numbers of building projects they were involved in [58]. The ten participants were briefly oriented on the literature available from other countries on green building benefits and government support to the construction industry, as well as strategies associated with the implementation of green buildings to enlighten them on the subject and create a solid basis for interviews [133].

3.4.2 Design and Contents of the Semi-Structured Interviews

In-depth semi-structured interviews were conducted with experts in the construction industry in Libya, as an attempt to ascertain other problems affecting green building practice in the country. The obtained data from interviews is used to validate the motivators, barriers, and strategies, which was obtained from the final questionnaire survey. For this objective, interview's questions were developed to cover these aspects in a sequential order, including 22 questions, most notably were:

- What were the major motivations that drive to be involved in green design?
- What were the critical barriers that hindered to be involved in green design?
- Do you think that green buildings are good for the Libyan environment?
- Is there a market of green building in Libya, particularly in Tripoli?
- What are the attitudes of the clients towards green building design?
- What can be the key strategies to increase the advantages of green buildings?
- What can be done to accelerate the green building movement in Libya?

The interview's questions were more of explanatory rather than descriptive to explore the perceptions of these experts toward the adoption of green design in building projects. More details and the rest of the interview's questions are presented in Appendix D.

The interview's questions were adopted by the 'Çankaya University Ethics Committee', and a report about it was received on 20 of November 2017, as displayed in Appendix E. Ten experts, who were asked to participate in advance, were contacted and communicated with them via their personal email accounts and social media. An electronic copy of the interviewer's questions was sent to them as an attached file through their emails during the period from 20 of November 2017 to 14 of December 2017.

Two weeks later, by the end of the working day on 28 of December 2017, all responses were received (a rate of 100 percent). These responses were analyzed and summarized according to the objectives of the questions of interview. The results of these analyses will be presented in detail in the next chapter.

CHAPTER IV
ANALYSIS AND RESULTS

This chapter presents the findings of quantitative and qualitative data obtained from two different sources of the preliminary data collection procedure and discusses their implications. In this study, the data obtained were collected mainly from the final questionnaire survey and interviews survey. Therefore, the chapter is divided into two parts, namely the results of questionnaire, and interviews survey. Section one presents the results of the final and detailed questionnaire survey, while section two presents the results from the descriptive analysis of the data collected from semi-structured interviews. The results obtained either from the questionnaire survey or from the semi-structured interviews are in compliance with the research objectives which were identified previously as follows:

- To identify the major motivators for developing green buildings.
- To identify the critical barriers against developing green building.
- To identify the major role players in developing green buildings.
- To identify the important strategies for green building implementation.

4.1 The Final Questionnaire Findings

The aim of the final questionnaire was to gather data for detailed analysis in order to answer the questions of research and prove the research theoretical framework which developed by the literature review. The following findings were derived from 74 valuable responses obtained from the final questionnaire survey conducted in Libya during the period from 02 of July 2017 to 06 of July 2017.

4.1.1 Reliability of Scales

In order to measure the internal consistency between the various factors to assess the reliability of the four-point scales, the Cronbach alpha coefficient was used [51]. Three reliability tests are carried out; one for the Motivators Scale, one for Barriers

Scale and the last one is for Strategies Scale. Ideally, the Cronbach alpha coefficient of a scale should be equal or above 0.7 (Connelly, 2011). The Cronbach alpha values of this study's tests were 0.893 for Motivators, 0.927 for Barriers, and 0.900 for Strategies, which were all greater than the threshold of 0.7, indicating that the measurements using the four-point scales were reliable at a 5% significance level. Thus, the collected sample as a whole, suitable for further ranking, and t-test analyzes can be processed in the following sections. Table 4.1. shows scale Cronbach's Alpha for each scale. In general, results indicate good scales that can be used in measurements of the indicated variables.

Table 4.1. Reliability Test of Motivators, Barriers, and Strategies Scales

Scale	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	Number of Items
Motivators	0.893	0.912	24
Barriers	0.927	0.928	24
Strategies	0.900	0.906	10

4.1.2 Demographic Profile of Respondents

Under descriptive statistical analysis, descriptive for demographic variables are produced. The results of the final survey has shown that 36.5% of the respondents were architects, 32.4% were civil engineers, 10% were mechanical engineers, and 7% were electrical engineers, while the urban and regional planners accounted only 4% of the total sample. This suggests that architects and civil engineers are more engaged in the design process than other project participants are. Table 4.2. shows the distribution of sample subjects according to their job title.

Table 4.2. Distribution of sample according to job titles

Job Titles	Frequency	Percent
Architect	27	36.5
Civil Engineer	24	32.4
Mechanical Engineers	10	13.5
Electrical Engineers	7	9.5
Urban & Regional Planner	4	5.4
Contractor	1	1.4
Investor	1	1.4
Total	74	100

The survey indicates that 41.9% of respondents have more than fifteen years of experience, followed by 14.9% of them with at least ten years of experience. This indicates that more than half of the respondents (56.8%) have significant experience and therefore are familiar with the design process that helps to provide this study with reliable data. Table 4.3. shows the distribution of sample subjects according to their years of experience.

Table 4.3. Distribution of sample according to the years of experience

Years of Experience	Frequency	Percent
Less than 5 years	17	23.0
From 5 to 10 years	15	20.3.4
From 11 to 15 years	11	14.9
More than 15 years	31	41.9
Total	74	100

The survey also indicates that 41.9% of respondents had an involvement of more than fifteen buildings, and 16.2% of them had an involvement at least ten buildings. This also indicates that more than half of the respondents (58.1%) have extensive experience in building projects and therefore the data collected from this survey are reliable and accurate because they were obtained from respondents with long experience in building sector in Libya who participated in many building projects. Table 4.4. shows the distribution of sample subjects according to the number of building projects they have been involved in.

Table 4.4. Distribution of sample according to the number of building projects

Number of Building Projects	Frequency	Percent
Less than 5 buildings	25	33.8
From 5 to 10 buildings	6	8.1
From 11 to 15 buildings	12	16.2
More than 15 buildings	31	41.9
Total	74	100

It is logical that the readings of the years of experience correspond to the readings of the number of building projects respondents were involved in. Figure 4.1. which combines the data of both Tables 4.3 and 4.4, clearly shows that those have more than fifteen years of experience (41.9%), were involved in more than fifteen building projects (41.9%). This gives a positive indication of the reliability and accuracy of the data obtained.

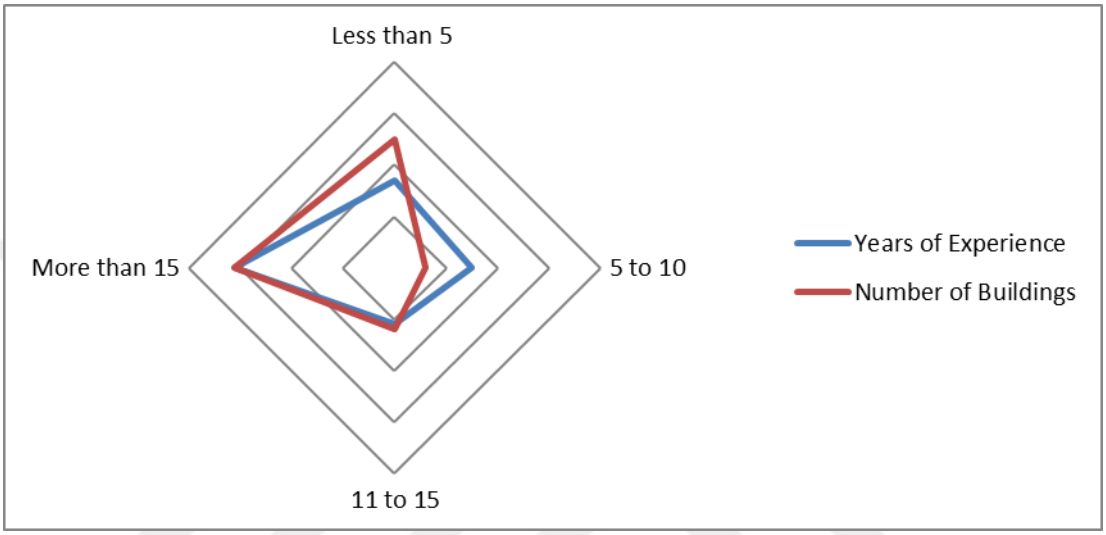

Figure 4.1. Distribution of sample according to the years of experience with the number of building projects

The majority of the respondents have their knowledge through the internet, seventy seven (77.02%) of the respondents confirmed that internet search was the main source of their knowledge of green buildings followed by forty two (56.75%) of them confirmed that sharing knowledge with their colleagues was the primary source of their knowledge of green buildings through, while only eleven (14.86%) of the respondents answered that taking related courses was the master sources of their knowledge of green buildings. This gives the impression that the majority of respondents had got their knowledge of green buildings through their personal efforts. Table 4.5. shows the distribution of participants' reply regarding to the main source of their knowledge in green buildings. While Figure 4.2 shows this distribution in a chart form.

Table 4.5. Sources of knowledge of green buildings

Sources of Knowledge	Participants' Reply		Total
	confirmed	unconfirmed	
Attending conferences	18	56	74
Reading commercial publications	30	44	74
Taking related courses	11	63	74
Working with consultants	18	56	74
Sharing knowledge with colleagues	42	32	74
Internet research	57	17	74

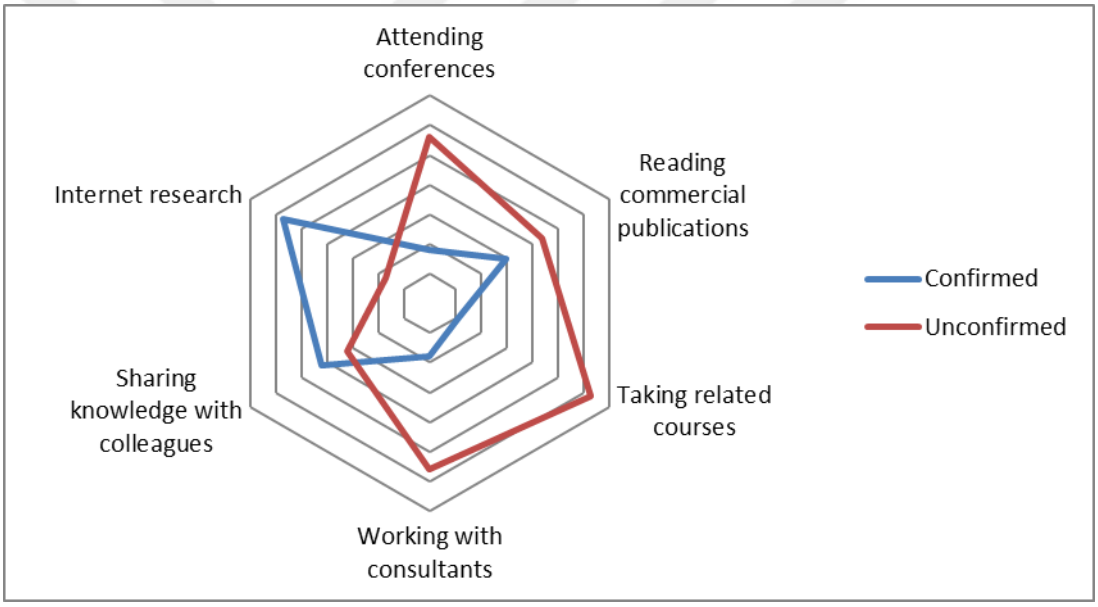

Figure 4.2. Sources of knowledge of green buildings

4.1.3 Perception of Green Building Tendency

In order to determine the extent of the participants' tendency towards the subject of "green buildings", their opinion regarding the "need for green buildings" in Libyan building projects were asked and then measured, using four-point scale ranging from (1) strongly disagree to (4) strongly agree. From the survey, as shown in Table 4.6. almost all respondents (94.6%) whether strongly agreed or agreed that the Libyan building projects needed to become 'green'.

Table 4.6. Participants opinion regarding the need for Libyan building projects becoming 'green'

Participants' opinion	Frequency	Percent
Strongly disagree	0	0.0
Disagree	4	5.4
Agree	39	52.7
Strongly agree	31	41.9
Total	74	100

In the context of the subject, Table 4.7. shows that more than half (51.4%) of the respondents strongly agreed, followed by 43.2% agreed that the construction policies in Libya needed to be developed to keep up with green buildings.

Table 4.7. Participants opinion regarding the need to develop the Libyan building policies

Participants' opinion	Frequency	Percent
Strongly disagree	1	1.4
Disagree	3	4.1
Agree	32	43.2
Strongly agree	38	51.4
Total	74	100

This gives an indication of the need of adopting the green design concept in Libyan building projects, as well as to the importance of this study as an attempt for developing the Libyan construction policies.

In the same context, and to expand the knowledge of the extent of awareness and culture of the participants, with regard to the green building adoption of the concept of green buildings, the respondents were asked to express their opinion on the mandatory or voluntary application of the concept of green design in Libyan building projects, both in public or private buildings.

Figure 4.3. shows that, more than half (64.86%) of the respondents confirmed that the application of the green design concept should be mandatory for public buildings. On the other hand, about two third (74.32%) of the respondents confirmed that the application should be voluntary for private buildings.

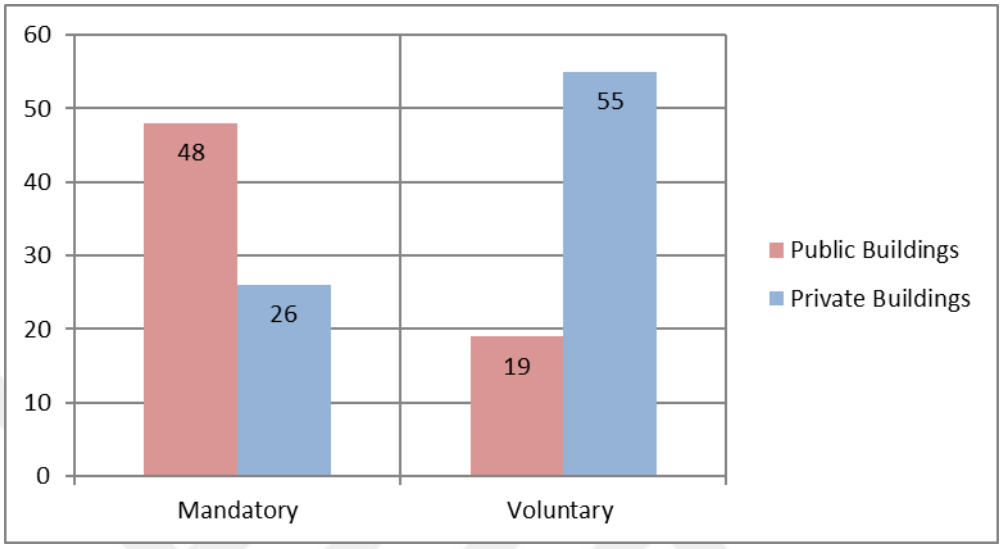

Figure 4.3. Policy choice of the application of the green design concept in public and private buildings

This gives a positive indication of the commitment of the participants to apply the principles of green buildings in the design and implementation of public building projects entrusted to them, that since most of them are employees in institutions of the government, directly or indirectly.

4.1.4 Building types, and decision-makers role in green building adoption

The mean value ranking method has been widely used in previous studies related to green buildings in order to rank and determine the important and critical factors among numerous factors. The t-sample test was used to ascertain the significance of the mean value of each factor [51]. The mean difference value ranking method was used in this study with the one-sample t-test. Here in this section, the one-sample t-test was used to measure the level of; importance of building types in designing as green buildings, importance of decision-makers in implementing green buildings, and importance of decision-makers in managing green buildings. The test value used is the midpoint of a seven point scale namely (4).

4.1.4.1 Level of importance of type of building in designing as a green building

A one-sample t test was conducted on 'the level of importance of building types as to designing them as green buildings' scores to evaluate whether their mean was significantly different from the midpoint of a seven point scale. The participants were requested to rank seven types of buildings according to their level of importance to be designed as green buildings. The results of the participants' perceptions are shown in Table 4.8.

The result shows that 'Health Care Buildings' had the highest mean difference (1.35) in being the most important of type of buildings that should be designed as a green building, while 'Industrial Buildings' had the lowest mean difference (-2.00) in being the least important of type of buildings in designing as green building. Mean differences are significant at p> .05 for all building types except Governmental Buildings.

Table 4.8. Ranking of type of buildings in designing as green building

Type of Building	Mean	Test value = 4			Rank
		Mean Difference	t	Significance	
Educational Buildings	5.16	1.162	5.758	0.000	**2**
Commercial Buildings	3.29	- 0.702	- 3.944	0.000	**5**
Governmental Buildings	4.08	0.081	0.442	0.660	**4**
Industrial Buildings	2.00	- 2.000	- 10.609	0.000	**7**
Residential Buildings	4.87	0.878	3.779	0.000	**3**
Hospitality Buildings	3.22	- 0.770	- 4.433	0.000	**6**
Health Care Buildings	5.35	1.351	7.345	0.000	**1**

Figure 4.4. represents these differences with the order of t-test values. The results support the conclusion that there are differences in the level of importance of building types to be designed as green buildings.

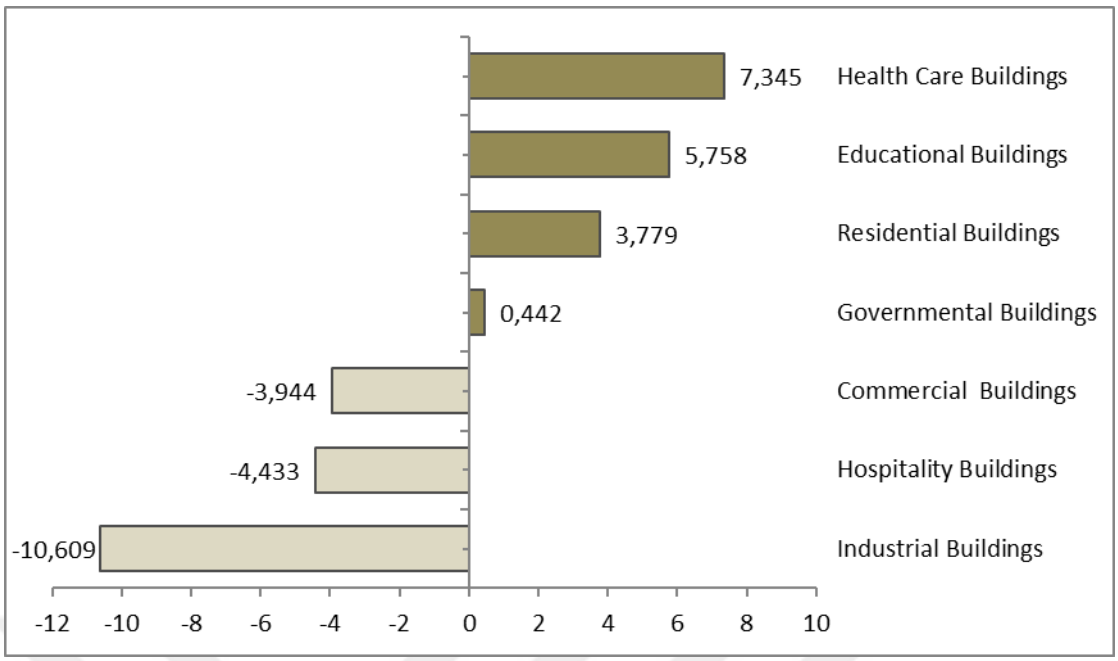

Figure 4.4. t-value of type of buildings in designing as green building

4.1.4.2 Level of importance of decision-makers role in implementing green buildings

The participant were also asked to rank the given decision-makers according to their level of importance in implementing green building projects. A one sample t-test was conducted to measure whether the difference in mean is significant or insignificant. The sample mean, mean difference, and t-test value for each category is presented in Table 4.9. The result shows that 'Architect' had the highest mean difference (1.945) in being the most important decision-maker role in implementing green buildings, while 'Occupants' had the lowest mean difference (-1.270) in being the least important decision-maker role. Mean differences are significant at p> .05 for all decision-makers categories except for Governmental Authorities.

