



Assessment of Green Building Construction Project Management Practice in Addis Ababa

A Research Project submitted in Partial Fulfillment of the Requirements
for the Award of Master of Arts Degree in Project Management

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Declaration

I Gizaw Chaka, do hereby declare that this project work entitled ‘Assessment of Green Building Construction Project Management Practice in Addis Ababa’ is my original work and that it has not been submitted partially; or in full, by any other person for an award of a degree in any other university /institution. All sources of materials used for the research paper have been duly acknowledged.

Signature _____

Date _____

Approval

This is to certify that Gizaw Chaka, who has carried out his research work on the topic entitled ‘Assessment of Green Building Construction Project Management Practice in Addis Ababa’ and submitted in partial fulfilment of the requirements for the degree of Master of Arts in project management complies with the regulations of the university and meets the accepted standards with respect to the originality and quality.

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Abbreviation and Acronyms

GB: Green Building

GBC: Green Building Construction

GBC: Green Building Council

LEED: Leadership in Energy and Environmental Design

BREEAM: British Research Establishment Environmental Assessment Method

WGBC: World Green Building Council

GBIG: Green Building Information Gate away

R&D: Research and Development

BCA: Building and Construction Authority

TOP: Technical Office Protocol

CIRIA: Construction Industry Research and Information Association

UNFPA: United Nations Population Fund

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Abstract

The building industry is the world's largest source of greenhouse gas emissions and contributor to environmental degradation, necessitating the need for green construction. Environmental sustainability and other ecological considerations drive green building programs, as well as the need to reduce the expense of building operations after construction to provide financial savings and a competitive advantage. However, the idea of green building projects is relatively new in Ethiopia, as it is in the majority of developing African countries. And even the very few green building projects in Addis Ababa continues to be hindered by a lack of a suitable project management system for such projects. This study explores Addis Ababa's green building construction project management practice, identifies obstacles, and expresses serious concern about taking the necessary steps for GBC development through project management for future projects. To address the research query, a quantitative data collection and analysis approach was used. Data was collected for statistical analysis using a questionnaire sent to professionals who participated in 5 Green Building projects in Addis Ababa. It was discovered that the existing green building construction practice in Addis Ababa is at a very low level and faces significant challenges, indicating the need for a shift from conventional practices to green specifications and the creation of a well-documented project management system to be led by in order to remain on track with project schedules, budgets, and quality. Planning of different construction technique, Difficulty in comprehending the green specifications in the contract details, Specific budget specification of the green project, Specific performance required for green building projects, Resistance to change from their traditional practices, Lack of the technical skill regarding green technologies and techniques, Workers' unaware of the correct methods and procedures and Lengthy BCA approval process for new technologies are among the top challenges found to be highly encountered. As the outcome of the study shows, schedule and cost overruns are highly anticipated in green building construction projects, though quality can be assured with relatively less impact. It was also discovered that Stakeholder management, materials resources management, schedule management and planning, cost management, communication management and risk management are found to be critical management knowledge areas that project managers must possess for GBC projects to succeed.

Keywords: *Green Building construction, Project Management*

Chapter One

Introduction

1.1. Background of the study

One of the key issues arising from internal/external drivers for construction and engineering firms is being green, or sustainable. Green building expands and supplements conventional building design considerations such as cost, utility, durability, and comfort. Green building is typically associated with the structure and implementation of environmentally responsible and resource-efficient processes throughout the life cycle of a building, from design to construction to operation, maintenance, renovation, and demolition. (Maltzman & Shirley, 2011). Green building includes several components including Energy Efficiency and Renewable Energy, Water Efficiency, Environmentally Preferable Building Materials and Specifications, Waste Reduction, Toxics Reduction, Indoor Air Quality and Smart Growth and Sustainable Development (Shi et al.2016).

With the intensifying environmental issues and growing concern over climate change, sustainable construction is progressively put forth globally. However, in developing countries, the construction of green buildings is still hampered by a lack of a clear project management system for such projects. According to the World Bank Development report of 2009, only South Africa has an established Green Building Council (GBC) in Africa but this is slowly changing with Morocco, Mauritius and Egypt being in the process of establishing their councils. (Malanca, 2010). Currently, the number of GBCs in Africa has increased including countries such as Ghana, Kenya, Namibia, Rwanda, Tanzania and Zambia but Ethiopia is yet to join these group.

Similar to the majority of developing African countries, the concept of green building project management is very new in Ethiopia. It is rare to find researches which address this topic except a master's project work conducted by (Taeka, 2015) which focused on finding out the nature of selected buildings based on the Green Building framework and Nura Mohammedata (2018) which focused on the application of Green Building Principles in the Professional Building Practice in Addis Ababa though they are not concerned on the project management concept. Thus, this paper raises serious concern to take the necessary actions for management of green building construction projects by conducting a survey study on the green building

projects found in Addis Ababa. A total of 5 green building projects were assessed focusing on their project management practice in contrast to international practices.

1.2. Problem Statement

Green building (GB) is receiving global praise as the most impressive answer to the unfavorable effects brought upon the environment by buildings and construction activities. The developed countries have accepted this as a best preference to the mitigation of the impacts on the environment and created codes, policies and frameworks to encourage and enforce the employment of green building concepts in their construction industries. Current evidence, on the other hand, indicates that green building adoption in developing countries, especially in Sub-Saharan Africa (SSA), is slow and characterized by the lack of green building construction project management codes and frameworks; though there have been significant attempts in the last few years to investigate green buildings.

The negative impact the construction industry brings to the environment is now widely known, leading to the development of a broad range of tools to monitor and guide the construction industry toward environmental sustainability. The natural environment is seen as a valuable resource that must be protected. However, nature cannot be protected easily and it is also a key factor to contribute the quality of our built environment and our well-being. Several attempts analyzes the positive effect of the induction of natural elements in building design. However, the use of natural elements in everyday construction practice is still uncommon, and there is a need to raise awareness of and use of natural elements' design potential. (Oberti & Plantamura, 2017).

According to Rumaithi and Beheiry (2016), Green construction is becoming more common around the world, and in many cases, it offers a promising rate of return on investment. Green buildings also have some benefits, such as a lower environmental impact and carbon footprint, a healthy lifestyle for occupants and end users, a longer service life, less water and energy usage, and less maintenance. The key impediment to widespread adoption of green and sustainable buildings in the construction industry is the higher initial cost and risks associated with such practices, all of which can be mitigated by using a green building construction project management method. Green building construction project management processes can reduce the costs and risks of green projects, giving them a competitive advantage over less efficient conventional projects.

Building construction has increased dramatically in Ethiopia, especially in the capital Addis Ababa, in recent years. However, as stated in Zegeye and Helawi (2012) the 'Dubai Fever', has reached Addis Ababa and the copy/paste of architectural strategies brings with it myriad of serious problems. Instead of using

locally available materials, more than 80% of the construction materials in Ethiopia, including steel and glass, are imported. The symptomatic glass towers of 'Dubai fever' have a significant impact on the city's energy consumption and, as a result, on the country's overall ecological footprint. Rather than taking advantage of and designing for Ethiopia's optimal climatic conditions, the glass facades force the use of technical cooling systems, depleting one of Ethiopia's few resources: energy. (Zegeye and Helawi, 2012).