Figure 4.5. represents these differences in t values. The results support the conclusion that there are differences in level of importance of decision-makers role in implementing green buildings.

Table 4.9. Ranking of decision-makers role in implementing green buildings.

Decision-makers	Mean	Test value = 4			Rank
		Mean Difference	t	Significance	
Architect	5.94	1.945	10.437	0.000	**1**
Engineer	5.12	1.121	6.920	0.000	**2**
Project Owner	3.20	- 0.797	- 3.881	0.000	**5**
Project Funder	3.52	- 0.472	- 2.431	0.000	**4**
Project Contractor	3.29	- 0.702	- 4.225	0.000	**6**
Occupants	2.72	- 1.270	- 6.019	0.000	**7**
Government Authorities	4.29	0.297	1.138	0.220	**3**

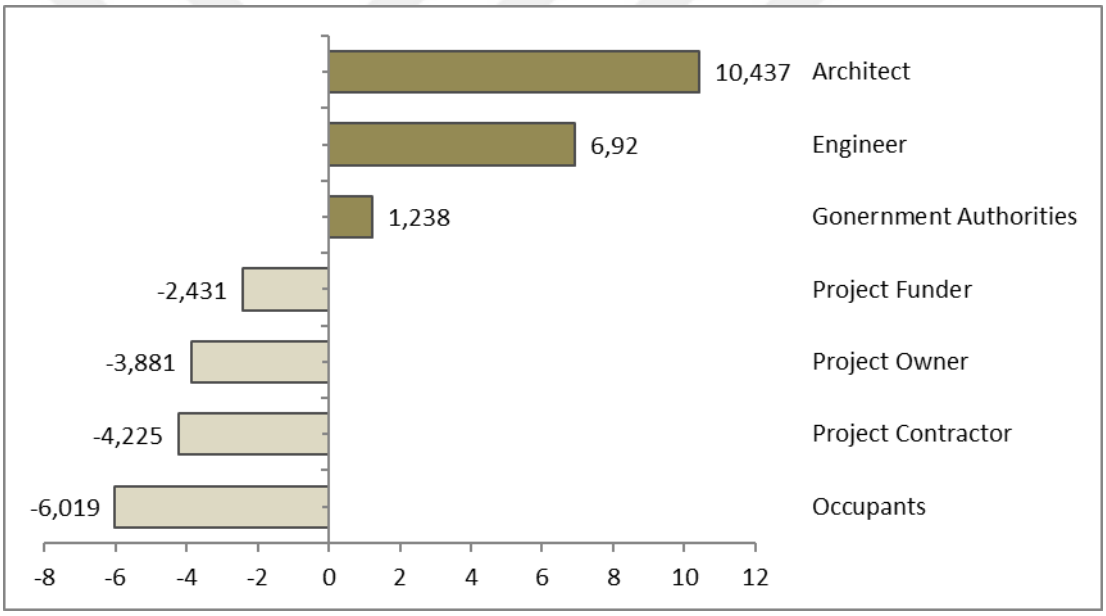

Figure 4.5. t-value of decision-makers role in implementing green buildings

4.1.4.3 Level of importance of decision-makers role in management of green buildings

Another question was asked to the participants for ranking the given decision-makers according to their level of importance in the management of green building projects. A one sample t-test was conducted to evaluate the replies of this question. The results are summarized in Table 4.10. It shows that 'Architect' had the highest mean difference (1.189) in being the most important decision-maker role in the management

of green building projects, while 'Government Authorities' had the lowest mean difference (-1.351) in being the least important decision-maker role. Mean differences are significant at p> .05 for all decision-makers categories. The calculated t-value results of decision-makers role in management of green building projects are presented graphically in Figure 4.6.

Table 4.10. Ranking of decision-makers role in management of green buildings

Decision-makers	Mean	Test value = 4			Rank
		Mean Difference	t	Significance	
Architect	5.189	1.189	6.881	0.000	**1**
Engineer	4.351	0.351	2.062	0.043	**4**
Project Owner	5.135	1.135	5.949	0.000	**2**
Project Funder	4.473	0.472	2.694	0.009	**3**
Project Contractor	2.864	- 1.135	- 6.424	0.000	**7**
Occupants	3.337	- 0.662	- 2.653	0.010	**5**
Government Authorities	2.648	- 1.351	- 4.986	0.000	**6**

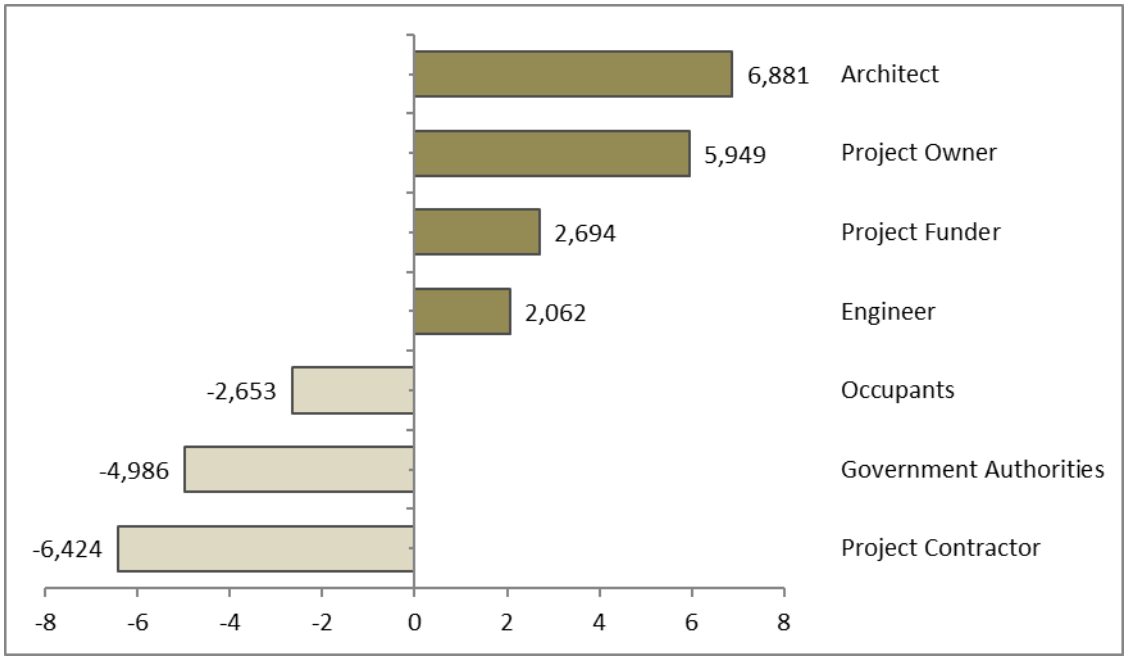

Figure 4.6. t-value of decision-makers role in management of green buildings

4.1.5 Evaluation of motivators for adopting green buildings

One-sample t test is used to evaluate the motivators that affect the implementation of green design in Libyan building projects. This test is used here to measure the level of effect compared to the average mean value of scores reported for each sub group of motivators namely; Environmental, Economic, and Social motivators.

A one-sample t test was conducted on Environmental Motivators, Economic Motivators, and Social Motivators that affect the implementation of green design in Libyan building projects scores to evaluate whether their mean was significantly different from (3.109), the average mean value of scores reported for the three types of motivators.

Table 4.11. shows one sample t test of the three types of motivators that affect the implementation of green design in Libyan building projects. Environmental Motivators varied from the test value significantly (3.109), $p < .05$. 'Environmental Motivators' is the most effective factor which had the highest positive mean difference (0.264). The least effective motivation factor is 'Economic Motivators' which had the highest negative mean difference (-0.095).

Figure 4.7. represents these differences in t values. These results support the conclusion regarding, Environmental Motivators being the most effective factor in the implementation of green design in Libyan building projects.

Table 4.11. Ranking of Environmental, Economic, and Social Motivators

Type of Motivators	Mean	Test value = 3.109			Rank
		Mean Difference	t	Significance	
Environmental Motivators	3.373	0.264	5.509	0.000	**1**
Economic Motivators	3.013	- 0.095	- 1.841	0.070	**3**
Social Motivators	3.037	- 0.071	- 1.185	0.240	**2**

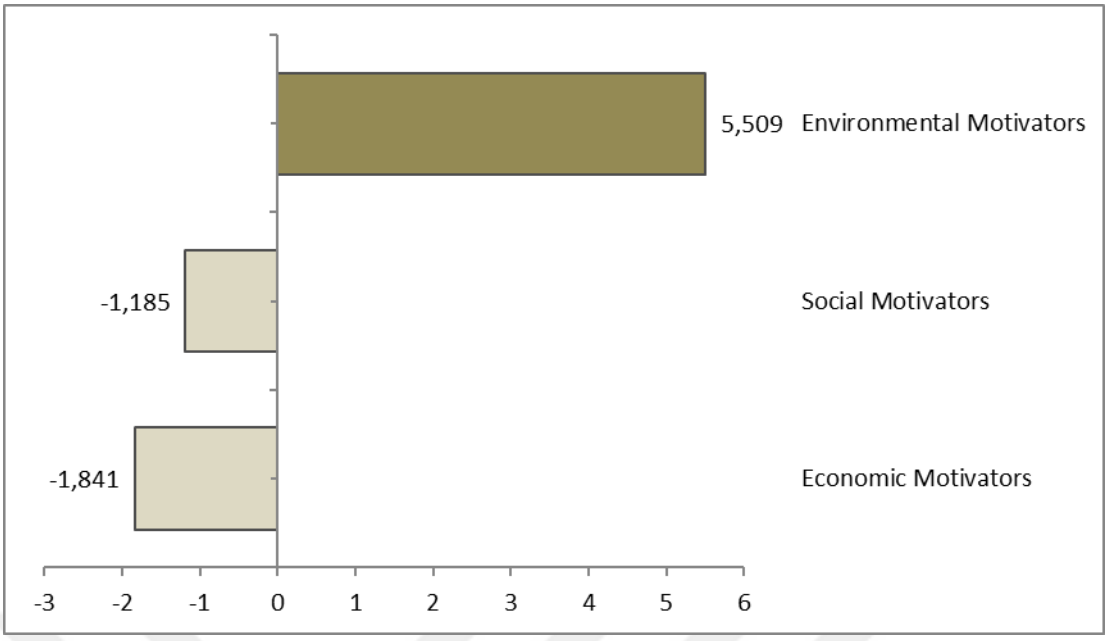

Figure 4.7. t-value of environmental, economic, and social motivators of green building adoption

4.1.5.1 Environmental Motivators

The participants were asked to rank the major environmental motivators as how they affect the implementation of green design in building projects according to their experience. A one-sample t test was conducted to evaluate whether their mean was significantly different from the average mean value of scores reported for environmental motivators, namely (3.373).

The overall result in Table 4.12. and Figure 4.8. show that none of the environmental motivators varied from the test value significantly (3.373), $p < .05$. The most effective environmental motivator was 'Protection of the environment and ecosystem' which had the highest positive mean difference (0.139). The least effective environmental motivator was 'Improve reusable and recycle building elements' which had the highest negative mean difference (-0.117). The results support the conclusion that there are no significant differences between environmental motivators that affect the implementation of green design in Libyan building projects.

Table 4.12. Ranking of Environmental Motivators

Environmental Motivators	Mean	Test value = 3.373			Rank
		Mean Difference	t	Significance	
Protection of the environment and ecosystem	3.513	0.139	1.924	0.058	**1**
Control of climate change	3.432	0.058	0.915	0.363	**2**
Compatibility with environmental regulations	3.297	- 0.076	- 1.214	0.229	**5**
Increasing indoor air quality	3.378	0.004	0.076	0.939	**3**
Recycling and waste reduction	3.364	- 0.008	- 0.131	0.896	**4**
Improve reusable and recycle building elements	3.256	- 0.117	- 1.752	0.084	**6**

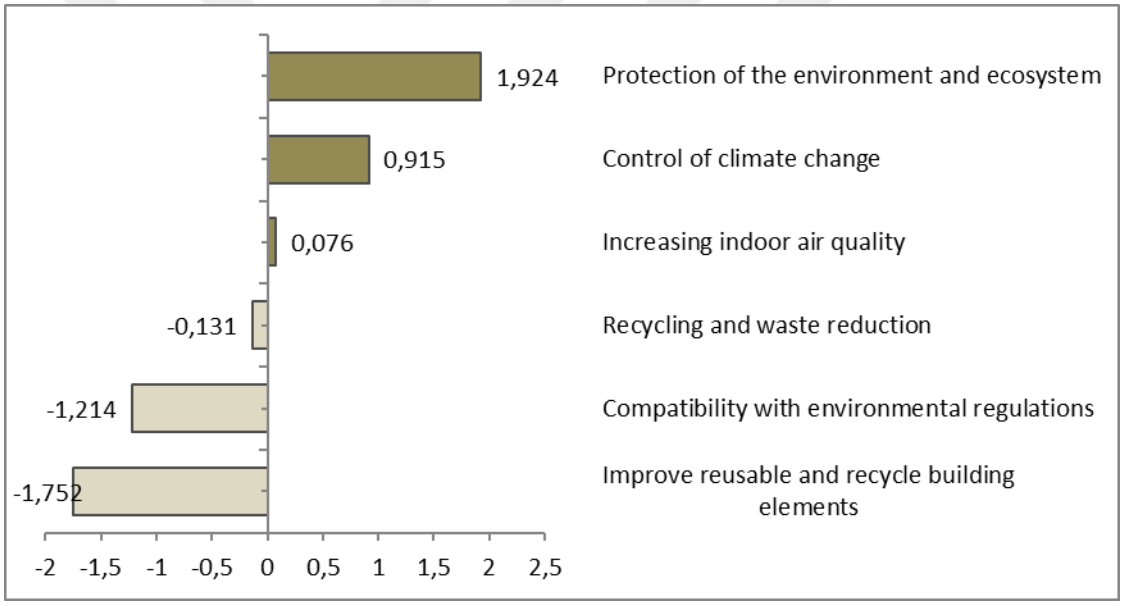

Figure 4.8. t-value of environmental motivators of green building adoption

4.1.5.2 Economic Motivators

The participants were also asked to rank the main economic motivators as how they affect the implementation of green design in building projects based on their experience. A one-sample t test was conducted to evaluate whether their mean was significantly different from the average mean value of scores reported for economic motivators, namely (3.014).

Table 4.13. shows mean and one sample t test of Economic Motivators that affect the implementation of green design in Libyan building projects. Six Economic Motivators varied from the test value significantly (3.014), p <.05. The most effective economic motivator is 'Providing lower annual energy cost' which had the highest positive mean difference (0.391). The least effective economic motivator is 'Having a good market for green buildings in Libya' which had the highest negative mean difference (-0.662).

Table 4.13. Ranking of Economic Motivators

Economic Motivators	Mean	Test value = 3.014			Rank
		Mean Difference	t	Significance	
Increasing building quality and value	3.270	0.256	4.377	0.000	**2**
Providing lower operation, maintenance, and repair cost	3.202	0.189	2.319	0.023	**5**
Providing lower building life-cycle cost	3.243	0.229	3.003	0.004	**4**
Providing a good opportunity for investment returns	3.121	0.108	1.407	0.164	**6**
Increasing occupant productivity	3.040	0.027	0.416	0.679	**7**
Increasing occupancy rate	3.013	0.000	0.000	1.000	**8**
Increasing rental and sale value	2.905	- 0.108	- 1.356	0.179	**10**
Providing lower annual energy cost	3.405	0.391	6.164	0.000	**1**
Providing lower water and wastewater cost	3.270	0.256	3.529	0.001	**3**
Giving a good reputation for marketers	2.986	- 0.027	- 0.336	0.738	**9**
Availability of more financing channels	2.891	- 0.121	- 1.361	0.178	**11**
Increase in demand of clients	2.473	- 0.540	- 5.110	0.000	**12**
Having a good market for green buildings in Libya	2.351	- 0.662	- 5.701	0.000	**13**

Figure 4.9. represents these differences in t values. The results support the conclusion that there are significant differences between economic motivators which affect the implementation of green design in Libyan building projects.

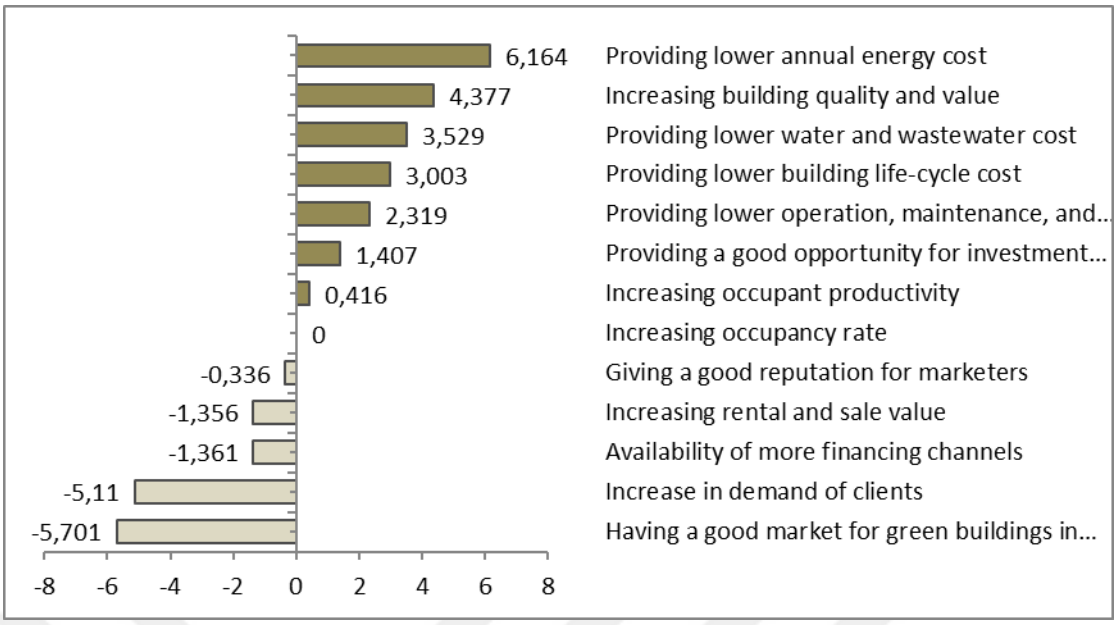

Figure 4.9. t-value of economic motivators of green building adoption

4.1.5.3 Social Motivators

The participants were also asked to rank the main social motivators as how they affect the implementation of green design in building projects according to their experience. A one-sample t test was conducted on Social Motivators that affect the implementation of green design in Libyan building projects scores to evaluate whether their mean was significantly different from (3.037), the average mean value of scores reported for Social Motivators.

The overall result in Table 4.14. and Figure 4.10. show that all Social Motivators varied from the test value significantly (3.037), $p < .05$. The most effective Social Motivator is 'Providing improved comfort, health, and well-being of occupants' which had the highest positive mean difference (0.381). The least effective Social Motivator is 'Libyan government policies and regulations support the green design concept' which had the highest negative mean difference (-0.605). The results support the conclusion that there are significant differences between Social Motivators which affect the implementation of green design in Libyan building projects.

Table 4.14. Ranking of Social Motivators

Social Motivators	Mean	Test value = 3.037			Rank
		Mean Difference	t	Significance	
Providing improved comfort, health, and well-being of occupants	3.418	0.381	6.261	0.000	**1**
Creation of better future opportunities	3.202	0.164	2.214	0.030	**3**
Getting the satisfaction from doing the right thing	3.351	0.313	4.819	0.000	**2**
Libyan government policies and regulations support the green design concept	2.432	- 0.605	- 4.360	0.000	**5**
Religion, customs and tradition support the green design concept	2.783	- 0.254	- 2.107	0.039	**4**

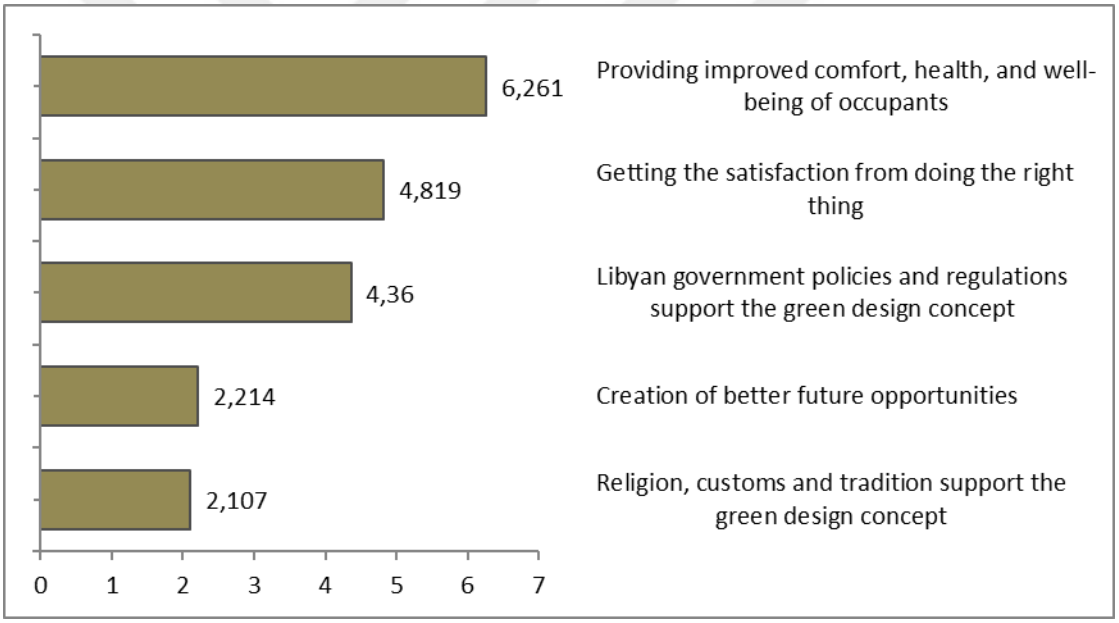

Figure 4.10. t-value of social motivators of green building adoption

4.1.6 Evaluation of barriers for the adoption of green buildings

One-sample t test is used to evaluate the barriers that affect the implementation of green design in Libyan building projects. This test is used here to measure the level of effect compared to the average mean value of scores reported for each sub group of barriers namely; Environmental, Economic, and Social Barriers.

A one-sample t test was conducted on Environmental Barriers, Economic Barriers and Social Barriers that affect the implementation of green design in Libyan building

projects scores to evaluate whether their mean was significantly different from the average mean value (3.197) of scores reported for the three types of motivators. Table 4.15. shows one sample t test of the three types of barriers that affect the implementation of green design in Libyan building projects. None of the three types of barriers varied from the test value significantly (3.197), p <.05.

Table 4.15. Ranking of Environmental, Economic, and Social Motivators

Type of Barriers	Mean	Test value = 3.197			Rank
		Mean Difference	t	Significance	
Environmental Barriers	3.098	- 0.099	- 1.358	0.179	**3**
Economic Barriers	3.180	- 0.016	- 0.328	0.744	**2**
Social Barriers	3.281	0.084	1.473	0.145	**1**

Figure 4.11. represents differences in t values. The results support the conclusion of the three barrier factors having no significant differences in their effects on the implementation of green design in Libyan building projects.

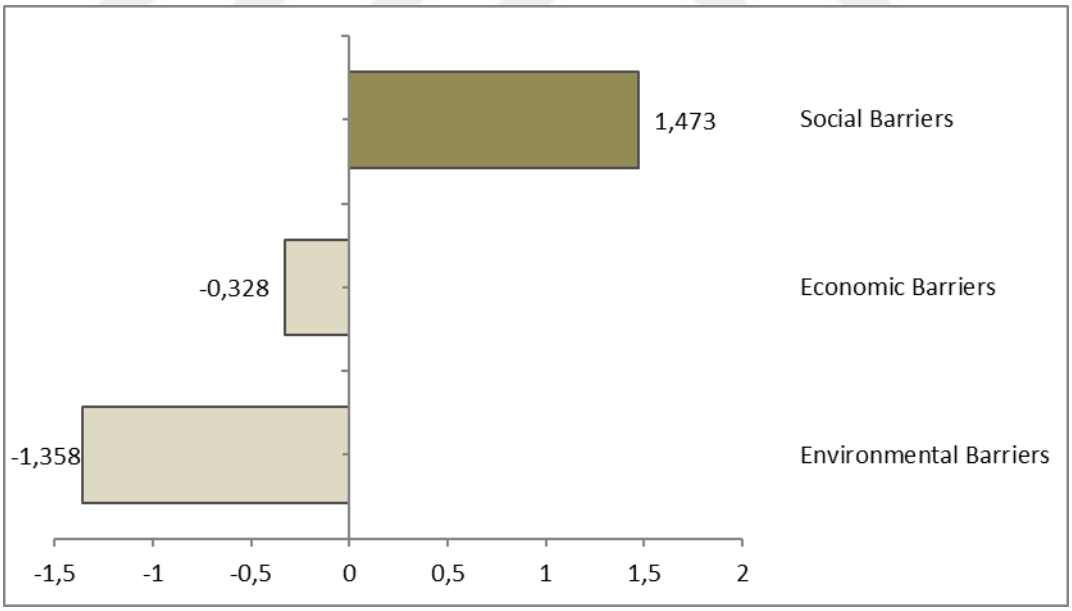

Figure 4.11. t-value of environmental, economic, and social barriers of green building adoption

4.1.6.1 Environmental Barriers

The participants were asked to rank the major environmental barriers as how they affect the implementation of green design in building projects according to their experience. A one-sample t test was conducted to evaluate whether their mean was significantly different from the average mean value of scores reported for environmental motivators, namely (3.038).

The overall result in Table 4.16. and Figure 4.12. show that the environmental barrier 'Lack of environmental concerns' varied from the test value significantly (3.038), $p < .05$. It is the most affective environmental barrier which had the highest positive mean difference (0.232). The least affective environmental barrier is 'Hardness of the local climatic conditions' which had the highest negative mean difference (-0.119). The results support the conclusion that 'Lack of environmental concerns' is a significant environmental barrier that affects the implementation of green design in Libyan building projects.

Table 4.16. Ranking of Environmental Barriers

Environmental Barriers	Mean	Test value = 3.038			Rank
		Mean Difference	t	Significance	
Lack of environmental concerns	3.270	0.232	2.748	0.008	**1**
Lack of accurate environmental data	3.202	0.164	1.748	0.085	**2**
Lack of green materials in the local market	3.000	- 0.038	- 0.387	0.700	**3**
Hardness of the local climatic conditions	2.918	- 0.119	- 1.270	0.208	**4**

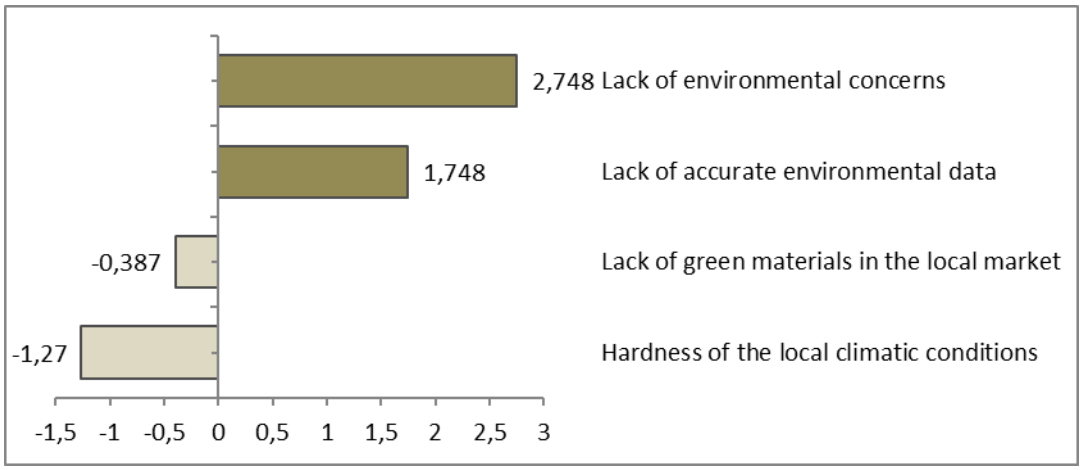

Figure 4.12. t-value of environmental barriers of green building adoption

4.1.6.2 Economic Barriers

The participants were also asked to rank the main economic barriers as how they affect the implementation of green design in building projects based on their experience. A one-sample t test was conducted to evaluate whether their mean was significantly different from the average mean value of scores reported for economic motivators, namely (3.181). Table 4.17. shows mean and one sample t test of economic barriers that affecting implementation of green design in Libyan building projects. The economic barrier 'Lack of demand of client' varied from the test value significantly (3.181), $p < .05$. It is the most affective environmental barrier which had the highest positive mean difference (0.170). The economic barrier 'The difficulty of applying changes in late design stages' which had the highest negative mean difference (-0.465) was the least affective economic barrier.

Table 4.17. Ranking of Economic Barriers

Economic Barriers	Mean	Test value = 3.181			Rank
		Mean Difference	t	Significance	
High cost of green building certification	3.202	0.017	0.282	0.779	**9**
Very long payback time for investment returns	3.175	- 0.005	- 0.073	0.942	**10**
Higher initial project cost	3.270	0.089	1.056	0.294	**3**
Higher financial risk	3.216	0.035	0.545	0.587	**8**
Having low electricity prices	3.243	0.062	0.709	0.481	**6**
Having low water prices	3.229	0.048	0.559	0.578	**7**
Higher green material costs	3.067	- 0.113	- 1.341	0.184	**11**
Higher green technology system cost	3.243	0.062	0.841	0.403	**5**
Having a short-term budget perception instead of long-term	3.067	- 0.113	- 1.615	0.111	**12**
Lack of demand of client	3.351	0.170	2.330	0.023	**1**
Lack of demand in the market	3.310	0.129	1.640	0.105	**2**
No financial incentives from the government	3.256	0.075	1.050	0.297	**4**
The difficulty of applying changes in late design stages	2.716	- 0.464	- 4.605	0.000	**13**

Figure 4.13. represents these differences in t values. The results support the conclusion that "Lack of demand of client" is the most significant economic barrier that affects the implementation of green design in Libyan building projects.

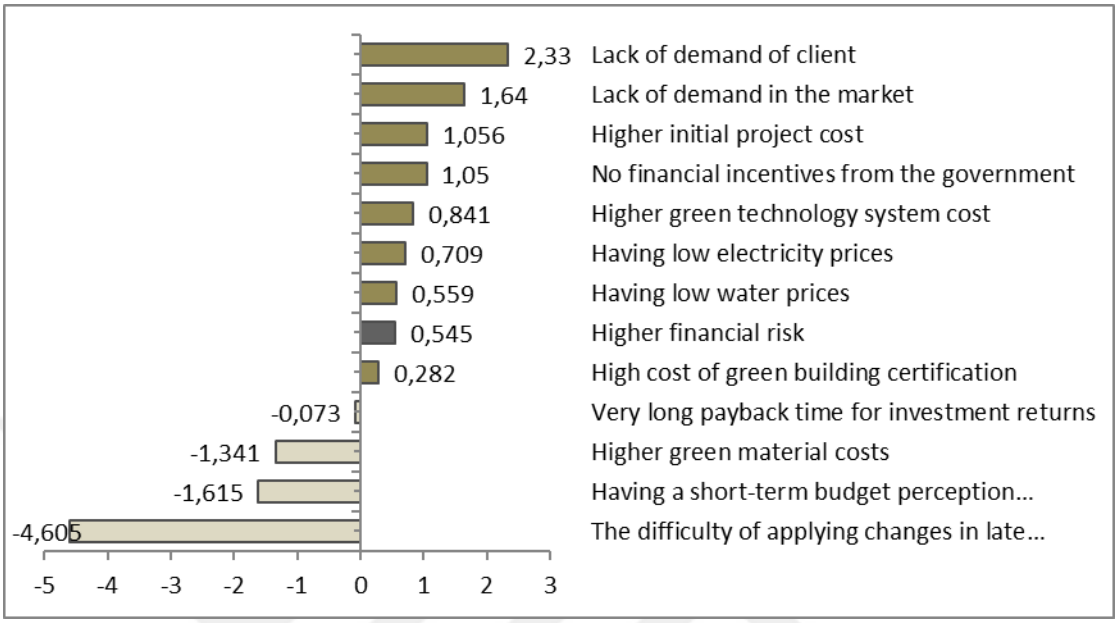

Figure 4.13. t-value of economic barriers of green building adoption

4.1.6.3 Social Barriers

The participants were also asked to rank the main social barriers as how they affect the implementation of green design in building projects according to their experience. A one-sample t test was conducted on social barriers that affecting implementation of green design in Libyan building projects scores to evaluate whether their mean was significantly different from (3.282), the average mean value of scores reported for Social Barriers.

The overall result in Table 4.18. and Figure 4.14. show that none of the Social Barriers varied from the test value significantly (3.282), $p < .05$. The most affective Social Barrier was 'Lack of awareness in the society'; it had the highest positive mean difference (0.137). The least affective Social Barrier is 'Lack of experience of consultants and contractors'; it had the highest negative mean difference (-0.120). The results support the conclusion that there are no significant differences between Social Barriers which affect the implementation of green design in Libyan building projects.

Table 4.18. Ranking of Social Barriers

Social Barriers	Mean	Test value = 3.282			Rank
		Mean Difference	t	Significance	
Lack of awareness in the society	3.418	0.136	1.726	0.089	**1**
Lack of knowledge	3.351	0.069	0.840	0.404	**2**
Lack of experience of consultants and contractors	3.162	- 0.119	- 1.358	0.179	**7**
Limited experience and skills of construction workers	3.189	- 0.092	- 1.036	0.304	**5**
Lack of funding and support of the private sector initiatives	3.189	- 0.092	- 1.116	0.268	**6**
Unsupportive government policies and regulations	3.337	0.055	0.679	0.499	**3**
Absence of an official green building body	3.324	0.042	0.517	0.607	**4**

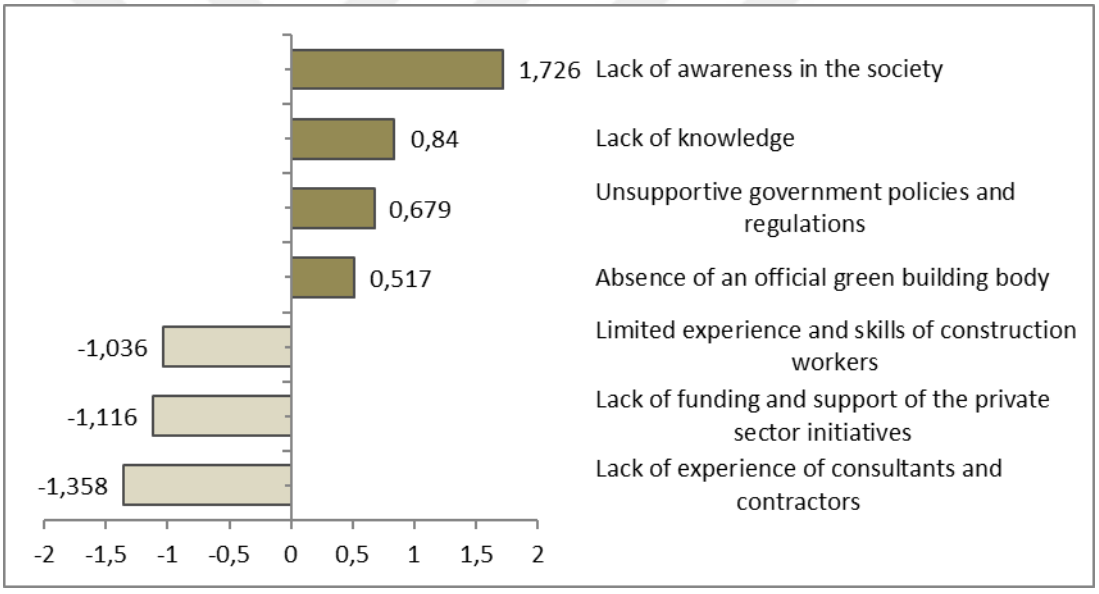

Figure 4.14. t-value of social barriers of green building adoption

4.1.7 Evaluation the Strategies to Promote Green Building Adoption

The participants were also asked to rank the important strategies as how they affect the implementation of green design in building projects according to their experience. A one-sample t test was conducted to evaluate whether their mean was significantly different from (3.446), the average mean value of scores reported for Potential Strategies. Table 4.19. summarizes the results on the relative importance of strategies to promote the adoption of green design in Libyan building projects.