Commercial buildings account for around 25% of total energy consumption in Ethiopia, which is a large part of the country's energy use. Furthermore, the commercial sector is expected to be the largest electricity consumer in 2030, accounting for 42% of total sales. Urban heat islands are being created as a result of high energy consumption combined with a lack of greenery around these buildings that can help with evapotranspiration, rainwater runoff reduction, and carbon absorption. Furthermore, the use of low albedo construction materials and impervious surfaces traps heat, while glass causes glares in nearby areas. Internally, the space is continuously partitioned into smaller spaces using magnesium board, and balconies are blocked to be used for other purposes, reducing the amount of light that enters the building, resulting in occupant discomfort and a decrease in efficiency, Bezawit (2013) which necessitates for the adoption of GBC.

On the other hand, out of the thousands of buildings in Addis Ababa only a few buildings are LEED certified green buildings. Even though many challenges including lack of knowledge, technology and lack of incentive on research and practice of green buildings stand in the way of its application in the city, the contribution of green buildings is undeniable. As a result, a project management system for green building construction must be built in order to remove any potential obstacles and potentially encourage the use of sustainable construction in future projects. Both the practice and the procedure of GBC will be consistent with the project management used.

Furthermore, this study is prompted by the absence of research on the challenges and prospects of applying these principles in Addis Ababa, which is critical in bringing about sustainable management practices and strategies that reduce the negative effects of traditional building management. As a result, the purpose of this study is to evaluate the green building construction project management practice in Addis Ababa in order to identify challenges and fill gaps by raising serious concerns about taking the necessary actions for GBC development through project management for future projects.

1.3. Research Questions

1. How is the current practice of green building construction projects in Addis Ababa?
2. How are the extents of the challenges in green building construction project management process?
3. How intense is the effect of the challenges on project objectives, i.e. Schedule, Budget and Quality of a project.
4. How important are the project management knowledge areas to meet the challenges of green building construction projects?
5. How do professionals perceive as solutions to overcome the top challenges in GBC projects?

1.4. Objective of the study

The study's general objective is to aid in the transformation to green building construction project management practices by showing off the modifications to traditional project management processes and practices; through the assessment of the current challenges in GBC project management practice, and searching for available solutions.

Specific Objective:

1. To assess the current green building construction project management practice in Addis Ababa.
2. To identify the extent of the challenges and their impact on the green building construction project management practice.
3. To assess the extent of important knowledge areas available for green building construction in Addis Ababa.
4. To assess the level of professionals' observance as a way of addressing the difficulties of green building construction project management in Addis Ababa.

1.5. Significance of the study

This study provides practical significance as it is an eye opener in the green building construction project management field of practice for our country Ethiopia, especially for the capital Addis; by awakening policy makers, concerned stakeholders and the public. And it would provide the foundation for a comprehensive uptake framework of the green building construction project management concepts in the Ethiopian construction industry and in the project management field of study by initiating the development of a specific project management framework for GBC projects.

The study will initiate governmental bodies to adjust their regulatory incentives to GBC so as to let its exponential growth and project managers to dispense sustainable construction according to clients' expectations, by making modifications to traditional project management processes and practices. Most importantly, it can be used as a valuable source for further similar studies in the field of project management.

1.6. Scope of the Study

The study is confined to selected green building construction projects in Addis Ababa so as to examine their project management practice against green building principles and its prospects and difficulties for application. Those selected buildings are based on their LEED certification; which are either LEED certified green buildings or are in the way for certification. Narrowing the selection of the projects to these gave a good impression to assess the current practice of GBC project management.

The study conducted data collection using a questionnaire from those firms' professionals who were engaged in the design, construction and management of the selected study building projects so as to get their realization on the current GBC project management practice of Addis Ababa.

The analysis of the data collected from the questionnaire was limited to descriptive quantitative method; where statistical calculation using percentage, mean, standard deviation and coefficient of variation were adopted. Ranking was adopted based on the value of mean value.

1.7. Limitation of the Study

The study has got its own limitations, with obvious reasons of insufficient sample size for statistical measurement as there are only a few green building projects in Addis Ababa which makes the study to stick on those few ones, which intern makes access to data very limited. Lack of previous studies was also another big constraint to start with as a baseline.

1.8. Definition of Terms/concepts

Green building

Also known as green construction or sustainable building indicates to both a structure and the application of processes that are environmentally responsible and resource-efficient throughout a building's life-cycle: from planning to design, construction, operation, maintenance, renovation, and demolition. U.S. Environmental Protection Agency. (October 28, 2009)

Project management framework

It is a framework developed to prompt adoption of sustainable management approaches for future green building projects and to overcome barriers. Bon-Gang Hwang, National University of Singapore (June 2012).

Green material and equipment

Those goods that provide environmental, social, and economic benefits while safeguarding public health and the environment during their entire life cycle, from raw material extraction to final disposal. Frank-Martin B. and Peattie, K. (2009).

Green product standards

Ranges from government regulations and guidelines to industry guidelines, to third party certification standards. Because of the detailed criteria spelled out in green product standards, many of them can also assist in the development of project specifications. John Amatruda (2016)

Public Awareness

Delivers the actual issues relating to biodiversity to the consideration of important groups that possess the strength to influence consequences.

Green Building Rating and Certification System

Are those systems which broaden the focus beyond the product to consider the project as a whole. Rating systems are a type of building certification system that rates or rewards relative levels of conformity or performance with specific environmental goals and requirement. Stephanie Vierra, (2019)

Green Mark Certification

It's a rating system for green buildings that assesses their environmental impact and efficiency. It offers a broad framework for evaluating the overall environmental performance of new and existing buildings in order to promote sustainable design and building best practices. (*Green mark assessing schemes*) available at <https://www.gov.sg/>.

Financial incentives (green loans)

Refers to a lending dependent on environmental criteria for the planned use of funds. It is part of the wider sustainable investing and aims to reduce the impact on the environment of new lending activities. Farah Imirana Hussain (2020).

Green building council (GBC)

It is any national non-profit, non-government organization that is a member of the World Green Building Council's global network. Aiming to encourage a sustainable built environment (buildings and cities that are environmentally sensitive, economically viable, socially just and culturally significant). (*World Green Building Council*) available at <https://www.worldgbc.org/>.

1.9. Organization of the Study

This paper is divided into five chapters: the first chapter covers the background of the study, the problem statement, the objectives of the study, the significance of the study, the scope of the study, the definition of terms, and the study's limitations. The second chapter is devoted to a study of the literature. The third chapter discusses research methodology, which includes the research strategy, form of research, sampling design, sample population, sampling technique, data collection sources, and data collection process. The fourth chapter focuses on data processing and presentation. Finally, Chapter 5 contains a rundown of the observations, as well as conclusions and recommendations.