The results shows that none of ten potential strategies varied from the test value significantly (3.446), p <.05. The most effective strategy is 'Promotion of the construction materials industry to depend on local resources'; it had the highest positive mean difference (0.081). The least affective strategy is 'Establishing sustainability as the core policy'; it has the highest negative mean difference (-0.122).

Table 4.19. Ranking the Strategies of Green Building adoption

Potential Strategies	Mean	Test value = 3.446			Rank
		Mean Difference	t	Significance	
Establishing sustainability as the core policy	3.324	- 0.121	- 1.410	0.163	**10**
Raising awareness towards green building and the environment in educational curriculum	3.500	0.054	0.837	0.405	**3**
Development and use of green building rating systems as assessment tools	3.459	0.013	0.137	0.892	**6**
Development and use of economic incentives	3.513	0.067	1.154	0.252	**2**
Modification of governmental building projects into green buildings	3.405	- 0.040	- 0.546	0.587	**8**
Implementing property tax incentives for green buildings	3.432	- 0.013	- 0.188	0.851	**7**
Sharing successful experiences related to green buildings through social media	3.364	- 0.081	- 1.006	0.318	**9**
Encouraging green building research	3.459	0.013	0186	0.853	**5**
Establishment of an official green building body	3.473	0.026	0.386	0.701	**4**
Promotion of the construction materials industry to depend on local resources	3.527	0.081	1.257	0.213	**1**

Figure 4.15. represents these differences in t values. The results support the conclusion that there are no significant differences between strategies that effect the acceleration of the green building movement in the Libyan construction sector. These results indicate that all ten potential strategies were considered to be of great importance, which means that these strategies have an enabling role in adopting green design in the building industry of Libya.

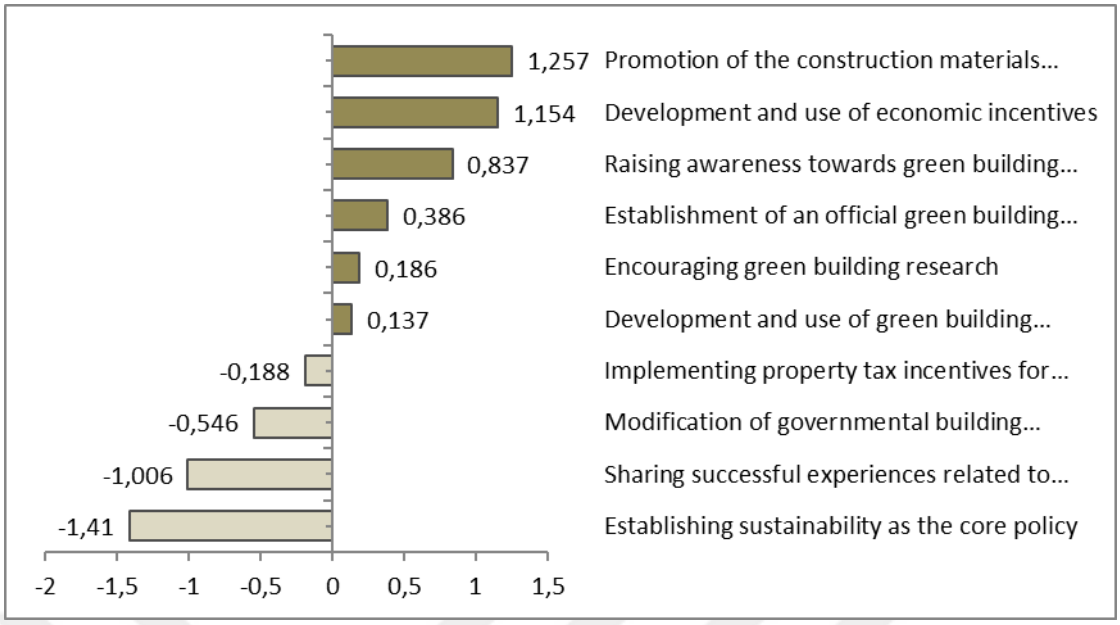

Figure 4.15. t-value of potential strategies of green building adoption

4.1.8 Evaluating the comments of respondents

At the end of the questionnaire, the respondents were asked to write their comments concerning the questionnaire or research topic. Most respondents wrote their comments as recommendations to accelerate the implementation of the green design concept in building projects in Libya. These recommendations were found to be different in expression but similar in meaning and content, therefore, they were grouped into six according to their significance and content. Table 4.20. show these summarized and grouped recommendations.

Table 4.20. Ranking of Respondent's Comments

Respondents Recommendations	Frequency	Percent	Rank
Raising awareness	21	31.81	**1**
Issuing Necessary Regulations and Legislation	15	22.72	**2**
Government Supports	12	18.18	**3**
Education and Research Encourage	9	13.63	**4**
Economic Incentive	7	10.60	**5**
Establish a Green Building Body	2	3.03	**6**
Total	66	100	

The results support the conclusion that ‘Raising awareness’, ‘Issuing Necessary Regulations and Legislation’, and ‘Government Supports’ are the top three recommendations that the respondents recommended as the important policies to accelerate the implementation of green design in Libyan building projects. For more details, the respondents' comments are displayed in Appendix F.

4.2 The Findings of Semi-Structured Interviews

The aim of the semi-structured interviews was to gather the required detailed data in order to validate the Motivators, Barriers, and Strategies of green design adoption in building projects which was obtained from the final questionnaire survey. The following results were obtained from valuable responses obtained from semi-structured interviews with ten experts in the building industry in Libya, during the period from 20 of November 2017 to 14 of December 2017. These responses were analyzed and summarized according to the objectives of the questions of interview. Table 4.21. show the summary of these responses.

4.2.1 Key motivators

When respondents with practical experience of green design were asked about the main motivation that led them to be involved in green design practices, the responses included two points:

- ✓ *Preserving the planet and turning to the green energy.*
- ✓ *Providing healthy and sustainable buildings that will ensure a better life for future generations.*

4.2.2 Key barriers

When the respondents were asked “what were the critical barriers that hindered you to be involved in the green design”, their answers were:

- ✓ *Current conditions in Libya are not appropriate.*
- ✓ *The failure of the state and lack of marketers for this proposition.*
- ✓ *Lack of awareness and knowledge in this area.*
- ✓ *Lack of material resources.*

4.2.3 Suitability

Respondents were asked: "Is green buildings are good for the Libyan environment ?", the answer was that:

- ✓ *The Libyan environment was very suitable for implementing the concept of green buildings due to its distinctive geographical location.*

4.2.4 Marketability

Respondents were asked: " Is there a market for green buildings in Libya, particularly in the city of Tripoli?", the answer was that:

- ✓ *Currently, there is no market for green buildings, but just the beginnings such as using the solar panels to provide electricity.*

4.2.5 Client's attitudes

When the respondents were asked "What are the attitudes of the clients towards green building design", their answers were:

- ✓ *There is a sincere desire by customers and a great trend towards the implementation of green buildings.*

4.2.6 Key strategies

When respondents were asked about the key strategies that lead to increase the advantages of green buildings, the responses included four points:

- ✓ *Educating citizens through holding seminars and television programs and urging them to use green buildings*
- ✓ *Advertising for green building products*
- ✓ *Provide green building requirements for the consumer at competitive prices*
- ✓ *Intensification of studies and research related to green building*

4.2.7 Accelerating the Movement

When the respondents were asked the question; "What can be done to accelerate the green building movement in the Libyan construction sector", their answers were:

- ✓ *Convince decision-makers of the importance of adopting the green building concept*

- ✓ *Spread environmental awareness among citizens*
- ✓ *Government support for sustainable projects*
- ✓ *Adoption of green buildings in government institutions and public sector*
- ✓ *Provide a local market capable of covering application needs*
- ✓ *Provide clear and accessible data to suppliers and investors*

Table 4.21. The summary of the Responses of the Semi-structured Interviews

Objectives	Questions	Responses	Frequency
Key Motivators	What were the major motivations that drive to be involved in green design?	Preserving the planet and turning to the green energy.	**2**
		Providing healthy and sustainable buildings that will ensure a better life for future generations .	**2**
Key Barriers	What were the critical barriers that hindered to be involved in green design?	Current conditions in Libya are not appropriate.	**2**
		The failure of the state and lack of marketers for this proposition.	**2**
		Lack of awareness and knowledge in this area.	**2**
Suitability	Do you think that green buildings are good for the Libyan environment?	The Libyan environment was very suitable for implementing the concept of green buildings due to its distinctive geographical location	**10**
Marketability	Is there a market for green buildings in Libya, particularly in the city of Tripoli?	Currently, there is no market for green buildings, but just the beginnings such as using the solar panels to provide electricity.	**10**
Client's attitudes	What are the attitudes of the clients towards green building design?	There is a sincere desire by customers and a great trend towards the implementation of green buildings.	**8**
Key Strategies	What can be the key strategies to increase the advantages of green buildings?	Educating citizens through holding seminars and television programs and urging them to use green buildings	**4**
		Advertising for green building products	**4**
		Provide green building requirements for the consumer at competitive prices	**4**
		Intensification of studies and research related to green building	**4**
Movement accelerate	What can be done to accelerate the green building movement in the Libyan construction sector?	Convince decision-makers of the importance of adopting the green building concept	**2**
		Spread environmental awareness among citizens	**8**
		Government support for sustainable projects	**6**
		Adoption of green buildings in government institutions and public sector	**4**
		Provide a local market capable of covering application needs	**4**

CHAPTER V
FINDING AND DISCUSSION

This study identifies and examines major drivers, critical barriers, and important strategies for promoting green building by analysing the professional views of Libyan construction industry experts. This chapter presents the discussion and evaluation the findings of the survey in order to understand and interpret respondents' views on the formulation of green building strategies in Libya. The following discussions give precedence to factors that rank higher in the results described in the previous section. The results were also compared with the results of the literature review regarding the adoption of green buildings.

5.1 The Major Motivators for Developing Green Buildings in Libyan Projects

The mean value of all motivators are higher than the average rating scale which was (2.5). These results indicate that the 24 motivators considered in this study play an important role in pushing the adoption of green design in Libyan building projects.

From the mean value listed in both Table 4.12, Table 4.13, and Table 4.14, 'Protection of the environment and ecosystem' (M1), with mean value = 3.5135, was the highest ranked motivator for developing green buildings in Libyan projects. This result is consistent with those of previous studies on green building motives conducted by McGraw-Hill Construction [45], and Dodge Data & Analytics [52], who found that the 'Protecting natural resources' is considered as the second most important environmental reason for adoption green buildings.

'Control of climate change' (M2), with mean value = 3.4324, was ranked by experts as the second major motivator to adopt the concept of green design in the building projects. This finding is consistent with other research [44, 58], which listed 'Climate change' as a primary motivation for the implementation of green buildings.

It is worth noting that both the first and the second motivators belong to the environmental motivators. This result is consistent with other research [57, 81], which identified the environmental motivators as main factors in implementing green buildings in studies on Australia and Nigeria. This gives the impression that participants are aware of the advantages and objectives of green buildings and that the environmental dimension of green buildings is the main motivation to adopt green design in construction projects.

The results of this study provide evidence that the third major motivation behind adoption of green buildings is 'Providing improved comfort, health, and well-being of occupants' (M20, mean value = 3.4189). This finding has been supported in literature by authors [21, 44, 45, 52, 58, 71, 76], who found in their studies that the motivators; 'Improved quality of life', 'Well-being of occupants', and 'Better occupant health', are considered as the most important factors for the adoption of green buildings.

While the 'Energy cost reduction' motivator topped the list of the motivators and ranked first in the potential motivators of green building adoption in most earlier studies conducted in United States [41, 48, 51]; Hong Kong and Singapore [62]; Sri Lanka [71]; Turkey [44]; Italy [59]; and Palestine [79], the motivator 'Providing lower annual energy cost' (M14), with a mean value of 3.4054, ranked fourth in this study. This may be because the low cost of energy in Libya which are almost free due to the government subsidies to the General Electricity Company through operational fuel subsidies as well as financial support.

Other top ten ranked motivators for green building adoption as ranked by the experts, include; 'Increasing indoor air quality' (M4); 'Recycling and waste reduction' (M5); 'Getting the satisfaction from doing the right thing' (M22); 'Compatibility with environmental regulations' (M3); 'Increasing building quality and value' (M7); and 'Providing lower water and waste cost' (M15), respectively. All of these advantages are generally known and associated with green buildings, and it is convenient to note that the industry can help drive the construction of green buildings.

'Libyan government policies and regulations support the green design concept' (M23), with mean value = 2.4324, and 'Having a good market for green buildings in Libya' (M19), with mean value = 2.3514, were ranked as the last two potential

motivators for adopting green buildings in Libya. Despite the fact that the Libyan environment is very suitable for the implementation of the concept of green buildings successfully due to its climate and geography, there is no market up to now for green buildings in Libya as confirmed by experts involved in the semi-structured interviews. This may be due to the lack of support for government policies to adopt the concept of green design in building projects as well as to the reluctance of the private sector to adopt this concept. Time should be taken to come up with strategies to widely promote these motivators in society in order to influence people to have interest in green buildings.

5.2 The critical barriers against developing green building in Libyan projects

The mean value of all barriers are higher than the average rating scale which was (2.5). These results indicate that the 24 barriers considered in this study play an important role in hindering the adoption of green design in Libyan building projects.

Based on the mean value listed in Table 4.16, Table 4.17, and Table 4.18, the results indicate that 'Lack of awareness in the society' (B18), with mean value = 3.418, ranked first and 'Lack of knowledge' (B19), with mean value = 3.351, ranked second, were perceived to be the most critical barriers. This finding is consistent with the previous studies including; [72, 73, 81, 86, 96], which identified the lack of awareness and knowledge about the green buildings from stakeholders as the first critical barriers against the adoption of green buildings. This is the result of deficiencies in the educational curriculum as well as deficiencies in the media regarding the building environment and ways of reducing the negative impact of buildings on the environment.

As a result of the first and second barriers, the 'lack of demand of client' occupied the third position. The high rank of this barrier supports the findings of previous research that lack of demand from the projects owners/clients is a major barrier to the adoption of green buildings [45, 52, 79, 98-100]. Without the owner's/client's full support of the green design concept, building projects cannot be done along green building principles.

The fourth barrier was 'Unsupportive government policies and regulations' (B23, mean value = 3.337), which provide evidence that this barrier has been of interest to

experts, seeing that policies and regulations are insufficient to adopt green design in Libyan building projects. Lack of government policies and regulations has been reported as a major barrier to the implementation of green buildings in other studies as well [12, 23, 44, 51, 52, 85, 90, 98, 101]. Stakeholders would like to see direct intervention from policymakers in the green buildings market in the form of more effective incentives to support the implementation of green buildings. Incentives can encourage market stakeholders to follow green building practices. However, if stakeholders cannot obtain adequate government support, it will be difficult for them to afford the higher costs of green buildings requirements.

With mean value = 3.324, 'Absence of an official green building body' (B24) was ranked high amongst the barriers for adopting green building concept in the Libyan projects; it was ranked as the fifth most critical barrier by the Libyan experts. Currently, Libya lacks an formal body that acts as a stakeholder in green buildings. In most developed or developing countries, which adopted the concept of green building in their building strategies have established such an official body for green building stakeholders, such as the United States Green Building Council (USGBC) in the United States, to seek advice, support and accreditation. Unfortunately in Libya, the stakeholders in building industry do not have such a guidance. The absence of a formal green building authority is a main barrier to the diffusion and adoption of green buildings in Libya. This result is similar to that of an earlier study on the diffusion and adoption of green buildings in Saudi Arabia by Ibrahim Mosly [101].

'Lack of demand in the market' (B15) with mean value = 3.310, ranked sixth. Although the Libyan environment was very suitable for implementing the concept of green buildings due to its climate and distinctive geographical location, there is no market for green buildings, except for some preliminary approaches, such as using the solar panels to provide electricity. This is a result of; the lack of demand of client, and unsupportive government policies and regulations. This finding is consistent with some global studies of McGraw-Hill [45] and Dodge [52], who ranked lack of market demand as the fourth and third challenges to increasing green building activity; respectively.

As a critical barrier to implementing green buildings in Libya, 'Lack of environmental concerns' (B1, mean value = 3.270), occupied the seventh position. Unfortunately,

environmental pollution is not an important issue for the majority of the public in Libya as well as for Libyan government. The majority of the public's lack of interest in environmental pollution is due to the inefficient recycling and reuse of waste. This result is completely consistent with the study by Ibrahim Mosly [101], who identified the lack of environmental concerns as a barrier toward green building implementation.

As expected, through previous studies, the barrier 'Higher initial project cost' (B7) is often ranked within the top ten critical barriers for the adoption of green buildings. It has been ranked first by [45, 52, 60, 100], and it was ranked as the third most critical barrier by [23, 51]. In this study it is ranked by the experts in eighth position. Green buildings require the use of new and innovative green technologies that are more expensive than their non-green counterparts, mainly due to the importation of such equipment from other countries, leading to higher prices compared to conventional equipment assembled or manufactured locally. This makes stakeholders reluctant to adopt green approaches in their projects. Key issues that inflate concerns about the increased cost of green buildings may be due to the lack of knowledge and misunderstanding of the real costs and benefits of green buildings.

The factor 'No financial incentives from the government' (B16) was ranked ninth (mean value = 3.256). This finding is consistent with the previous studies including; [23, 51, 62, 85, 88, 91, 96]. This provides evidence that the lack of government incentives is a major impediment to the implementation of green buildings. Financial incentives can motivate stakeholders to adopt and implement green buildings. Stakeholders would like to see the intervention of policy makers in the green building market in the form of more effective incentives to support the implementation of the green building concept.