Chapter Two

Literature Review

This chapter reviews the literature that was found to be relevant to the analysis that was performed. It is divided into two sections: theoretical and empirical analyses, both of which aids in determining what hypotheses currently exist, their associations, and the extent to which current theories have been explored, as well as examining prior empirical studies to address a specific research question by summarizing the results of previous related studies.

2.1 Theoretical Review

2.1.1 The Fundamental Principles of Green Building

The construction of green building is part of sustainable construction. According to (Kibert 2008), the ecological, social, and economic problems of a building in the context of its environment are addressed through sustainable construction. From design to demolition, sustainable construction is used in the construction process. Through designing and overseeing a construction project in accordance with the contract agreement, such construction aimed to reduce the environmental effects of construction practices. (Glavinich, 2008).

According to (Zuo and Zhao, 2014), similar with that of sustainability, green buildings have three aspects including:

a. Technical and environmental Aspect: traditionally, the attention of green building is placed on environmental aspect of sustainability which takes into account issues such as energy efficiency, water efficiency, resource efficiency and greenhouse gas emission reduction.

b. Social Aspects: In the construction context, social sustainability mainly covers the quality of living, occupational health and safety, and future professional development opportunities. In building context, social sustainability means providing a healthy and safe environment to all stakeholders, e.g. construction personnel, users and operators.

c. Economic Aspects: Access, education, inclusion, cohesion, affordability, economic benefit, impacts on the local economy, indoor health, cultural insight, and inspiration are some of the social and economic goals of green buildings. The benefits of energy retrofitting initiatives are reflected not only on the cost savings derived from improved energy efficiency but also the potential value added to the property. This helps to reduce the payback period of investment for energy efficiency measures.

As a result, a green building may have a very specific meaning (e.g., solely environmental sustainability) or a very broad definition (i.e. adopting triple bottom line approach). Green building practices can aid a variety of purposes and are often categorized into multi-faceted designs and approaches that are valuable for both communities and businesses. Green building principles have been classified by policymakers and the construction industry to help direct future planning and design. Green building activities that are structured around the life cycle performance of green buildings have been identified. The concepts include each of the green building phases, including development, service, maintenance, and decommissioning, in an integrated and systematic approach.

Sustainable Siting— this approach optimizes land use and construction in order to mitigate negative effects and reduce the building's ecological footprint.

Energy Efficiency— this approach focuses on establishing performance goals that account for planned use, occupancy, and other energy operations for new construction and renovation projects.

Water efficiency— this technique stresses the importance of improved landscaping, integrated rainwater catchments, gray water recycling, and wastewater treatment systems in reducing fresh water demands and lowering wastewater generation.

Building Materials— by utilizing sustainable construction materials and resources, extraction, manufacturing, storage, solid waste, and use have all been reduced thanks to green building materials.

Healthy Indoor Environmental Quality— through ventilation and thermal comfort, moisture management, daylighting, ambient tobacco smoke control, and maintaining indoor air quality during building construction, these processes have improved the sustainability of communities.

Green principles remain a critical component of sustainable development and have developed environmentally sound technologies, designs, and buildings. Because the green building construction field

is promptly advancing, national and local governments will need to keep abreast of changes to green building certification programs, rating systems, standards, and technology advancements.

2.1.2. Comparison between the conventional and green building projects

After acquiring the concepts of green building, it's a good idea to compare traditional and green building projects in terms of design, planning, and commissioning stages before diving into the green building construction project management practice.

Design

Since the design team must frequently evaluate alternative materials and systems, green building design can be more complex than what is usually needed for traditional buildings. (Glavinich, 2008). Schematic designs, which consist of a simplified and general idea of how buildings will look, are used at the start of the planning phase in traditional construction projects. (SBE, 2009). However, because green buildings have many specific design features not usually found in traditional buildings and need deep integration, a holistic and integrated design approach is used right from the start of the project in green building projects. (Kibert, 2008). The most important green building design features are divided into three categories: indoor lighting, building materials, and layout. (Yudelson, 2008). The lighting design in a green building combines low-energy lighting fixtures with natural lighting through strategic window placement and the use of energy-efficient fluorescent lighting. (Yudelson, 2008). To ensure that green buildings are safe, environmentally friendly building materials, such as recyclable bamboo flooring, as well as toxic-free materials, such as formaldehyde-free cabinets and non-toxic paint, are used. (Yudelson, 2008). Building layout plays a significant role in ameliorating energy efficiency of the building. Green buildings also take advantage of natural ventilation through the building's orientation (Yudelson, 2008).

Construction

Green building projects must use sustainable construction techniques in addition to traditional construction methods, as described in green building rating systems such as LEED. A waste management strategy (CIRIA, 2001) to reduce waste generation on the construction site is one example of such activities. (Kibert, 2008). Sustainable practices such as using recycled aggregates for concrete work and using timber from renewable sources are also needed in the construction of green buildings. In addition, the main contractor and project manager must monitor soil erosion, waterway sedimentation, and airborne dust production to

ensure that contamination from the building is kept to a minimum. USGBC, 2009). Furthermore, the natural habitat should be protected by building placement that minimizes disturbance to the current natural environment. (USGBC, 2009). These considerations are often neglected in traditional construction.

Commissioning and Closing out

A green building project's commissioning and completion is typically more difficult than a traditional project. This is particularly true if the developer wants to get LEED, BREEAM, or Green Mark certification from a third party (Glavinich, 2008). In order to ensure sustainability, it is also essential to pass on awareness of green building systems to new facilities management teams and end users. Furthermore, ease of maintenance must be ensured. (CIRIA, 2001).

Following the identification of the fundamental differences between traditional and green building construction in the three project stages, the next step should be to define the challenges faced in green building construction project management.

2.1.3. Challenges in Green Building Construction Project Management

Higher costs for green construction practices and materials

Green projects are typically more expensive to build than traditional projects. Capital costs for green infrastructure are 1 to 25% higher, according to Tagaza and Wilson (2004). The higher costs are due to the sophistication of the designs as well as the modeling costs associated with incorporating green practices into projects. (Zhang et al., 2011). Green materials and green building methods are also correlated with higher costs. (Hwang and Tan, 2010). According to Zhang et al. (2011), using green materials costs 3 to 4% more than using traditional building materials. Some green materials are considerably more expensive than their traditional counterparts; compressed wheat board, for example, is roughly ten times the price of ordinary plywood. Since project managers are responsible for planning and completing their projects within a budget, the higher costs of green construction directly impact them. (Pettersen 1999; Ling, 2003).

Technical difficulty during the construction process

A project manager puts a project schedule into action by approving the execution of tasks that result in project deliverables (Pettersen 1999; Ling, 2003). Green technologies frequently necessitate complex techniques and construction processes (Zhang et al., 2011). If complications are not properly handled, the project manager's output will suffer. One of the key problems in green building, according to Tagaza and Wilson (2004), is the technical difficulties encountered during the construction phase. (Hwang and Tan, 2010).

Risk due to different contract forms of project delivery

According to Tagaza and Wilson (2004), the form of contract used to execute the project had a significant impact on the progress of designing and implementing a green design. Green building construction contracts must include all of the specifics of a fully integrated green design. If the design is locked before it is fully formed, this causes a problem. If green features are added later, several changes of large size are probable, resulting in a higher total project cost. (Hwang and Tan, 2010).