An interesting finding is that the experts ranked 'Having low electricity prices', (B9, mean value = 3.243), among the top ten barriers which prevent the adoption of green building concept in Libya. This factor has been mentioned as a major barrier for the implementation of green buildings in an earlier study by only [101]. The Libyan government is supporting the General Electricity Company by subsidizing operating fuel and monetary support to reduce its prices to the public. Unfortunately, this led to the fact that the majority of the public is not interested in the issue of electricity conservation and rationalization of consumption. Most populations see that the

energy costs in Libya is very low and almost free, so they do not pay attention to the issue of sustainability and energy conservation, and think that there is no need of more payment for green building achievement. The Libyan government may have to replace subsidies for electricity by subsidizing the costs of renewable energy technologies such as solar energy to encourage people to adopt green building technologies.

5.3 The important strategies that will facilitate the adoption of green buildings in Libyan projects

For successful and widespread adoption of green buildings, different strategies are needed to take advantage of motivators and overcome barriers of green buildings implementation. The literature review documents several strategies for the motivation of the adoption of green buildings in many countries, however, these strategies may not apply to Libyan environment, due to the environmental, economic and social differences among countries. This study explored the most important strategies, derived from previous studies (Table 2.12), that encourage the adoption of green buildings in Libya and verified their effectiveness by experts in the construction industry in Libya.

The results of 'Mean' value and 't-test' score listed in Table 4.19, indicate that all of the strategies had significant importance and they have a role in facilitating the adoption of green buildings in Libyan projects. The mean scores of the strategies range from 3.324 to 3.527. It should be noted that the average scores of all strategies were much higher than 2.5, the average value of the rating scale, indicating that all strategies were of great importance. This findings can be attributed to the vision of Libyan professionals to transform the built environment in Libya towards sustainability, therefore all strategies that encourage the adoption of green buildings have become necessary. This result is consistent with the study conducted in Ghana by Darko and Amos [134].

Although there is a difference in 'Mean' values, this difference is too small and does not exceed 0.203, as well as the 'Mean Difference' value of the last ranked strategy is very small too (0.121). This gives evidence of the need to apply all of these strategies as a package to reach a successful application on a large scale and in record time for

the concept of green building in Libyan projects. Despite the importance of all strategies, their ranks would enable policy makers to understand strategies that deserved to focus on more attention, and then prioritize strategies to promote the adoption of green buildings. From the 'Mean' analysis results, these strategies are ranked and discussed below.

'Promotion of the construction materials industry to depend on local resources' (ST10) was ranked first with the highest mean score (3.527). The results represent that ST10 was considered the most important strategy. The importance of this strategy was also supported by [73]. Building materials manufacturers should use local resources as a basis for product development and must cooperate with designers to develop environmentally friendly building materials that are available in the local environment rather than imported from another remote location. For example, in Libya, construction materials manufacturers should focus on the sand and be considered it as the main raw material of all building materials in Libya instead of cement and other imported industrial materials. This can reduce the cost of building materials, thereby reduce the overall cost of green buildings and contribute to overcome the barriers related to the cost.

The strategy 'Development and use of economic incentives' (ST4) was ranked second (mean score = 3.513). Incentive schemes are a very important strategy to promote the adoption of green buildings. This result is in line with numerous studies including [23, 51, 57, 127], which suggest that financial incentives would help to motivate demand of stakeholders. Many developed countries have adopted incentive schemes as a strategy to encourage the adoption of green buildings in different forms. Rising costs of green buildings represent a significant loss of money. Therefore, strategies to reduce the cost burden for stakeholders can accelerate the adoption of green buildings. In Libya, for example, the government should provide financial incentives to those interested in green buildings, in forms of financial support for solar energy technologies, which are largely ignored by stakeholders because of the high cost of equipment, rather than electricity subsidies. This may overcome the 'initial high cost' barrier.

The strategy 'Raising awareness towards green building and the environment in educational curriculum' (ST2) received the third position (mean = 3.500). These

results indicate that increased education and training in green buildings, efforts are key to the continued promotion of green building in Libya. This finding is consistent with the studies of; [23, 51, 69, 99, 101, 112]. The concept of sustainability, green buildings, environmental protection, and global warming in curricula of schools and university, can raise green building awareness. In addition, conferences and exhibitions in green buildings will help increase public awareness and awareness among field practitioners. These awareness-raising measures will help to build a green building society and allow for sharing of knowledge.

The strategy 'Establishment of an official green building body' (ST9) occupied the fourth position (mean = 3.473). The establishment of a formal green building body in Libya is an important step towards the adoption of green buildings. This result is similar to the studies of [101, 124, 127]. All the leading green building countries, such as the United States, Germany and Malaysia, have started to adopt and implement the green building concept in their buildings by establishing a green building body known as 'Green Building Council'. These bodies serve as a guide for all stakeholders in green buildings in terms of standards and certifications, as well as contribute significantly to raising awareness, public awareness and help practitioners. In addition, the green building body can motivate the private sector to patron the green building events and as a result become a positive participant in the maturity of the green construction industry.

With 'Mean' value=3.459, the strategy 'Encouraging green building research' (ST8) received the fifth position. This strategy was mentioned in previous studies as an important strategy for adoption green buildings [44, 97, 101, 124]. Green building research should concentrate on studying the green buildings benefits and expanding the positive applications of these buildings in Libya. In addition, green building research should look at solving problems related to the green buildings in Libyan environment. The initial phase of green building research should be funded by the government through researchers and academics at universities and research institutions.

Similar to strategy ST8, the strategy 'Development and use of green building rating systems as assessment tools' (ST3) obtained a mean score of 3.459, but because its Std.Deviation value (0.847) was higher than the Std.Deviation value of strategy S8

(0.623), it was ranked sixth. This result is consistent with [87, 99, 120, 124, 125]. The whole world started to develop new methods and systems in the design and planning processes to create high performance green buildings, i.e. *BREEAM* in United Kingdom, *LEED* in United States, *ESTIDAMA* in United Arab Emirates and *GPRS* in Egypt. In order to meet the new requirements of the future era, all these systems were designed, taking into account sustainable economic thinking and maintaining an appropriate life on earth. The green building approach varies between countries and regions. Different countries and regions have a range of characteristics, such as unique climatic conditions, unique traditions and cultures, which shape their approach to constructing green buildings. Considering this issue, the establishment of a green buildings assessment tool in Libya is essential and is a key factor in successfully implementing green buildings.

The strategy 'Implementing property tax incentives for green buildings' (ST6) occupied the seventh position (mean = 3.432). This result is consistent with [22, 23, 57, 67, 72, 127], who noted that the practice of providing property tax incentives is important to promote the adoption of green buildings in the construction market.. One of the most popular incentives in green buildings in the United States is the tax incentive system, where tax discounts or completely exempt from paying taxes, are offered to stakeholders who adopt green buildings. To do this efficiently and effectively, the Libyan government can learn from the experiences of developed countries in implementing such strategies as incentives to adopt and apply the concept of green building.

The results of this study provide evidence that the strategy 'Modification of governmental building projects into green buildings' (ST5), which ranked eighth with mean value = 3.432, is one of the most effective strategies behind the adoption of green buildings. This findings is in line with an earlier study conducted by Ibrahim Mosly [101], who found that transforming all the government building projects as a green projects will have a favorable effect on the built environment. Government buildings are frequented by most segments of society, therefore it is suitable for anyone who wants to know and experience the benefits of green buildings in reality. The government has a greater ability to withstand the risks of change more than the private sector. Therefore, the government's adoption of the concept of green building

and its implementation to its building projects would be a successful experience and a guide for the private sector to apply this concept into its own construction projects. This could be contributing to overcoming the barriers related to awareness, knowledge, market demand, and financial risk.

'Sharing successful experiences related to green buildings through social media' (ST7), with mean value = 3.364, received the ninth position. This strategy is mentioned by Darko et al. [51] as a ninth strategy out of twelve strategies that affect the acceleration of the adoption and implementation of the concept of green buildings. Media advertising, such as print media, the internet, radio and television programs, is an effective way to increase stakeholder's awareness in green buildings. Moreover, when successful experiences on green buildings are shared by people and realized their benefits through the social media, problems of lack of information and awareness, as well as lack of collaboration can be solved.

In the last ranking, the strategy 'Establishing sustainability as the core policy' (ST1), received the tenth position (mean = 3.324). This finding has been supported by studies in literature [51, 134]. Success in reaching the goal and achieving the desired goal is an effective motivator itself. When sustainability is considered as an ultimate goal and objective of any institution, the institution's policies will be in the service of this objective and will be most concerned for searching means to achieve this goal. This will have an effective role in accelerating and spreading the adoption of green building concept, whereas green buildings is a means of applying sustainability in the construction industry.

Green buildings adoption is very young in Libya. Therefore, at this early stage, the government has a crucial and vital role in promoting the adoption of green buildings, as well as formulate and implement appropriate strategies to push industrial practitioners and the public to implement green buildings. The results of this study showed that the importance of all strategies was statistically significant. In general, differences in perceptions about the importance of strategies were not statistically significant. In implementing these strategies, it is extremely important to monitor and evaluate their performance and impact on promoting the adoption of green buildings. This will help to make the necessary adjustments on strategies to improve and maximize their effectiveness during the various stages of development of the adoption

of green buildings. In developing countries such as Libya, the adoption of green buildings is slower than in developed countries. This requires specific strategies that can help promote and accelerate the adoption of green buildings in developing countries. This will be derived based on the motivators and barriers that affect the adoption of green buildings in Libya by conducting a strength-weakness-opportunity-threat (SWOT) analysis. The established SWOT analysis strategic matrix on '*Motivators*' and '*Barriers*' will enable the formulation of strategies for Libyan decision makers of green building adoption.

5.3.1 Established specific strategies that can accelerate the adoption of green buildings in Libya

SWOT analysis methodology is used to study strategic planning of enterprises or industries. This approach was initially adopted in the fields of business and marketing, and has been gradually applied to various fields [135]. This analysis has been applied by Zarandi [136], to formulating managerial strategies for development of green buildings in Tehran municipality (Figure 5.1). It was also used by Mohindroo [114], to explores business opportunities and feasibility in the field of green building business, as well as to provides a package of necessary facts and analysis for entering green building business in India. In addition, this approach was used by Zhang et al. [135], to establish an appropriate strategic plan for the promotion of energy efficiency in rural buildings of China (Figure 5.2).

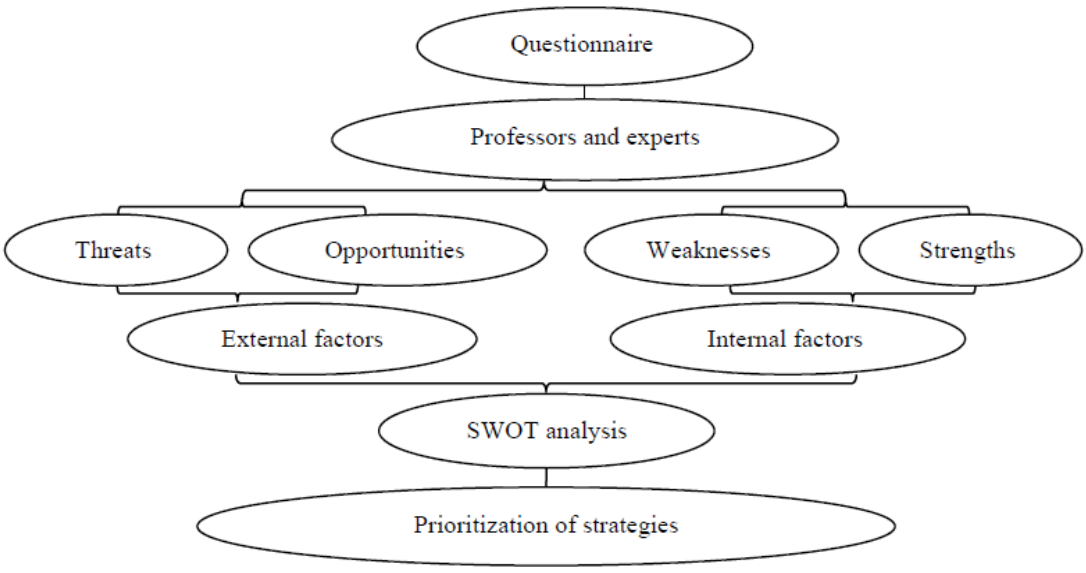

Figure 5.1. Research process of Zarandi (2016) study

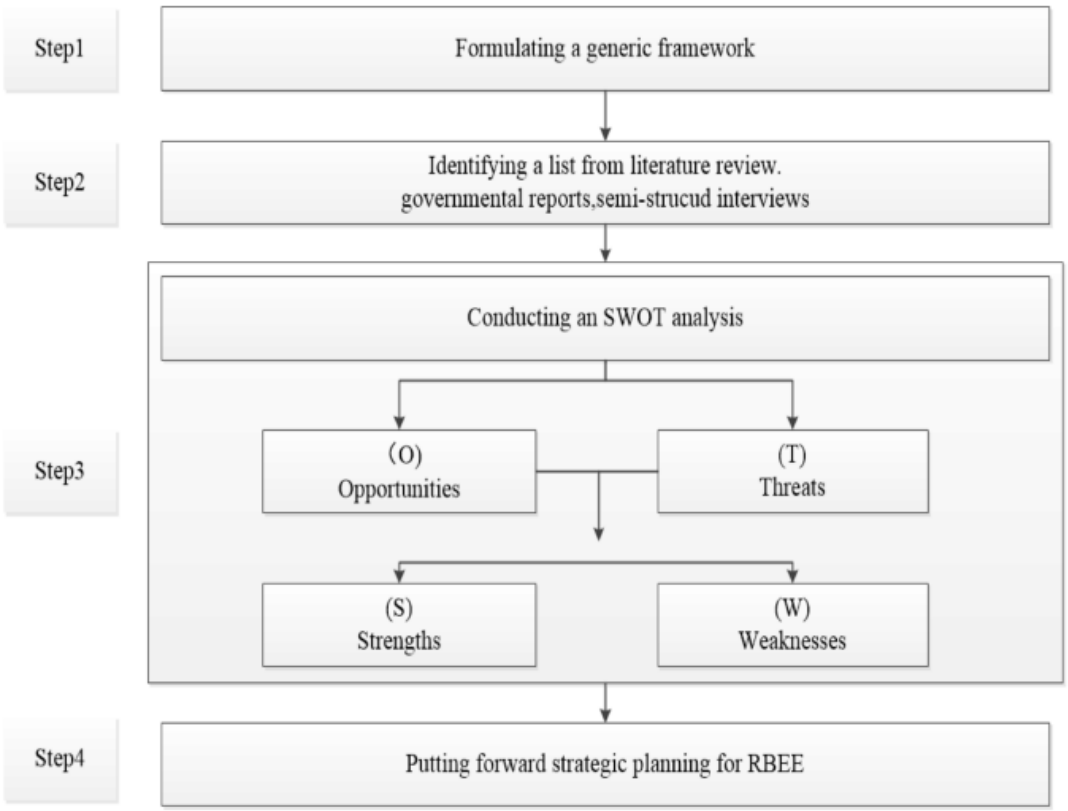

Figure 5.2. The basic flow of research of Zhang et al. (2018) study

Results of 'Motivators' (M1-M24) and 'Barriers' (B1-B24), that were derived from the literature review and validated through the questionnaire survey will be utilized in the SWOT analysis to get an insight on key strategies to be establish for green building adoption in Libya. The motivators list (M1-M24) can be divided into *Strengths* and *Opportunities*, while the barriers list (B1-B24), can be divided into *Weaknesses* and *Threats* categories. While both the *Strengths* and the *Weaknesses* are internal factors related to the system of green building, both *Opportunities* and *Threats* are external factors related to the green building system application environment (Figure 5.3) .

All *Strengths*, *Weaknesses*, *Opportunities* and *Threats* related to the implementation of green buildings listed in the SWOT analysis, will be placed into the confrontation matrix to understand the different combinations. The confrontation matrix is useful in getting an idea of the new strategies of information already in the SWOT analysis. It is made by combining the strengths, weaknesses, opportunities and threats of a system [114].

Figure 5.3. Confrontation matrix of the SWOT analysis

Through Table 2.4 related to the motivators and Table 2.8 related to the barriers; strengths, weaknesses, opportunities and threats factors can be derived as follows:

5.3.1.1 Strengths (S)

Strengths can be described as the advantages or the positives of the system that act as motivators for stakeholders to adopt this system. From the list of the potential motivators leading to adopt green buildings which were listed in Table 2.4, the strengths of green buildings system that motivate stakeholders of building industry in Libya to adopt the green buildings concept in their projects, can be derived and listed as follows:

- ✓ S1 - Protection of the environment and ecosystem
- ✓ S2 - Control of climate change
- ✓ S3 - Compatibility with environmental regulations
- ✓ S4 - Increasing indoor air quality
- ✓ S5 - Recycling and waste reduction
- ✓ S6 - Improve reusable and recycle building elements
- ✓ S7 - Increasing building quality and value
- ✓ S8 - Providing lower operation, maintenance, and repair cost
- ✓ S9 - Providing lower building life-cycle cost
- ✓ S10 - Providing a good opportunity for investment returns
- ✓ S11 - Increasing occupant productivity
- ✓ S12 - Increasing occupancy rate
- ✓ S13 - Increasing rental and sale value
- ✓ S14 - Providing lower annual energy cost

- ✓ S15 - Providing lower water and wastewater cost
- ✓ S16 - Giving a good reputation for marketers
- ✓ S17 - Availability of more financing channels
- ✓ S18 - Providing improved comfort, health, and well-being of occupants
- ✓ S19 - Creation of better future opportunities
- ✓ S20 - Getting the satisfaction from doing the right thing

5.3.1.2 Weaknesses (W)

Weaknesses can be described as the disadvantages or the negatives of the system that act as barriers for stakeholders to adopt this system. From the list of the potential barriers that hinder to adopt green buildings, which were listed in Table 2.8, the weaknesses of green buildings system that hinder stakeholders of the building industry in Libya to adopt the green buildings concept in their projects, can be derived and listed as follows:

- × W1 - High cost of green building certification
- × W2 - Very long payback time for investment returns
- × W3 - Higher initial project cost
- × W4 - Higher financial risk
- × W5 - Higher green material costs
- × W6 - Higher green technology system cost
- × W7 - Having a short-term budget perception instead of long-term
- × W8 - The difficulty of applying changes in late design stages

5.3.1.3 Opportunities (O)

Opportunities can be described as the positive characteristics available in the environment of system application that act as motivators for stakeholders to adopt this system. From the list of the potential motivators leading to adopt green buildings which were listed in Table 2.4, the opportunities of the Libyan environment that motivate stakeholders of building industry to adopt the green buildings concept in their projects, can be derived and listed as follows:

- ✓ O1 - Increase in demand of clients
- ✓ O2 - Having a good market for green buildings in Libya
- ✓ O3 - Libyan government policies and regulations support the green design

- ✓ O4 - Religion, customs and tradition support the green design concept

5.3.1.4 Threats (T)

Threats can be described as the negative characteristics and practices in the application environment that act as barriers for stakeholders to adopt this system. From the list of the potential barriers that hinder to adopt green buildings which were listed in Table 2.8, the threats of the Libyan environment that hinder stakeholders of building industry to adopt the green buildings concept in their projects, can be derived and listed as follows:

- × T1 - Lack of environmental concerns
- × T2 - Lack of accurate environmental data
- × T3 - Lack of green materials in the local market
- × T4 - Hardness of the local climatic conditions
- × T5 - Having low electricity prices
- × T6 - Having low water prices
- × T7 - Lack of demand of client
- × T8 - Lack of demand in the market
- × T9 - No financial incentives from the government
- × T10 - Lack of awareness in the society
- × T11 - Lack of knowledge
- × T12 - Lack of experience of consultants and contractors
- × T13 - Limited experience and skills of construction workers
- × T14 - Fund shortage and private sector initiatives support
- × T15 - Unsupportive government policies and regulations
- × T16 - Absence of an official green building body

5.3.1.5 Confrontation Matrix

Through the confrontation matrix shown in Table 5.1. four types of strategy can be derived, which are; Offensive Strategy, Reactive Strategy, Adjust Strategy, Defensive Strategy.