Lengthy approval process for new green technologies and recycled materials

The market environment indicates that the planning process will take a long time because allowing the use of emerging green technology and recycled materials can be time consuming. Tagaza and Wilson,

2004). Similarly, surveys conducted by Zhang et al. (2011) and Eisenberg et al. (2002) indicates that additional time is expected in order to gain approval. Project managers face a difficult task in developing the plan and approving progress payments to contractors and suppliers due to a lengthy approval process. (Pettersen, 1999; Ling, 2003).

Unfamiliarity with green technologies

Several studies have confirmed that green technologies cause certain challenges for developers, clients and contractors. Insufficient knowledge or technological experience, as well as unfamiliarity with the products, materials, method, or design, are two explanations suggested by Eisenberg et al. (2002). The key difficulty is that green technologies are typically more complex and distinct from traditional technologies (Tagaza and Wilson, 2004). This was proven by Zhang et al. (2011). A project manager is responsible for delivering the project according to the client's requirements (Pettersen, 1999; Ling, 2003), and strangeness with the performance of green technologies may affect the performance outcome.

Greater communication and interest required amongst project team members

To be effective, the project manager must manage a large number of suppliers, subcontractors and team members. Communication is especially crucial for the green building project in order to convey the sustainable practices anticipated from the team members.

More time required to implement green construction practices on site

Green building practices take more time to incorporate on-site. Random inspections and on-site visits by project managers are typically expected to ensure that sustainable practices are implemented on-site. This is due to the fact that when a project has a tight deadline, staff can opt out of time-consuming sustainable practices (Tagaza and Wilson, 2004).

As per the study conducted by B.-G. Hwang, W.J. Ng, (2012) various challenges that project managers face during green construction project management are identified in the table below.

Category	Challenge
Planning- related	<ul style="list-style-type: none"> - Adoption of different contract forms of project delivery - The design, orientation and structure of the building - Planning of different construction sequence - Planning of different construction technique - Lengthy approval process for new green technologies within the organization - Longer time required during the pre-construction process - Difficulty in comprehending the green specifications in the contract details
Project-related	<ul style="list-style-type: none"> - Difficulty in approving payment disbursement to suppliers and subcontractors - Difficulty in assessing the progress of completion in green construction - Difficulty in the selection of subcontractors in providing green construction service - More time is required to implement green construction practices onsite - More alteration and variation with the design during the construction process
Client-related	<ul style="list-style-type: none"> - Specific budget specification of the green project - Objective of the building project - Required date of completion -Level of risk the client is willing to take in green technologies - Client uses a lot of time in making decision - Special request from client pertaining to specified green technologies to be used
Project team related	<ul style="list-style-type: none"> - Conflict with the architect over the type of material to be used - Lack of communication and interest among project team members - Frequent meetings with green specialists - Green consultant delay in providing information - Conflict of interest between consultant and project manager - Specific performance required for green building projects
Material and equipment	<ul style="list-style-type: none"> - related High cost in green material and equipment - Uncertainty with green material and equipment - Availability of green material and equipment - Decision on different green material and equipment - Imported green material or equipment
Labor-related	<ul style="list-style-type: none"> - Resistance to change from their traditional practices - Lack of the technical skill regarding green technologies and techniques - Workers' unaware of the correct methods and procedures
External	<ul style="list-style-type: none"> - Government policy - Lengthy BCA approval process for new technologies - More time required for TOP due to green mark certification process by - Unforeseen circumstances in green project

Table 1: Analysis summary: Challenges. By B.-G. Hwang, W.J. Ng, 2012

After identifying the potential obstacles, it is critical to investigate the project management knowledge areas for green building construction in overcoming the challenges.

2.1.4. Project management Knowledge areas for Green Building Construction

When the industry evolves, project managers are faced with new challenges and are required to take on positions that have not previously been part of their responsibilities (Edum-Fotwe and McCaffer, 2000). (Ceran and Dorman , 1995) and (Russell et al. , 1997) recognized the evolving position of construction project managers and argued that, in order to meet today's professional needs, they must expand their conventional roles with non-engineering expertise and skills. Today's project manager is responsible for not only conventional project management responsibilities, but also for ensuring that the project is managed in the most productive and effective way possible in terms of sustainability.

The survey conducted by B.-G. Hwang, W.J. Ng, 2012 for the identification of the extent of project management knowledge and skills for green construction in overcoming the challenges are discussed in the empirical literature review section below.

2.1.5. The main actors' influencing the development of green building projects

According to GIZ, (2010), the main actors and their respective roles in the development of green buildings are discussed below:

Building materials and construction industry

The construction industry is vast, diverse and complex. There are no comprehensive data on the types and size of companies engaging in green building. Improved information would help to reduce transaction costs, improving efficiency and competition, which would help the industry in general and also provide the foundations for improving sustainability. Recognizing the diversity of actors within construction and materials production, and the differing incentives and needs of SMEs and of large firms, is key to promoting a commercial market for green buildings.

Government (national and municipal)

Governments are a dominant force in the move towards green building where their main function is to help overcome market barriers caused by the discrepancy between the private costs faced in producing green buildings and the social costs of climate change and social gains of energy efficiency. Governments not only provide the policy and regulatory framework for the construction and building materials sectors but are also a major buyer of their services. Governments play an indirect role in promoting demand and developer activity by raising awareness and demonstrating the validity of the concept. By commissioning green buildings, governments can provide the local market with tangible experience of sustainable building practices.

Financial institutions

Financial institutions relevant to green construction range from responsible property investors or impact investors who have strong environmental imperatives (even requirements of environmental returns on investments), to commercial actors seeking market-rate returns on individual mortgages or large loans to property developers. Engaging financial institutions requires both data and also cost incentives to invest in green construction, but investment decisions tend to be firmly rooted in short-term economic gains rather than in long-term savings in energy costs.

Non-governmental organizations, membership and consumer groups

Currently, there are some 70 GBCs around the world in various stages of development. The World Green Building Council (WGBC) is the umbrella organization with regional networks for Asia–Pacific, Europe, the Americas and Africa (Malanca, 2010). One of the main activities of most GBCs is the establishment of rating tools for green buildings. The US Green Building Council has attempted to transform the market by identifying critical research needs and fostering research activity. While continual improvement of the LEED rating systems depends on pending research, the context and benefits of funding, conducting and applying such research are much broader.