Table 5.1. Confrontation Matrix

	Motivators	**Barriers**
Internal Factors	S1 Protection of the environment S2 Control of climate change S3 Compatibility with environmental regulations S4 Increasing indoor air quality S5 Recycling and waste reduction S6 Improve reusable and recycle building elements S7 Increasing building quality and value S8 Providing lower operation, maintenance, and repair cost S9 Providing lower building life-cycle cost S10 Providing a good opportunity for investment returns S11 Increasing occupant productivity S12 Increasing occupancy rate S13 Increasing rental and sale value S14 Providing lower annual energy cost S15 Providing lower water and wastewater cost S16 Giving a good reputation for marketers S17 Availability of more financing channels S18 Providing improved comfort, health, and well-being of occupants S19 Creation of better future opportunities S20 Getting the satisfaction from doing the right thing	W1 High cost of green building certification W2 Very long payback time for investment returns W3 Higher initial project cost W4 Higher financial risk W5 Higher green material costs W6 Higher green technology system cost W7 Having a short-term budget perception instead of long-term W8 The difficulty of applying changes in late design stages
External Factors	O1 Increase in demand of clients O2 Having a good market for green buildings in Libya O3 Libyan government policies and regulations support the green design concept O4 Religion, customs and tradition support the green design concept	T1 Lack of environmental concerns T2 Lack of accurate environmental data T3 Lack of green materials in the local market T4 Hardness of the local climatic conditions T5 Having low electricity prices T6 Having low water prices T7 Lack of demand of client T8 Lack of demand in the market T9 No financial incentives from the government T10 Lack of awareness in the society T11 Lack of knowledge T12 Lack of experience of consultants and contractors T13 Limited experience and skills of construction workers T14 Fund shortage and private sector initiatives support T15 Unsupportive government policies and regulations T16 Absence of an official green building body

1. *Offensive Strategy*, it is derived from integration between strengths and opportunities (SO). With strengths and opportunities, conditions will be

favorable for implementation. Therefore, the decision makers have to take the initiative, and the strategies to achieve this include:

- ✓ 'Promoting demonstration projects of green buildings'. These demonstration projects can be started in some developed regions then expanded to other regions. A prefabrication construction approach can be employed in the demonstration projects to speed up the development of green buildings.

2. *Reactive Strategy*, it is derived from intersection between strengths and threats (ST). This strategy is primarily based on the system's strengths to defend against threats from outside the system and include:
   - ✓ 'Formulation of policy guidance (carrot and stick policy)' to ensure the implementation of green building technology. Due to lack of commitment by stakeholders to building codes due to the lack of capital support and technical guidance in the standards implemented, accordingly, an appropriate management mechanism must be established. "Carrot and stick" strategies are among the best choices.
   - ✓ 'Establishment of research and technology development institutions'. Reasonable technology is an effective channel for solving the problems of green building implementation. Research, development and technological development is an important matter.
3. *Adjust Strategy*, It is obtained from the intersection of weakness and opportunities (WO). By taking the advantage of opportunities, weaknesses can be neglected or at least their negative impacts can be minimized. This strategy include:
   - ✓ 'Holding technical working groups and seminars on the importance of environment and green development for executives in the construction industry'.
   - ✓ 'Carrying out green buildings technical training'. Training is an effective approach to promoting green buildings. Training can increase stakeholder awareness of green buildings and improve the skills of artisans in building industry.
4. *Defensive Strategy*, it is obtained from integration between weaknesses and threats (WT). Threats can be repressed by addressing weaknesses. This can be achieved by:

- ✓ ‘Exchange science and technology with developed and leading countries in green building’ to benefit from similar work experiences.
- ✓ ‘Attract international investment by environmentally active bodies’ to reduce initial costs of green buildings technology.

Through the conducted SWOT analysis, seven new strategies were formulated to achieve long-term purposes given the mission of adopting and implementing green buildings in Libyan projects. These strategies can add to the important strategies to accelerate the green building movement in Libyan construction sector which were derived from the literature review and listed in Table 2.12.

As mentioned earlier, the lack of stakeholders' awareness and knowledge are the most important threats of adopting green buildings. The best solutions and strategies to reduce weaknesses and threats are to convene technical working groups and seminars on environmental importance and development of green stakeholders, especially decision makers, and attract foreign and domestic investment as the best strategy for green building development.

Based on the findings, an implementation strategy model was proposed to promote the adoption of green buildings as shown in Figure 5.4. To ensure the effectiveness of the proposed implementation strategy model, only factors that have been ranked within the top ten factors associated with the application of green buildings have been included. Identification of the major motivators of green building adoption is considered as the first step in the model, while identification of the critical barriers is considered as the second step in the model. The third step is to conduct a SWOT analysis on both motivators and barriers. The fourth step in the model is to derive the appropriate strategies of green building adoption. The last step in the model is decision-making to implement the appropriate strategies that will address the barriers and promote the motivators. Thus, through the application of this model by the main stakeholders of the building sector who are the government, the designer, and the owner, the adoption and application of the green design concept can be accelerated in Libyan building projects as well as in developing countries.

Based on the above findings and discussions, the instructions and guidelines constructed in detail, for the government, designers and owners will be presented in the next chapter.

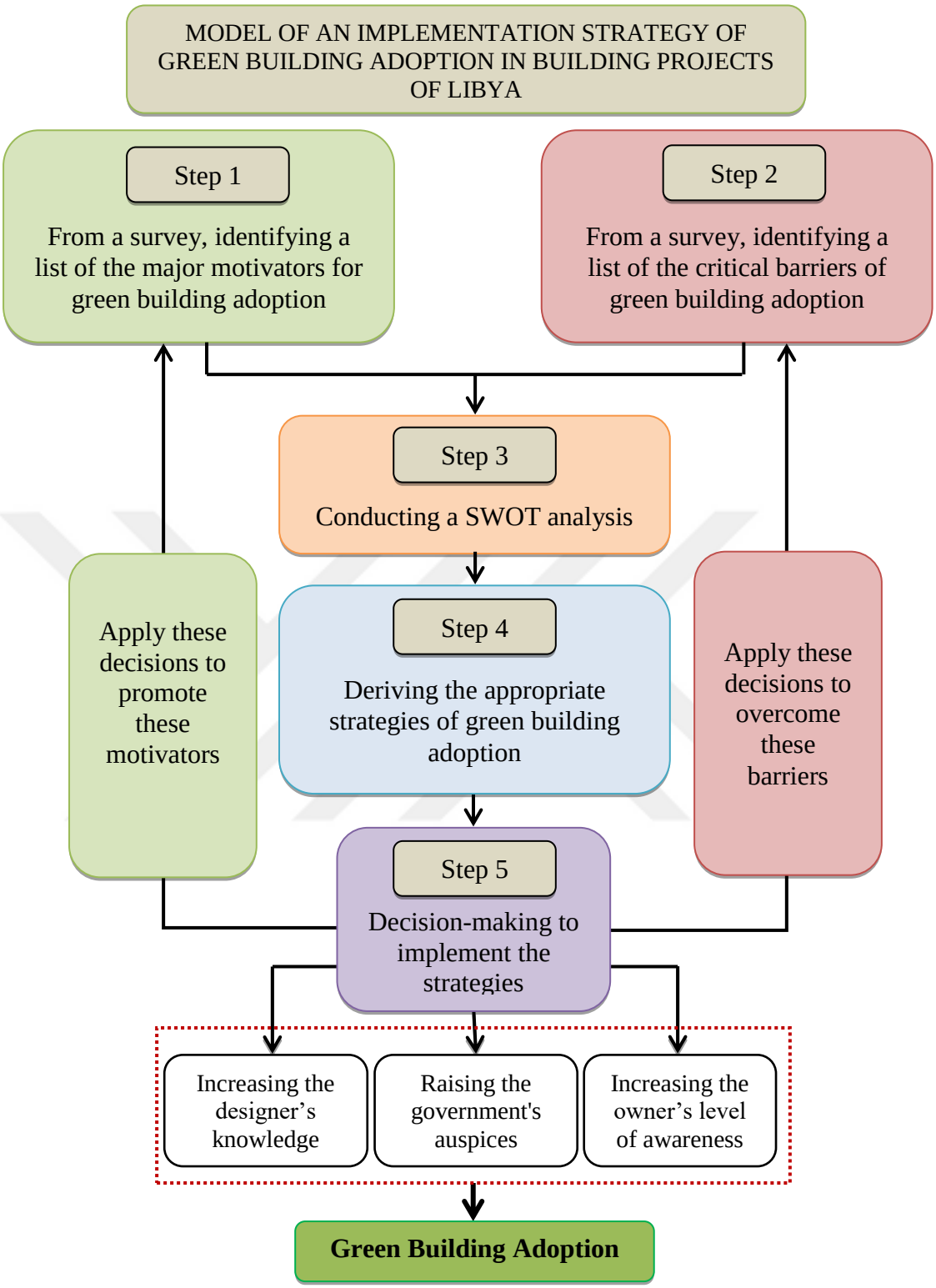

Figure 5.4. An Implementation Strategy Model

CHAPTER VI
RECOMMENDATIONS AND CONCLUSION

This chapter presents several recommendations and instructions suggested to the government, designers, and owners to promote and accelerate green building adoption in building projects of Libya through the previous objectives which were studied in this research. After that, the conclusion of this study is presented. The final section of this chapter presents the limitations of the study and several suggestions for further research.

6.1 Recommendations

Through the literature and the results of the survey with regard to the most important decision-makers in building industry to implement and manage green construction projects, government, designer, and owner are ranked as the most important decision-makers for the adoption of green design concept in building projects.

6.1.1 Recommendations for government

It could be argued that the government, especially local governments, have a distinctive and effective role that cannot be ignored as being the only one of the stakeholders have the right and full power in the enactment of the legislation and laws, whether mandatory or motivational, to implement plans, programs and projects. According to the results of the survey, most respondents agreed that the Libyan government should formulate a green building policy. The following instruments should be taken by Libyan government as guidelines to accelerate the adoption of green buildings:

6.1.1.1 Government supports

The government should support the concept of green building through:

- ✓ Support this type of building from governmental institutions

- ✓ All governmental buildings should be obligated to have a certain level of green certificate
- ✓ Adopt the green building concept in the government housing policy
- ✓ Accelerate the establishment of responsible bodies for green building adoption such as Libyan Green Building Council
- ✓ Support the use of renewable energies, especially solar energy
- ✓ Eliminating government subside on electricity and fuel and moderating energy and water prices

6.1.1.2 Necessary regulation and legislation

- ✓ Application of green strategies should be mandatory
- ✓ Building environmental performance regulations should be created
- ✓ Develop programs and policies by the government in this direction
- ✓ Enactment of laws that encourage the use of green buildings
- ✓ Develop higher mandatory standards for energy efficiency codes and adoption of minimum green standards
- ✓ Amend the current building codes to be in line with green building requirements
- ✓ Issuing the Libyan building code including the specifications regarding the green building concept
- ✓ Development of city planning in line with climate change

6.1.1.3 Education and research encouragement

- ✓ Educating and raising awareness of community about the benefits of green buildings and their positive impact on the environment and health through different media
- ✓ Supporting scientific research related to the green building applications
- ✓ Conferences and seminars about green building concept should be held by governmental institutions
- ✓ Highlighting the green building concept in architecture and engineering faculties and make sustainable design a priority in the curriculum

- ✓ Establish a sustainable development research institute to create unified research and development center and providing a database on sustainable design for researchers

6.1.1.4 Adopting the economic incentives policy

- ✓ Government incentives such as reduction of property tax on green buildings should be established and implemented immediately
- ✓ Reducing the unit price for resources such as energy and water for buildings with green certification
- ✓ Opening investment opportunities for the local companies
- ✓ Rationalize the domestic investors to embrace the green buildings
- ✓ Support investors financially
- ✓ Government should encourage local manufacturers of building materials by an incentives to produce a green building materials

6.1.2 Recommendations for designers

- ✓ Designers should take environmental problems and the issue of climate change as first concern during all design phases of building projects
- ✓ Designers should adopt the principles of green building concept in design as a solution to Libya's problems
- ✓ Designers should study green buildings and monitor green techniques professionally
- ✓ Designers should continuously attend to development courses, conferences and workshops to get informed of what is new in the construction industry and what they should be doing
- ✓ Designers should benefit from facilitator, consultant or local resource centers to fill the educational gap
- ✓ Designers, in particular the architect, should explain the principles of green buildings thoroughly and educate the clients regarding the benefits of green buildings on the environment and users, starting from the initial stages of project design
- ✓ They should have specialization in environmental design and their standards

- ✓ Designers must learn simulation techniques according to simulation ability to solve complex problems
- ✓ Designers have to rely on passive design strategies for building's heating, cooling, lighting, and ventilation systems
- ✓ Designers must learn and implement the modern techniques such as water management technology, renewable energy technologies, recycling and reuse techniques that will promote the adoption of the concept of green building in Libya.

6.1.3 Recommendations for owners

- ✓ Owners or clients should raise their knowledge and culture about the environment in general and of sustainable buildings in particular
- ✓ Owners or clients should have a concern for the environment and be willing to contribute to reducing the risks of climate change
- ✓ They should show effort to minimize the consumption of natural resources
- ✓ They should refuse 'imported' or typical designs and insist for the design of buildings in line with the requirements of the environment of project location, topographically and climatically

6.2 Conclusion

Despite the wide spreading of the concept of green building in many developed and developing countries around the world, it does not possess a similar status in Libya and is still in its early stages. This is noted by the absence of strategies, policies, and regulations that encourage the adoption and implementation of green building concept in building projects of Libya.

This study examines the main issues affecting the adoption of the concept of green buildings from the views of construction experts in Libya. Thus, given the limited empirical studies on issues affecting the adoption of green buildings, this study contributes to the knowledge body by identifying key issues for decision makers of adopting the concept of green buildings in Libya. It concluded that many issues affect the implementation and formation of green buildings. A wide range of motivators, barriers, and strategies of green building adoption were identified and examined using

a combination of research methods which included literature review, questionnaire survey, and semi-structured interviews. Issues that affect the adoption of green buildings have been analyzed using ranking technique, thus providing a clear understanding of key issues that deserve further attention in efforts to promote the adoption of green buildings. The factors that affect the adoption of green buildings in Libya have been analyzed using ranking method utilizing the quantitative statistical analysis package software (SPSS) version 25, thus providing a clear understanding of key issues deserving more attention in efforts to promote the adoption of green buildings. The study examined 24 motivators, 24 barriers, and 12 promotion strategies from the views of construction experts.

With respect to the green building adoption motivators, results indicated that the 24 motivators considered in this study play an important role in pushing the adoption of green design in Libyan building projects, with the top ten motivators being 'Protection of the environment and ecosystem', 'Control of climate change', 'Providing improved comfort, health, and well-being of occupants', 'Providing lower annual energy cost', 'Increasing indoor air quality', 'Recycling and waste reduction', 'Getting the satisfaction from doing the right thing', 'Compatibility with environmental regulations', 'Increasing building quality and value', and 'Providing lower water and waste cost', respectively.

Regarding to the green buildings adoption barriers, results indicated that the 24 barriers considered in this study play an important role in hindering the adoption of green design in Libyan building projects, with the top ten barriers being 'Lack of awareness in the society', 'Lack of knowledge', 'lack of demand of client', 'Unsupportive government policies and regulations', 'Absence of an official green building body', 'Lack of demand in the market', 'Lack of environmental concerns', 'Higher initial project cost', 'No financial incentives from the government', and 'Having low electricity prices', respectively.

With respect to the strategies, results indicated that all of the 12 strategies for green building adoption have been recognized as highly important strategies, with the ranking strategies being 'Promotion of the construction materials industry to depend on local resources', 'Development and use of economic incentives', 'Raising awareness towards green building and the environment in educational curriculum',

‘Establishment of an official green building body’, ‘Encouraging green building research’, ‘Development and use of green building rating systems as assessment tools’, ‘Implementing property tax incentives for green buildings’, ‘Modification of governmental building projects into green buildings’, ‘Sharing successful experiences related to green buildings through social media’, and ‘Establishing sustainability as the core policy’, respectively. The study also indicated that to achieve successful implementation on a large scale and in a short time for the concept of green building in Libyan projects, all these strategies need to be applied as whole package.

While the barriers identified in this study were identified as barriers to the adoption of green buildings, most of them can be overcome by utilizing motivators and specific strategies. It is concluded that the adoption of green buildings is very young in Libya, therefore, at this early stage, the government has a vital role in promoting the adoption of green buildings, as well as formulating and implementing appropriate strategies to accelerate the adoption and implementation of the concept of green buildings.

Based on the motivators and barriers that affect the adoption of green buildings in Libya, the study conducted a strength-weakness-opportunity-threat (SWOT) analysis in order to derive and establish specific strategies that can accelerate the adoption of green buildings in Libya, which were; ‘Promoting demonstration projects of green buildings’, ‘Formulation of policy guidance (carrot and stick policy)’, ‘Establishing technology research and development institutions’, ‘Holding technical working groups and seminars for executives in the construction industry’, ‘Carrying out green buildings technical training’, ‘Exchange science and technology with developed and leading countries in green building’, and ‘Attract international investment by environmentally active bodies’.