NGOs, civil society organizations (CSOs), consumer groups and the media can help to raise awareness of the benefits of green building. They can also monitor the performance of government and industry in creating and implementing relevant policy, private-sector adherence to regulations, and the impact on

particular sectors of the population. Help can be provided through engagement with the public and private sector, facilitating leadership and bridging efforts to support public and private-sector activities

Research and educational institutions

Research organizations can help to address data gaps and contribute to monitoring and evaluation (M&E) work. Educational institutions can develop the skills required to build green practices into commercial activities, for example through vocational secondary and tertiary education and training for those working in the built environment

International organizations

There is a wide range of cross-country and global green building initiatives, alongside multiple programs and institutions addressing climate change and sustainable and inclusive development, all of which affect green building. The United Nations and national government partnerships have deployed regional-level approaches. UN Habitat established a five-country partnership in East Africa, sponsored by the Global Environment Facility (GEF), to focus on buildings' energy and resource efficiency through codes, policy, practice, housing finance, and across the building sector through reviewing the status quo (compiling data), then raising awareness and helping to leverage finance, as well as providing demonstration projects. The scheme is soon to be introduced in West Africa.

Professionals

Architects, engineers, planners and contractors have to work together with local councils to determine and identify the limitations of the environment and developing designs that incorporate environmentally friendly practices such as solar heating, recycling of local materials, and minimizing the use of materials so as to have the least possible effect on the environment.

2.1.6. Green Building Rating System

Green Building Councils are non-profit organizations made up of corporations and organizations involved in the construction and building industry. As members of the World Green Building Council, they work to improve green building in their own countries while also collaborating with other Green Building Councils to achieve global environmental, economic, and social goals. There are currently around 70 Green Building Councils around the world, each at a different stage of their green building journey.

Green building rating tools, also known as certification, are used to evaluate and award buildings that meet certain environmental specifications. Companies and organizations that create and run greener buildings are recognized and rewarded using rating tools, which are mostly voluntary. This encourages and incentivizes them to push the limits of sustainability. They jumpstart the market by establishing standards, which raise the desire for government building codes and regulations, employee preparation, and corporate strategies. They take a variety of approaches and can be used during the planning, design, development, operation and maintenance, restoration, and eventual demolition processes. Different tools or subsets of tools are used for various building types such as houses, commercial buildings, or even whole neighborhoods, and rating tools can vary in the types of buildings they are applied to.

A few of these programs are single-attribute, aiming merely on water or energy, while others are multi-attribute addressing emissions, toxicity, and overall environmental operation in addition to water and energy. While the philosophy, approach, and certification method alter across the systems, a shared objective is that projects awarded or certified within these programs are designed to reduce the built environment's cumulative effect on human health and the environment.

The application for green mark certification is highly important. Since, in the long run, green projects can provide the following benefits: meaningful market differentiation, positive effect on corporate image, leasing and resale value of buildings, reduction in energy, water, and material resource use, reduced potential environmental impact, improvement in indoor environmental quality for better health and wellbeing, and provide clear direction for contingency planning. Developers, building owners, and government agencies may apply for green mark certification for new and existing buildings, neighborhoods, parks, facilities, and building interiors that meet the following criteria: climatic sensitive design, building energy efficiency, resources stewardship, smart and safe building, and advancement of green efforts.

LEED Rating System

Leadership in Energy and Environmental Design (LEED) is a green building certification program used worldwide and in our country Ethiopia too. Developed by the non-profit U.S. Green Building Council (USGBC). It comprises a set of rating systems for the design, construction, operation, and maintenance of green buildings, homes, and neighborhoods which intends to help building owners and operators be environmentally responsible and use resources efficiently. Since its inception in 1998, LEED has evolved to better reflect and incorporate new green building technologies. LEED New Construction (NC) v1.0 was the pilot version, which led to LEED NCv2.0, LEED NCv2.2 in 2005, and LEED 2009 (formerly known as LEED v3) in 2009. In November of 2013, LEED v4 was released. New projects had the option of using LEED 2009 or LEED v4 until October 31, 2016. LEED v4 has been mandated for all new projects registered after October 31, 2016.

LEED Credit System

In LEED-NC and LEED-CS there is a 100-point scale with additional 10 bonus points to earn. The points are only positive, which means that points only are added when doing something good and that there is no possibility to get negative points for doing something that is bad. The points are divided into the five major categories and the two bonus categories. Each category has one part that is mandatory to be certified in that specific category. These prerequisites are there to guide the customers and to enhance the credibility of the LEED certification. The prerequisites do not give any extra points; it is just mandatory. Thereafter are there subcategories that can be chosen to work towards to get more points. (USGBC, 2011)

There are four possible levels of certification that can be achieved by exceeding the following point thresholds: Certified 40 - 49 points, Silver 50 - 59 points, Gold 60 - 79 points, Platinum 80 points and above.

According to (USGBC, 2011), there are seven categories of LEED which are *Sustainable Sites (SS)*: 26 points; this category accentuates the project's sustainability with the development of existing infrastructure but also aims to diminish the impact on the local ecosystem and the natural resources. *Water efficiency (WE)*: 10 points; covers a buildings water usage. *Energy and Atmosphere (EA)*: 35 points; this category covers the use of energy and how the origin of the energy. This is done by encouraging different kinds of energy strategies such as the use of renewable energy. *Materials and Resources (MR)*: 14 points; is a category that promotes the choice of sustainable materials and how to handle waste. *Indoor Environmental Quality (IEQ)*: 15 points; concerning questions like daylight and clean air. *Innovation and Design (ID)*: 6

points; promotes the use of different innovations and designs that goes beyond what is covered in the categories above. *Regional Priority (RP)*: 4 points; addresses the geographical placement of the building. This category is at the moment a template for international projects.

2.1.7. Mobilizing innovative financial products and services for GBC

Financial regulators, such as central banks, can incentivize banks to set up environmentally friendly projects with easier capital access. In some cases, emerging market regulators can achieve a very positive result by combining regulations, guidelines, taxation, fiscal and non-fiscal incentives, and award schemes.

As a result of mandatory Green Credit Guidelines released by the China Banking Regulatory Commission and the People's Bank of China, green credits such as loans to ventures that contribute to energy conservation or pollution reductions now account for roughly 10% of the portfolios of China's top 21 banks. As of July 2018, the Malaysian government's Green Technology Financing Scheme (GTFS) had involved 28 banks and financial institutions in 319 projects (totaling approximately US\$875 million in loans). For qualifying green ventures, the Scheme provides borrowers with a 2% discount on total interest paid by banks, as well as a guarantee of 60% of the total approved loan. Green loan portfolios of Bangladeshi central bank set a minimum annual goal for banks and other financial institutions to devote 5% of total loan disbursements and investments to green financing, which increased from BDT24.2 billion to BDT94.1 billion in 2018.

Rise of the labeled Green Loan

Applying a globally applicable approach to determine if a loan is "green" will assist banks and financial institutions in tracking the green share of their lending portfolio in relation to their sustainability objectives, transferring resources to achieve targets, and even considering divesting in assets that are vulnerable to climate events. GLP-aligned loans also assist regulators in applying generally agreed eligibility standards for benefits such as grants or tax rebates, enabling small-scale projects with lower investment requirements to obtain more affordable funding. Such loans can also be converted into Covered Green Bonds by banks and financial institutions. As global need for sustainable finance endures to surge, the allocation of these types of loans is expected to increase, especially from companies committed to reducing their carbon footprint and achieving positive impact. (Farah Imirana Hussain, 2020)

2.2. Empirical Literature Review

According to a survey conducted by Nura Mohammedata (2017), in Addis Ababa: Awareness and education is found to be more of a challenge than economic issues followed by shortage of professional specializing on green building and insufficient education programs, resource or documentation and research on the topic. The researcher suggested that, working on education and awareness and changing the mindset of all involved in the industry is indicated as a key to the progress of green building construction.

The top five challenges in managing green building construction projects, according to many survey's findings, are: Increased Project Costs; Lack of Communication and Interest among Project Team Members; High Green Practice Implementation Costs; Lack of Credible Research on Green Building Benefits; and Lack of Interest from Clients. These issues were discovered to be interconnected, resulting in a high cost premium for green buildings. The lack of R&D on the benefits of green buildings and green technologies is one of the primary reasons for the lack of demand for green buildings beyond what is required by law.

A survey conducted in Singapore by Bon-Gang Hwang & Wei Jian Ng, (2012), revealed that the most important knowledge areas that are essential to respond to the challenges in GBC projects were schedule management and planning, stakeholder management, communication management, cost management, and human resources management. In addition, the most important skills that are required to mitigate the challenges were analytical, decision-making, team working, delegation, and problem-solving skills.

Through a questionnaire survey with 104 green building experts around the world conducted by Albert Ping Chuen Chan, Amos Darko, and Ernest Effah Ameyaw (2017). Green building experts from different countries and with different backgrounds had significant agreement on the relative importance ranking of the promotion strategies. “Financial and further market-based incentives for GBTs adopters”, “availability of better information on cost and benefits of GBTs”, “mandatory governmental policies and regulations”, and “green rating and labeling” were identified as the top four important promotion strategies.

2.3. Conceptual Framework

In order to demonstrate the cause and effect relationship well, it is important to first chart the expectations within the Conceptual Framework and to divide the cause-effect relationship into variables. In this context, the variables are the characteristics that summarize the cause-and-effect relationship.

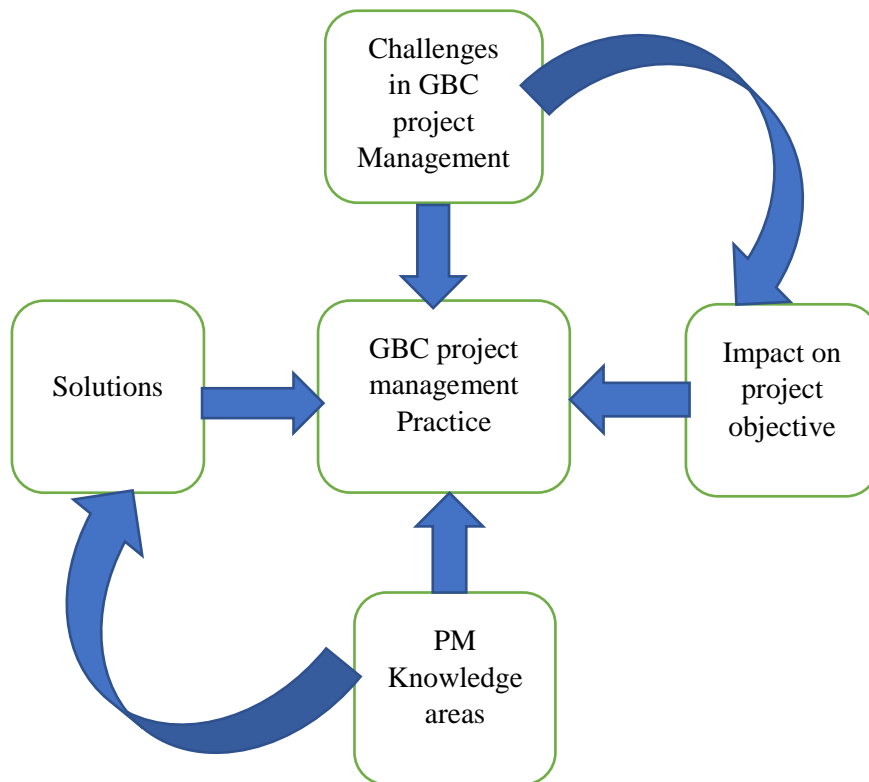
Dependent Variable – GBC Project management practice which is what the project tried to find out and depends on other factors that are measured. It is the presumed effect.

Independent Variable – Challenges in GBC projects, Impact on project objective, Knowledge areas, Solution. Where they are the presumed cause and affect the dependent variable.

Frameworks – The dependent and independent variables are drawn up in the frames.

Arrows – the arrows between two concepts indicate that there is a causal link; where the arrow comes from influences where the arrow points to.

Figure 1: Conceptual Framework



Source: Computed by the researcher, 2021

Chapter Three

Research Methodology

This section discusses the specific procedures or techniques used to identify, select, process, and analyze information about the topic. It explains the methodological approach and design used, describes the methods of data collection and methods of analysis.

3.1. Research Approach and Design

The research method used is a survey type, where all LEED certified green buildings and those registered for certification are included in the study; though they are very few in number. Quantitative data collection and analysis method is used to answer the research question which is collected for statistical analysis using questionnaire sent across to section of population.

The research design used is descriptive, as the study tries to gather preliminary information that will help define problems and describe the data and characteristics about what is being studied i.e. the assessment of green building construction project management practice in Addis Ababa, by applying statistical calculation.

A cross-sectional analysis method is used, as the sample is studied and completed only once; in contrary with longitudinal study in which the research continues for a longer period of time using the same sample at each phase.

3.1.1. Study Variables

The variables in a study of a cause-and-effect relationship are called the independent and dependent variables.

- The independent variable is the cause. Its value is *independent* of other variables in your study.
- The dependent variable is the effect. Its value *depends* on changes in the independent variable.

Dependent Variable – GBC Project management practice which is what the project tried to find out and depends on other factors that are measured. It is the presumed effect.

Independent Variable – Challenges in GBC projects, Impact on project objective, Knowledge, Solution. Where they are the presumed cause and affect the dependent variable.

In statistical research, a variable is defined as an attribute of an object of studying order to choose appropriate statistical tests and interpret the results of the study.

Data is generally divided into two categories:

- **Quantitative data** represents amounts.
- **Categorical data** represents groupings.

A variable that contains quantitative data is a quantitative variable; There are two types of quantitative variables: discrete and continuous.

Categorical variables represent groupings of some kind. They are sometimes recorded as numbers, but the numbers represent categories rather than actual amounts of things.