Based on the findings, and as an academic contribution, this study suggested a model for the implementation strategy to encourage the adoption of green buildings in Libya in particular and in developing countries in general. This model include three stages to achieving green buildings adoption which are;

- ✓ First step, identification the major motivations of green buildings adoption
- ✓ Second step, identification the critical barriers to green buildings adoption
- ✓ Third step, identify important strategies that will address the barriers and promote the motivators

Finally, several recommendations and instructions are suggested to the government, designers, and owners to promote and accelerate green building adoption in building projects of Libya through the previous objectives which were studied in this research. These recommendations were derived from the green buildings' motivators, barriers, and strategies that were identified and evaluated in this study, as well as studied from practical experiences and practices for the adoption and implementation of green buildings during literature review.

The results of this study are expected to contribute valuable information to policy-making in the building industry and to the implementation of green buildings in Libyan projects in the future. The results contribute to a deeper understanding of key issues affecting the adoption of green buildings. Although, the results are relevant to green building adoption and implementation in Libyan projects, it might also be useful for policy makers in other developing countries.

6.3 Limitations of the Study

This thesis has achieved its initial objectives and presented an in-depth analysis of the motivators, barriers and strategies towards adopting green design in the building projects of Libya. However, the thesis has some limitations. With limited resource constraints and availability of information on Libya, the literature review of this study did not include all of the issues related to the development of green buildings and all of the green building policies in countries. Therefore, only the issues and policies of some representative countries are selected as focus studies. Besides, there are many sets of policy options for formulating a package of green building policies, each policy option can play its role in respect of the environmental, social and economic characteristics of the country.

In this study, only the general principle was chosen for some common options to include in the literature review and survey of this study. Lastly, due to the political and security instability of the country during the survey process, the survey was limited in the Tripoli region only and did not include the rest of the regions which are Barqa (eastern region of Libya) and Fezzan (southern region of Libya). It would have been better to include all of the three regions of Libya to formulate more comprehensive strategies and policies. Furthermore, it is understood that if more replies are collected, the result will be more representative. However, with best efforts, only 74 of 150 responses could be collected, which may have limit the representation of results. It should be noted that this study adopted a neutral approach to conducting the research study and interpretation of the results of the survey in order to avoid any unnecessary biases.

6.4 Further Research

This thesis begins with the development of strategies and policies that needed for the adoption and implementation of green buildings, and corresponding options should be included within the state policy framework. There is still a lot of future work to make the whole green building policy effective. It would be beneficial to carry on this research in the following area:

- ✓ A comprehensive study should be undertaken to conduct similar research in other countries in order to validate the research results and the theoretical framework applicable in this study.
- ✓ An inclusive research is needed to determine the governance system variables that significantly influence green design performance of building projects.
- ✓ Further research could be conducted on the governments that have developed various policies and regulations to improve the issue of sustainable development around the world. Thus, these government incentives can be investigated.
- ✓ There is need for comprehensive studies that focus on single green strategy to demonstrate the impacts and benefits of these green building strategies. An analysis of the financial advantages and risks of each strategy can be

undertaken provided that these strategies have a strong and sound statistical basis.

- ✓ Similar research can be conducted with different respondents to include building users (occupants) and building contractors. The results obtained can be compared with the current results for further validation.
- ✓ Further study is needed on the phases of the project life cycle, such as construction and renovation phases. The main objective will be to define green assessment criteria for the entire life cycle of the project.
- ✓ Further research is needed on the advantages and disadvantages of using mandatory green aspects in design practice rather than volunteering. Results may change the roles of parties involved in green design to improve overall green performance.
- ✓ The recruitment of the integrated design approach can be studied, and the low initial cost of green buildings should be proved.
- ✓ Increasing public awareness of the benefits of green buildings is of great importance. It is hoped that people will begin to build green buildings in public places using sustainable strategies in their homes. To achieve this, a survey can be conducted to understand their knowledge and demand. This also helps in determining the target needs of residential buildings.

To summarize, the adoption of the concept of green design in building projects in Libya is not only a matter that requires the efforts of the Libyan government, but also the cooperation of all stakeholders, i.e. public and private organizations, academics or even every citizen. The contribution and participation of all stakeholders is very important in facilitating the formulation and implementation of green building policy and making the built environment in Libya green and sustainable for future generations to enjoy. It is believed that, in the near future, principles of sustainable design will be widely adopted and green buildings will be designed and constructed in Libya as well.

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APPENDIXES

APPENDIX: A

CANKAYA UNIVERSITY
GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES
FACULTY OF ARCHITECTURE

A QUESTIONNAIRE ON POLICY OF GREEN DESIGN IMPLEMENTATION IN BUILDING PROJECTS OF LIBYA

Dear Sir / Madam

You are invited to participate in the captioned research study conducted by a Ph.D. student which is an on-going study at the Graduate Program in the Faculty of Architecture at the Cankaya University.

Definition: "Green Buildings" are buildings that have less negative impact on the environment by achieving efficiency in energy and water consumption, choosing optimal site and orientation, as well as utilizing resources and materials as to achieve a high quality at the building interior.

The Benefits of a Green Building: It has been reported that green buildings can:

- Reduce energy, water, and maintenance costs,
- Reduce health and safety costs
- Improve employee productivity

The purpose of this study is to have an overview of the perception and approaches of the professionals in the building industry in Libya, concerning green design implementation. The findings of this study will underline the growing importance of green buildings. This green building survey, which you are about to complete, should take approximately 30 minutes. Any information provided from participators will be confidential and used only for academic purposes.

If you have any questions about this project, please contact me via my email almkeekrem@yahoo.com. I would like to thank you for your time and contribution to my study.

Survey Consent Form

I understand the content described above and agree to participate in this study.

[ ] Yes [ ] No

FIRST SECTION-RESPONDENT INFORMATION

1.1 What is your job title?

[ ] Architect [ ] Civil Engineer [ ] Electrical Engineer [ ] Mechanical Engineer

[ ] Contractor [ ] Investor [ ] Urban & Regional Planner

1.2 How long have you been involved in the construction industry?

[ ] Less than 5 years [ ] 5 to 10 years [ ] 11 to 15 years [ ] More than 15 years

1.3 How many building projects have you been involved in?

[ ] Less than 5 [ ] 5 to 10 [ ] 11 to 15 [ ] More than 15

1.4 Do you have any knowledge on green buildings?

[ ] Yes [ ] No

1.5 Where did you get your knowledge of green buildings? (Mark all that apply)

[ ] Attending conferences [ ] Reading commercial publications

[ ] Taking related courses [ ] Working with consultants

[ ] Sharing knowledge with colleagues [ ] Internet research

SECOND SECTION-GENERAL PERCEPTION ABOUT GREEN BUILDINGS

2.1. Rank the given type of buildings according to their level of importance to be designed as green buildings.

(1-most important, 7-least important)

Item	Type of building	Rank *(From 1 to 7)*
1	Educational buildings (Schools/Colleges)	
2	Commercial buildings (Shopping Malls)	
3	Governmental buildings	
4	Industrial buildings	
5	Residential buildings	
6	Hospitality buildings (Hotels)	
7	Healthcare buildings	

2.2. Rank the given decision-makers/professionals according to their level of importance in implementing green building projects.

(1-most important, 7-least important)

Item	Decision-makers/Professions	Rank *(From 1 to 7)*
1	Architect	
2	Engineer (Mechanical, Electrical, Civil)	
3	Project Owner	
4	Project Funder	
5	Project Contractor	
6	Occupant(s)	
7	Governmental Authorities	

2.3. Rank the given decision-makers/professionals according to their level of importance in the management of green building projects.

(1-most important, 7-least important)

Item	Decision-makers/Professions	Rank *(From 1 to 7)*
1	Architect	
2	Engineer (Mechanical, Electrical, Civil)	
3	Project Owner	
4	Project Funder	
5	Project Contractor	
6	Occupant(s)	
7	Governmental Authorities	

2.4. What is your opinion regarding the need for Libyan building projects becoming 'greener'?

[ ] Strongly disagree [ ] Disagree [ ] Agree [ ] Strongly agree

2.5. What is your opinion regarding the need to develop 'green' construction policies in Libya?

[ ] Strongly disagree [ ] Disagree [ ] Agree [ ] Strongly agree

2.6. Please state your opinion on whether the policy to accelerate the application of green design in Libyan building projects should be "Mandatory" or "Voluntary" depending on the type of building.

Type of Building	Mandatory	Voluntary
Public Building		
Private Building		

2.7. According to your experience, evaluate the following motivators as to how they affect the implementation of green design in Libyan building projects.

(*Please check the appropriate box).*

Label	**Motivators**		Definitely does not affect	Probably does not affect	Probably affects	Definitely affects
M1	**Environmental**	Protection of the environment and ecosystem				
M2		Control of climate change				
M3		Compatibility with environmental regulations				
M4		Increasing indoor air quality				
M5		Recycling and waste reduction				
M6		Improve reusable and recycle building elements				
M7	**Economic**	Increasing building quality and value				
M8		Providing lower operation, maintenance, and repair cost				
M9		Providing lower building life-cycle cost				
M10		Providing a good opportunity for investment returns				
M11		Increasing occupant productivity				
M12		Increasing occupancy rate				
M13		Increasing rental and sale value				
M14		Providing lower annual energy cost				
M15		Providing lower water and wastewater cost				
M16		Giving a good reputation for marketers				
M17		Availability of more financing channels				
M18		Increase in demand of clients				
M19		Having a good market for green buildings in Libya				
M20	**Social**	Providing improved comfort, health, and well-being of occupants				
M21		Creation of better future opportunities				
M22		Getting the satisfaction from doing the right thing				
M23		Libyan government policies and regulations support the green design				
M24		Religion, customs and tradition support the green design concept				

2.8. According to your experience, evaluate the following barriers as to how they affect the implementation of green design in Libyan building projects.

(*Please check the appropriate box).*

Label	Barriers		Definitely does not affect	Probably does not affect	Probably affects	Definitely affects
B1	**Environmental**	Lack of environmental concerns				
B2		Lack of accurate environmental data				
B3		Lack of green materials in the local market				
B4		Hardness of the local climatic conditions				
B5	**Economic**	High cost of green building certification				
B6		Very long payback time for investment returns				
B7		Higher initial project cost				
B8		Higher financial risk				
B9		Having low electricity prices				
B10		Having low water prices				
B11		Higher green material costs				
B12		Higher green technology system cost				
B13		Having a short-term budget perception instead of long-term				
B14		Lack of demand of client				
B15		Lack of demand in the market				
B16		No financial incentives from the government				
B17		The difficulty of applying changes in late design stages				
B18	**Social**	Lack of awareness in the society				
B19		Lack of knowledge				
B20		Lack of experience of consultants and contractors				
B21		Limited experience and skills of construction workers				
B22		Lack of funding and support of the private sector initiatives				
B23		Unsupportive government policies and regulations				
B24		Absence of an official green building body				

THIRD SECTION-FUTURE EXPECTATIONS ABOUT GREEN BUILDINGS

3.1. According to your experience, evaluate the following strategies as to their effects to accelerate the green building movement in the Libyan construction sector.

(*Please check the appropriate box)*

Label	**Strategies**	Definitely does not affect	Probably does not affect	Probably affects	Definitely affects
S1	Establishing sustainability as the core policy				
S2	Raising awareness towards green building and the environment in educational curriculum				
S3	Development and use of green building rating systems as assessment tools				
S4	Development and use of economic incentives				
S5	Modification of governmental building projects into green buildings				
S6	Implementing property tax incentives for green buildings				
S7	Sharing successful experiences related to green buildings through social media				
S8	Encouraging green building research				
S9	Establishment of an official green building body				
S10	Promotion of the construction materials industry to depend on local resources				

Other (please specify):

.....

.....

.....

3.3. If you have any comments concerning the questionnaire or research topic, please write them below:

……...

…...……

……...……

If you would like the summary of the research result, free of charge, please write your name, address and Email:

Name: ……...
Address: ……....
Email: ……

THANK YOU VERY MUCH FOR TAKING PART IN THIS SURVEY

APPENDIX: B

A BRIEF DESCRIPTION OF SELECTED GOVERNMENT INSTITUTIONS INVOLVED IN CONSTRUCTION IN LIBYA

1- NATIONAL CONSULTING BUREAU

The National Consulting Bureau was established as the first joint stock company under law no. 63 of 1975 with a capital of one million dinars divided into shares wholly owned by the state. The law establishing the office was put into effect only in 1978 by the formation of its technical and administrative apparatus. The bureau has played an important role in the development plans and programs of the State in accordance with the available means and capacities under the prevailing legislation and within the framework of the slogan of quality, commitment and teamwork. The bureau has a wealth of information, expertise, experiences and methods to enable it to embark on a new stage of development and construction in a new vision and strategy.

Services of Bureau:

- ✓ Conduct surveys and studies related to the feasibility of economic, technical and construction projects and supervise their implementation
- ✓ Surveying works of various types
- ✓ Soil analysis and construction materials tests
- ✓ Provide all technical expertise, consultancy and engineering in various specialties and aspects

Projects of Bureau:

- ✓ Preparing a technical study for the maintenance and rehabilitation of Al Emadi Administrative Complex
- ✓ Designing systems and infrastructure for communication and information technology to create 25 university compounds
- ✓ Preparation of technical studies and engineering designs for Benghazi International Exhibition Project
- ✓ Preparation of the preliminary outline plan for the coordination of the general site of the University of Tripoli (a), (b)
- ✓ Waterfront development and design project - Karkarach
- ✓ Building of the Department of Architecture at the University of Tripoli
- ✓ Preparation of master plans for the waterfront project of Sirt City Corniche
- ✓ Project of supervision of the implementation of the university compound in AlKumes
- ✓ Project of supervising the implementation of the university compound in Gharyan
- ✓ Project supervision of the implementation of the university compound in Jafara
- ✓ Project supervision of the implementation of the university compound in Nalut
- ✓ Supervision of the implementation of the university compound in Darnah
- ✓ Project supervision of the implementation of the university compound in Sabha

- ✓ Project supervision of the implementation of the headquarters of the National Company for drilling and maintenance of oil wells (administrative building)
- ✓ Preparation of the architectural design of the Supreme Court building and the development of the Italian square in Tripoli
- ✓ Project supervision of the implementation of the university compound in Sabratha
- ✓ Project supervision of the implementation of the university compound in Opary
- ✓ Project supervision of the implementation of the university compound in Benghazi
- ✓ Project supervision of the implementation of the university compound in Brak
- ✓ Project supervision of the implementation of the university compound in Tobruk

https://www.ncblibya.com/index.html

2- ENGINEERING CONSULTING OFFICE FOR UTILITIES (ECOU)

The Engineering Consulting Office for Utilities (ECOU) was established by the General People's Committee under the decision no. 745 of 1981 with a capital of four million dinars divided into 4000 shares wholly owned by the state. The Engineering Consulting Office for Utilities, is one of the main engineering consulting offices in Libya which is involved in the design works of major projects

https://www.libyaninvestment.com/libya-jobs/199927

3- ORGANIZATION FOR DEVELOPMENT OF ADMINISTRATIVE CENTERS (ODAC)

Development of Administrative Centers Authority was found under decision No. 371 for year 1989 issued on 7th of May. Development of Administrative Centers Authority is one of the great significant achievements which drew the wide lines for development in the wide geographical area and all prospects of this country, with a serious desire to success and an epic of hard and intrepid work to achieve the spatial development that elevate the homeland and the citizen through the great achievements in all fields: Residential, Educational, Health, Service, and infrastructure which meets all requirements of the needed infrastructure.

Fields of Work:

- ✓ Under this decision the Authority was assigned to implement the following:
- ✓ Supervising the process of urban development and the implementation of various projects in all around Libya
- ✓ Supervising the implementation of public projects and carry out coordination among the various projects in order to achieve their desired goals
- ✓ Supervising the application of the adopted plans for development projects
- ✓ Adoption of the designs and specifications that being on basis of execution
- ✓ Adoption of the estimated budget for the implementation of projects
- ✓ Hiring people with expertise and specialty from specialized bodies or offices
- ✓ Study, contracting, and implementation, which enables the Authority to carry out its tasks and works in the desired ability and the speed and good implementation

www.odac.ly

4- HOUSING AND INFRASTRUCTURE BOARD

The Housing and infrastructure board was established by the decision of the General People's Committee in March 2006, where it began to carry out its tasks of implementing housing projects and facilities in the Libyan State with a clear mechanism of action based on the completion of projects received from the various regions of Libya and the implementation of new projects, it was assigned the tasks of implementing infrastructure projects and integrated facilities.

Tasks of Board:

- ✓ Implementation of planned projects in the field of housing
- ✓ Development of degraded areas and neighborhoods
- ✓ Development of cities and villages in accordance with the requirements of contemporary life
- ✓ Implement urbanization and prepare the necessary land for the implementation of housing projects and necessary facilities
- ✓ Contribute to the preparation and composition of technical plans necessary for the implementation of the Agency's projects in cooperation with the competent authorities
- ✓ Contracting and carrying out all actions and procedures that would achieve the purpose for which the Authority was established
- ✓ Follow up the global technical development in the field of construction and public utilities and benefit from the implementation of the projects entrusted to him to implement and study the economics of construction and development of implementation methods to serve the transfer of knowledge and the resettlement of technology
- ✓ Providing the needs of building materials, equipment, equipment, local equipment or imports from abroad, and manufacturing the building materials necessary for the implementation of its projects

www.hibly.net

5- CITIES DEVELOPMENT ORGANIZATION

Cities Development Organization is a government organization, established by the General People's Committee under the decision No. 401 for the year 2010. It is follows The Ministry of Housing and Utilities.

Tasks of Organization:

- ✓ Proposing operational development plans and programs for degraded areas.
- ✓ Development and rehabilitation of public housing buildings which implemented during previous periods.
- ✓ Implement the approved plans for the development, development and rehabilitation of degraded areas within the approved plans.
- ✓ Maintenance of public buildings targeted for development.
- ✓ Maintenance, restoration and development of old cities and historical buildings except Ghadames
- ✓ Implementation of major parks projects.
- ✓ Implementation of the works related to the waterfront.
- ✓ Development and improvement of the urban environment (spaces, buildings and other elements).

https://www.facebook.com/pg/TATWEER.ALMUDON/about/?ref=page_internal

6- CENTRE FOR SOLAR ENERGY RESEARCH AND STUDIES (CSERS).

The Centre for Solar Energy Research and Studies was established by the decision of the General People's Committee in mid-1978. This decision set the objectives of the Centre in three points:

- Research and scientific studies in the field of solar energy
- Develop and propose plans to achieve the expanded exploitation of solar energy
- Spread scientific awareness in the field of solar energy.