Table 3.1.1: Description of Study Variables

Quantitative Variables		
Type of Variable	What does the data represent	Study Variables
Discrete (Integer) variables	Counts of individual items or values.	- 5 point Likert scale values - Mean Values
Continuous (ratio) variables	Measurements of continuous or non-finite values.	Respondents biographic values
Categorical variables		
Type of Variable	What does the data represent	Study Variables
Nominal variables	Groups with no rank or order between them.	- Coding & numbering to groups - Categorized Challenges
Ordinal variables	Groups that are ranked in a specific order.	Ranking based on Mean values

Source: Computed by the researcher, 2021

3.2. Sampling Design

3.2.1. Population of the study and Sampling Technique

Population of the Study

The population of the study was identified to be Green Building Construction projects in Addis Ababa. A total of 5 green building projects in Addis Ababa were selected for the study; which are LEED certified as green buildings or are in the way for certification. The selection is assisted by GBIG (The Green Building Information Gateway), a global innovation platform for exploring and comparing the green dimensions of the built environment. GBIG is the world's leading search engine for green building data, delivering insights that help people create better homes and communities. On the web-site it was easy to find those building projects which are already certified as a green building and those registered for certification in Addis Ababa. Thus all Building projects both certified and on the way for certification found in Addis Ababa are included in the study. Which are:-

- EADG (Ethio–American Doctor’s Group. INC) Hospital (LEED HC Registered)
- HoAREC (Horn of Africa’s Regional Environment Center Office) (LEED NC 2009 Gold Certified)
- NEC, US Embassy Addis Ababa (LEED NC 2.2 certified)
- ICS Addis Ababa (LEED schools 2009 Registered), and
- CBE’s New Head Quarter Building Project (LEED v4 BD+C NC Silver certified)

Sample Size

Sample was taken from the population identified above, by means of purposive sampling technique (*a technique which relies on the judgement of the researcher when choosing who to ask to participate. Researchers may implicitly thus choose a “representative” sample to suit their needs, or specifically approach individuals with certain characteristics*). Respondents whom are professionals in the firms which involved in the design, construction and management of the selected study buildings were selected to participate.

They were Professionals from:-

- **ZIAS** - Involved in the design, supervision and contract administration of EADG project.
- **ICS Addis** - Engineers and Facility and Maintenance Directors

- **Elmi Olindo contractors** - involved in the construction of new classroom and sport pavilion projects in ICS Addis.
- **Abba Architects** - Architects and resident engineers involved in HoAREC project.
- **NEC, new embassy compound** - Facility engineers
- **China State Construction Engineering Corporation (CSCEC)** - involved in the construction of the new Commercial Bank of Ethiopia Headquarters building project
- **AAiT** - consultants in the new Commercial Bank of Ethiopia Headquarters building project.

3.3. Sources of Data Collection:

Primary Data

The source of primary data was obtained from questionnaire filled by professionals (i.e. project managers, engineers and architects) of the selected projects.

Secondary Data

As a secondary data, national and international literature on green building construction projects and its management practice was collected through internet sources, books and government statistics reports. Policies, codes & standards and regulations on GBC projects were also referred and used as an input to the study.

3.4. Method of Data Collection:

Having carried out a comprehensive literature review, a closed-ended survey questionnaire with a five point Likert scale is developed which provided participants with options from which to choose a response and sent to the selected projects' via e-mail and in print and then collected back after being filled.

The survey questionnaire aimed to assess the project management practice of green building construction in Addis Ababa is mainly adopted from earlier studies conducted by B.-G. Hwang & W.J. Ng, (2012) entitled *Project management knowledge and skills for green construction: Overcoming challenges*, Bon-Gang Hwang* and Jac See Tan (2010) entitled *Green Building Project Management: Obstacles and Solutions for Sustainable Development* and Nura Mohammedata, (2018) entitled *Constraints and Opportunities in the Application of Green Building Principles in the Professional Building Practice in Addis Ababa*; which are designed to answer the questions of the study and meet the study's objectives.

3.5. Data Analysis method

Data collected from the questionnaire filled is first prepared for analysis by checking its completeness and coding it by grouping and assigning values from the responses found. Then it is analyzed using quantitative descriptive statistics using mean, standard deviation, coefficient of variation and percentage with the help of Excel 2013. Where the mean is the numerical average of the set of values found from the five point Likert scale. Standard deviation is a measure of the amount of variation or dispersion of a set of values. The coefficient of variation (relative standard deviation) is a statistical measure of the dispersion of data points around the mean; the metric is commonly used to compare the data dispersion between distinct series of data. The mean score is used in the analysis as a tool for ranking. And, the percentage is used to express how a value or group of respondents in the data contributes to a broader group. The analyzed data is then identified and displayed in a tabular form.

3.6. Instrument Validity and Reliability

3.6.1. Instrument Validity

Validity refers to the degree to which the findings of data analysis accurately reflect the phenomenon under investigation. Validity is a function of degree rather than absolute value. Until conducting the final process, a pilot study was conducted to refine the approach and test instrument, which is a questionnaire, in order to ensure instrument validity. Questionnaires were tested on 3 respondents in

addition to the suggestion and comments from my advisor to make the data collection instruments objective, relevant and suitable to the problem and made a few refinement. Finally, the revised questionnaires were printed, duplicated, and circulated. Expert opinions and a literature search were examined first, and then material validity was determined.

3.6.2. Instrument Reliability

Reliability refers to the extent to which an instrument consistently measures what is supposed to. The study measured the internal consistency of cross-sectional data collection instrument, i.e., questionnaire, using Cronbach alpha coefficient. The Cronbach alpha coefficient, which is based on the average correlation among items, was calculated for the 5 main Constructs using Excel and the result is presented in the following table:

Table 3.6.2: Cronbach alpha values for main constructs

Main Constructs	Cronbach Alpha (α)	A rule of thumb for interpreting alpha for Likert scale items
Current Green Building Construction Project Practice in Addis Ababa	0.77	Acceptable
The challenges that project managers face in managing green building construction projects.	0.96	Excellent
Impacts of the challenges on Project Objectives	0.90	Excellent
knowledge areas to deal with the challenges	0.87	Good
Solutions for the Challenges	0.79	Good

Source: computed from own survey data, (2021)

A rule of thumb for interpreting alpha for Likert scale items

If Cronbach's Alpha is ≥ 0.9 , the internal consistency of scale is Excellent.

If Cronbach's Alpha is $0.90 > \alpha \geq 0.80$, the internal consistency of scale is Good.

If Cronbach's Alpha is $0.80 > \alpha \geq 0.70$, the internal consistency of scale is Acceptable.

If Cronbach's Alpha is $0.70 > \alpha \geq 0.60$, the internal consistency of scale is Questionable.

If Cronbach's Alpha is $0.60 > \alpha \geq 0.50$, the internal consistency of scale is Poor.

If Cronbach's Alpha is $0.50 > \alpha$, the internal consistency of scale is Unacceptable.

3.7. Ethical considerations

Every respondent has had the right to determine whether or not to participate in the research project. The information provided from the questionnaire was kept private and the respondents were assured that the information they provide is confidential and used for academic purpose only.

In addition, all sources cited in this study have been duly acknowledged.