Tasks of the centre

- ✓ Proposing policies and priorities of scientific research and setting plans and programs in the field of solar energy, wind energy and sources of other renewable energies, and supervising their implementation in light of the general policy of the state and approved scientific plans.
- ✓ Conduct scientific studies and researches related to the use and development of technologies and uses of solar energy, wind energy and other renewable sources of energy.
- ✓ Conducting the necessary surveys to assess the sources of solar energy, determine its potential and evaluate it, and develop plans and programs necessary for its investment.
- ✓ Pilot projects, pilot projects and extensive use projects in the fields of solar energy, wind power and other renewable sources of energy and the evaluation of technical and economic performance.
- ✓ Participate and contribute to the development of a national program for the transfer and resettlement of solar energy utilization and utilization techniques.
- ✓ Follow-up scientific discoveries and developments in the field of competence and work on the development of scientific and practical programs to benefit from them.
- ✓ Provide scientific and technical advice to public and private bodies and prepare studies and training courses in various fields of specialization.
- ✓ Propose and develop national standards for solar and wind power equipment and systems and other renewable energy sources, and test systems and certify quality.
- ✓ Conduct technical and economic feasibility studies for applied projects in the fields of solar energy, wind power and other renewable energy sources, and develop technical specifications and supervision in all stages of implementation and use national and international expertise whenever required.
- ✓ Carry out actions that would increase the understanding of the national capabilities of the technologies related to the Center's activities and expand their use and utilization.
- ✓ Work on the development and implementation of programs to strengthen and rehabilitate and stimulate the research and technical staff working in the Center.
- ✓ To carry out studies related to the social and environmental phenomena that accompany or result from the practice of the Center for its activities and to develop effective methods to address its negative and generalize its positives.
- ✓ Holding conferences, seminars and lectures related to the Center's activities and participating in regional and international conferences and forums. As well as organizing exhibitions that highlights its activities.

- ✓ To make proposals on legislation relating to the activities of the Center and those related to the exercise of its functions.
- ✓ To carry out the activities of the Center through the various media, as well as through the preparation of brochures and posters and the issuance of scientific journals and periodicals that reflect his activities.
- ✓ Dissemination of scientific awareness among citizens in relation to the Center's competencies through various media.

www.csers.ly

7- INDUSTRIAL RESEARCH CENTRE (IRC)

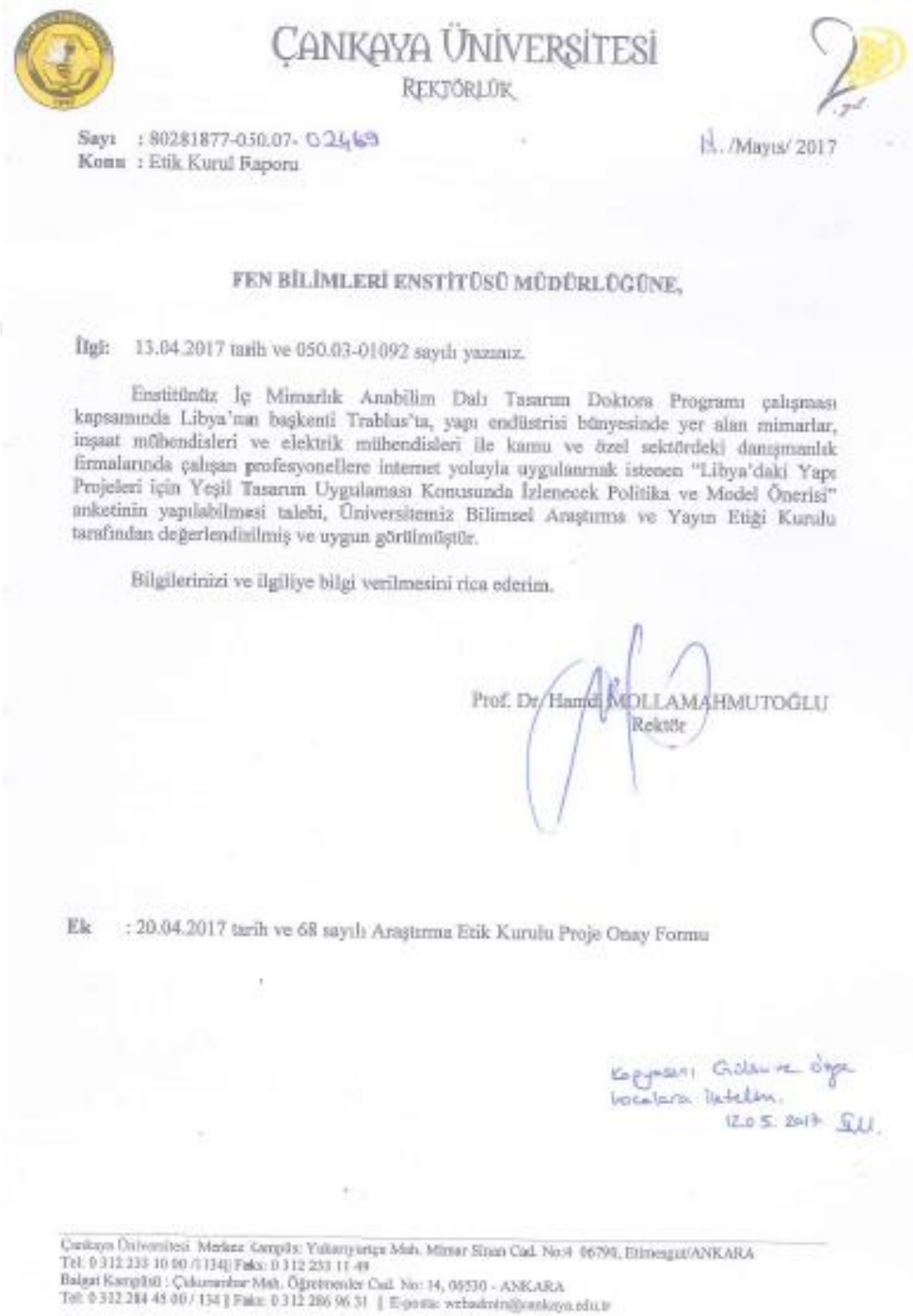
The Industrial Research Centre is one of the departments specialized in the development of the national economy in Libya in all aspects of industrial research to enhance the technical research capacity aimed at expanding the use of local materials, resources and materials in the industry. For the entities engaged in the industry, whether public or private in the fields of investment and increase production as a kind and raise the efficiency of production and improve methods of conservation and packaging and packaging of industrial products and research and exploration for mineral raw materials by conducting surveys Geological and provide expertise and advice to achieve the objectives of industrial development as well as the centre is working to implement research projects for the operators in the industrial sector and other related sectors based on the agreements concluded with them to strengthen its financial and technical capabilities. The Industrial Research Center contains the following departments:

- ✓ Management of projects and technical research, which provides advice for future projects and expected economic and financial statistics of the State of Libya.
- ✓ Management of geological research and mining concerned with the geological mapping of Libya. It has almost collected all documents related to the mineral and non-metallic resources and the geological formation of the Libyan State
- ✓ Management of laboratories, which divided into a group of departments containing many laboratories dealing with the treatment of tradable commercial goods, whether food or clothing, clothing, shoes, perfumes, detergents, drinking water and many other consumables for the citizen, as well as building materials such as bricks and cement as well as mineral materials and related materials industry Engineering, such as coatings, reinforcing steel tests, etc., of the tests, each according to the section to which the sample is referred, after determining the required tests according to the international standard in Libya and abroad
- ✓ The Office of Inspections, which is responsible for the inspection of goods and the release of samples of traders in cooperation with customs
- ✓ Department of information and information department specialized in the province and there is a large number of documented studies of many projects of interest to the state
- ✓ The Patent Office, an office that documents and grants the patent to the debtor and registers it internationally.

http://www.irc.ly/ar2/

APPENDIX: C

REPORT OF THE ETHICS COMMITTEE REGARDING THE ADOPTION OF THE QUESTIONNAIRE FORM



ÇANKAYA ÜNİVERSİTESİ
REKTÖRLÜK

Sayı : 80281877-050.07- 02469
Konu : Etik Kurul Raporu

12./Mayıs/ 2017

FEN BİLİMLERİ ENSTİTÜSÜ MÜDÜRLÜĞÜNE,

İlgi: 13.04.2017 tarih ve 050.03-01092 sayılı yazınız.

Enstitünüz İç Mimarlık Anabilim Dalı Tasarım Doktora Programı çalışması kapsamında Libya'nın başkenti Trablus'ta, yapı endüstrisi bünyesinde yer alan mimarlar, inşaat mühendisleri ve elektrik mühendisleri ile kamu ve özel sektördeki danışmanlık firmalarında çalışan profesyonellere internet yoluyla uygulanmak istenen "Libya'daki Yapı Projeleri için Yeşil Tasarım Uygulaması Konusunda İzlenecek Politika ve Model Önerisi" anketinin yapılabilmesi talebi, Üniversitemiz Bilimsel Araştırma ve Yayın Etiği Kurulu tarafından değerlendirilmiş ve uygun görülmüştür.

Bilgilerinizi ve ilgiliye bilgi verilmesini rica ederim.

Prof. Dr. Hamdi MOLLAMAHMUTOĞLU
Rektör

Ek : 20.04.2017 tarih ve 68 sayılı Araştırma Etik Kurulu Proje Onay Formu

Kopyasını Gidecek Öğr. Üyelere İletelim.
12.05.2017

Çankaya Üniversitesi Merkez Campüs: Yukarıyurtçu Mah. Mimar Sinan Cad. No:4 06790, Etimesgut/ANKARA
Tel: 0 312 233 10 00 /1134| Faks: 0 312 233 11 49
Balgat Kampüsü : Çukurambar Mah. Öğretmenler Cad. No: 14, 06530 - ANKARA
Tel: 0 312 284 45 00 / 134 | Faks: 0 312 286 96 31 | E-posta: [illegible]

APPENDIX: D

CANKAYA UNIVERSITY
GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES
FACULTY OF ARCHITECTURE

QUESTIONS OF SEMI-STRUCTURED INTERVIEWS ON POLICY OF GREEN DESIGN IMPLEMENTATION IN BUILDING PROJECTS OF LIBYA

Name of Institution or Firm: ……...……

Field of the Work:……

Participant's Name: ……..…….....

Current Position in Organization: ……..……

Please answer the questions listed below as completely and accurately as possible

1. Do you have practical experience in green building design?
2. If so, what were the major motivations that drive you to be involved?
3. If not, what were the critical barriers that hindered you to be involved?
4. How would you evaluate working on green building design, compared to conventionally designed projects?
5. Does working on a project with a green approach promote an integrated design process? How does it affect the teamwork?
6. Have you ever used any green concepts in your building designs? If so, what was the approximate additional cost for one project?
7. Do you think that green buildings are good for the Libyan environment? Why do you think so?
8. Is there a market for green buildings in Libya, particularly in the city of Tripoli?
9. Have your firm encouraged staff members to gain expertise in sustainable design?
10. Will your firm recruit new employees with experience in green building rating systems?
11. Have you created any new marketing materials for green buildings?
12. Do you have trouble in specifying and obtaining green products?
13. What are the attitudes of the clients towards green building design?
14. What can be the key strategies to increase the advantages of green buildings?
15. What can be done to accelerate the green building movement in the Libyan construction sector?

Thank you very much for your interest and participation in my research study

APPENDIX: E

REPORT OF THE ETHICS COMMITTEE REGARDING THE ADOPTION OF THE INTERVIEW QUESTIONS

ÇANKAYA ÜNİVERSİTESİ
REKTÖRLÜK

Sayı : 80281877-350.07-
Konu : Etik Kurul Raporu

20 Kasım 2017

FEN BİLİMLERİ ENSTİTÜSÜ MÜDÜRLÜĞÜNE,

İlgi: 01.11.2017 tarih ve 050.03-02188 sayılı yazınız.

Enstitünüz İç Mimarlık Anabilim Dalı Doktora çalışması olan "Libya'daki Yapı Projelerinde Yeşil Tasarımın Uygulanması İçin İzlenecek Politikalar" konulu çalışma kapsamında Libya'da Yapı Endüstrisi bünyesinde yer alan mimarlar, inşaat mühendisleri, makine mühendisleri ve elektrik mühendisleri ile kamu ve özel sektördeki danışmanlık firmalarında çalışan profesyonellere internet üzerinden uygulanacak bir 'yarı yapılandırılmış görüşme' çalışmasının yapılabilmesi için Proje Onay Formu talebiniz, Üniversitemiz Bilimsel Araştırma ve Yayın Etiği Kurulu tarafından değerlendirilmiş ve uygun görülmüştür.

Bilgilerinizi ve ilgiliye bilgi verilmesini rica ederim.

Prof. Dr. Hamdi [illegible]LAMAHMUTOĞLU
Rektör

Ek : 07.11.2017 tarih ve 99 sayılı Araştırma ve Yayın Etiği Kurulu Proje Onay Formu

Çankaya Üniversitesi Merkez Kampüs: Yukarıyurtçu Mah. Mimar Sinan Cad. No:4 06790, Etimesgut/ANKARA
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Balgat Kampüsü : Çukurambar Mah. Öğretmenler Cad. No: 14, 06530 - ANKARA
Tel: 0 312 284 45 00 / 134 | Faks: 0 312 286 40 78 || E-posta: webadmin@cankaya.edu.tr

APPENDIX: F

Items	Comments of Respondents	Group
1	Awareness of green buildings should be increased through conferences and seminars by specialists and the use of different media for this purpose	Raising awareness
2	The need to become more aware of the philosophy of green building and to raise awareness of it and to encourage the community to use it	
3	The need to raise awareness about the impact of this type of buildings on the environment	
4	Awareness of green building culture should be disseminated through the various media for citizens and through workshops for professionals	
5	The need for workshops and awareness leaflets about it	
6	The need to increase the environmental awareness of citizens	
7	Must be clearly definition of the green building for the citizens	
8	Building exhibitions contribute to the definition of this concept	
9	Raise public awareness of the importance of green building through publicity and media	
10	Sensitize citizens to the importance of green building	
11	Spreading scientific awareness in this field and definition the green building concept	
12	Raising awareness from the beginning of elementary school to the consolidation of green building culture	
13	Increase the awareness of the people and the government's attention	
14	Awareness then awareness	
15	Publishing the benefits of green building to the public and professionals, especially decision-makers	
16	Holding workshops to define this concept to investors, owners and developers	

17	Expand the publishing of the concept of green buildings	
18	Raising awareness of the importance of green building	
19	Raising awareness by the civil society organizations	
20	Increasing awareness of the Libyan citizen about the advantages of green buildings and their positive impact on the environment and health	
21	Make people understand by convincing them.	
22	Support this type of building from governmental institutions	Government Supports
23	In the early years of the experiment, the government should pay for construction costs	
24	Supporting this proposal by the higher authorities in the State by educating citizens about the culture of green buildings because of their positive repercussions	
25	The need to take important decisions at the state level	
26	The government should support studies in this area	
27	Adopt the concept of green buildings in the government housing policy	
28	Providing raw materials at competitive prices supported by the government	
29	Eliminating government subsidies on electricity and fuel	
30	The government should encourage academics, researchers and decision-makers on the culture of green buildings	
31	Governmental institutions and decision-makers should cooperate with green building specialists to develop a strategy to implement this concept	
32	Government support	
33	The Libyan government supports for such beneficial projects and encourage people to do that will be through the provision of specialist companies and experts such as architects, planners and ecologists.	
34	To develop the appropriate laws in particular	

35	Need to find specialized cadres in green construction	
36	Development of city planning in line with climate change	
37	Specialization in environmental design and their standards	
38	The need to issue legislation and regulations to enforce the green building	
39	Develop programs and policies by the government in this direction	Issuing Necessary Regulations and Legislation
40	Issuing necessary legislation by the government	
41	Enactment of laws and legislation that encouraging the use of green building	
42	Issuing laws	
43	Work on issuing regulations, legislation, and specifications regarding to this concept	
44	Issuing the Libyan building code including the specifications of the green building	
45	Issuing necessary regulations and legislation	
46	Amend existing building codes	
47	Enactment of laws	
48	Creating laws for that.	
49	Educating the population about the benefits of green building	Education and Research Encourage
50	Educating people through seminars and lectures	
51	The need to educate citizens	
52	Highlighting the concept of green buildings in engineering faculties	
53	Holding conferences and seminars in particular	

54	Conduct further studies and research	
55	Supporting scientific research, especially regard to building materials	
56	Specialization in environmental management	
57	It must educate the community and taking the steps and decisions in this direction by the government	
58	Economic and financial studies and calculation of project costs	
59	Invest in the sale of excess power from buildings and projects as an incentive	
60	Start green buildings with small projects	
61	Open investment opportunities for the vernacular companies	Economic Incentive
62	Rationalize domestic investors to embrace this idea	
63	Support investors financially	
64	Encouraging investment in this area by the government and decision-makers	
65	Assigning a supervisory body to revise the implementation of green building projects	Establish a Green Building Body
66	Accelerate the establishment of responsible bodies	

APPENDIX: G

CURRICULUM VITAE

PERSONAL INFORMATION

Surname, Name: Mohamed Akreim

Date and Place of Birth: 30 November 1968, Tripoli

Marital Status: Married

Phone: +90 5439125037

Email: c1488601@student.cankaya.edu.tr , almkeekrem@yahoo.com

EDUCATION

Degree	Institution	Year of Graduation
M.Sc.	Belgrade Univ., Faculty of Civil Engineering, Belgrade	2004
B.Sc.	Nasser Univ., Faculty of Engineering, Tripoli	1991
High School	7th of April High School, Tajura	1986

WORK EXPERIENCE

Year	Place	Enrollment
2014- Present	Çankaya Univ. The Graduate School of Natural and Applied Science	Ph.D. student
2012-2014	AL – Mergeb Univ., Faculty of Engineering, Garaboulli	Lecturer
2005-2012	Command and Staff College, Libyan Army, Tripoli	Architect
1992-2005	Technical Research Centre, Tripoli	Architect

LANGUAGE SKILLS

- ✓ Arabic-Mother Language.
- ✓ English (reading and written).

COMPUTER SKILLS

- ✓ Microsoft Office Programs,(Word, Exile, and PowerPoint).
- ✓ Drawing Programs, (AutoCad and SketchUp).
- ✓ SPSS Program

PUBLICATIONS

- ✓ Akreim, M. A., & Suzer, O. (2018). Motivators for Green Buildings: A Review. Environmental Management and Sustainable Development, 7(2), 137-156.

HOBBIES

Reading, Travel, Swimming