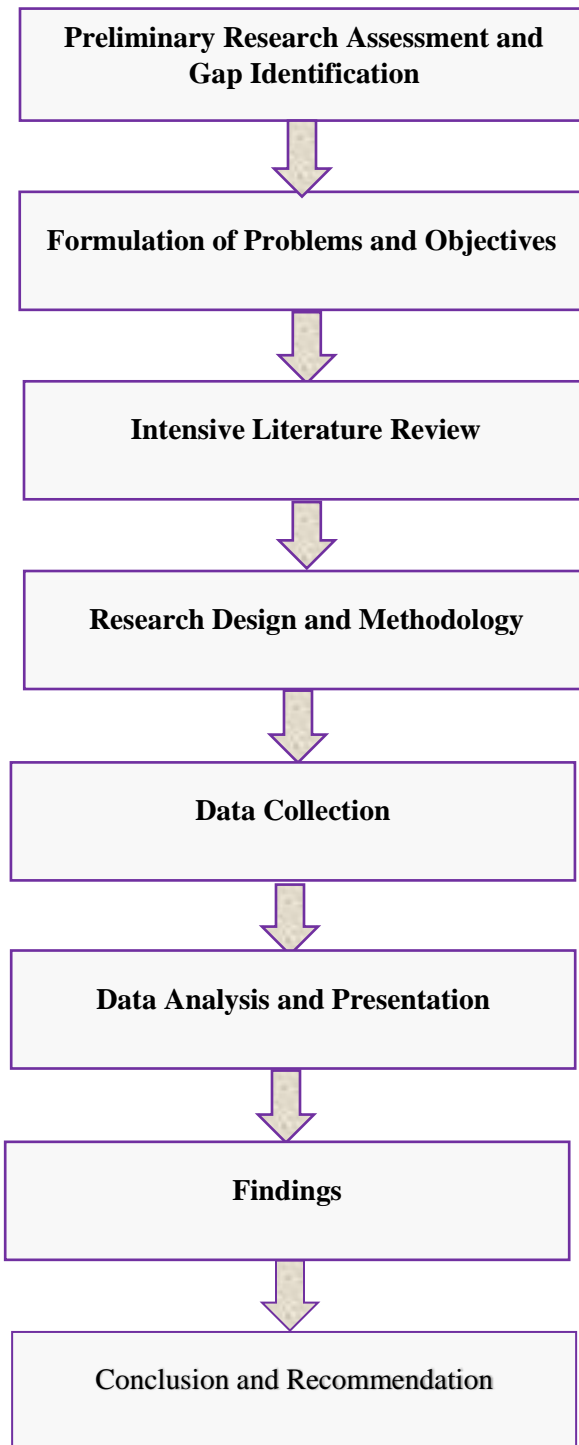


Figure 2: Research Design

Chapter Four

Findings, Interpretation and Discussion

4.1. Introduction

In this section the findings from the questionnaire are analyzed, interpreted and discussed. The data found is organized and analyzed in to six sections so as to answer the research questions raised and meet the objectives of the study. Where the first section presents the response rate and the profile of the respondents by years of professional experience and job title. The second section analyzes how the current practice of green building construction project in Addis Ababa is. The third section analyzes the extent of challenges that project managers face in managing green building construction projects in Addis Ababa. The fourth section analyzes the impact of the challenges on project objectives i.e. schedule, budget and quality of the green building construction projects studied. The fifth section analyzes the extent of importance of knowledge areas to deal with the challenges encountered. The last section analyzes the solutions for the challenges perceived by the professionals involved in the study.

4.2. General profile of Respondents

Out of 23 questionnaire distributed a total of 17 completed survey questionnaires were received, tabulated and analyzed in sections below which makes the response rate 74% to be considered as good.

4.2.1. Respondents' profession/Job title and Years of Professional Experience

Table 4.2.1 Respondents Biographic Variables

<i>Respondents' job title</i>				
Senior Project Managers	Project Managers	Architects	Facility & Maintenance directors and Engineers	Others
41%	29%	18%	12%	0%
<i>Respondents' years of professional experience</i>				
<5	6-11	12-15	16-20	>20
0	12%	29%	24%	35%

Source: computed from own survey data, (2021)

As it is shown in the table above, 41% of the respondents are found to be senior project managers, 29% project managers, 18% architects and 12% facility and maintenance directors & engineers who participated in the study conducted. And respondents' years of professional experience in construction project management found to be nil for below five years, 12% for years six to ten, 29% for years twelve to fifteen, 24% for sixteen to twenty years and 35% for above 20 years of experience.

4.2.2. Familiarity to the concept of Green Building Construction

Table 4.2.2. Respondents' Familiarity to GBC

Familiarity	Frequency	Percent (%)	Valid Percent	Cumulative percent
Totally Unfamiliar	0	0	0	0
Neutral	0	0	0	0
Fairly Familiar	0	0	0	0
Familiar	6	35	35	35
Completely Familiar	11	65	65	100.0

Source: computed from own survey data, (2021)

It is found that all respondents have participated in green building construction projects, where 11 out of 17 respondents which is around 65% rated 5 out of 5 points for their familiarity signifying they are completely familiar and 6 out of 17 respondents were familiar as they rated their familiarity 4 out 5 points which is about 35% to the concept of green building construction.

4.3. Analysis of Green Building Construction Project practice in Addis Ababa

This section tried to answer the research question raised how the current practice of green building construction projects in Addis Ababa is. Respondents were requested to rate the following statements, on a scale of 1 to 5, according to the best of their knowledge. Where, 1 represents ‘fully agree’ 2 = Agree, 3= Neutral, 4= Disagree and 5 represents ‘fully disagree’. And the data collected is analyzed and tabulated below.

Table 4.3.1: Analysis of Green Building Construction Project practice in Addis Ababa

GBC project Practice in Addis Ababa	Code	Mean	Standard Deviation (SD)	Coefficient of Variation (CV)	Rank based on Mean
There is more interest in green building by clients in recent times	PP1	2.70	0.98	0.364	9
Information and training about green building is readily available	PP2	3.70	0.85	0.23	4
There is an interest in green building by building practitioners (e.g. town planners, builders, etc.)	PP3	2.88	0.78	0.271	8
Recycled materials are being incorporated into building designs	PP4	3.65	0.93	0.255	6
There is an improved enforcement by local government for GBC	PP5	4.06	1.03	0.253	3
Financial incentives e.g. green loans etc. are available	PP6	4.17	0.81	0.194	2
green building rating system such as LEED is being implemented	PP7	3.65	0.70	0.192	6
There is a developed GBC project management framework	PP8	3.70	0.77	0.208	4
There is a good understanding and public awareness of GBC projects	PP9	4.35	0.61	0.139	1

Source: computed from own survey data, (2021)

As per the questionnaire received and tabulated above, respondents gave their degree of agreement, where the rank shows their degree of disagreement

Thus:-

Respondents disagreement with the existence of Good understanding and public awareness of GBC projects is ranked 1st with a mean value of 4.35 indicating the current poor understanding of such projects by the public. Financial incentives like green loans availability is ranked 2nd with a mean value of 4.17, which shows that there isn't tangible financial support for the green building construction sector by financial institutions. The un-improved enforcement by local government for GBC is a great marker that this sector is not seen as of a great concern by governmental bodies currently and is ranked 3rd with a mean value of 4.06. The availability of GBC project management framework is ranked 4th with a mean value of 3.70, exposing the absence of a well-documented framework for such construction projects to be guided with followed by the unavailability of information and training about green building construction with a similar mean value. Implementation of green building rating system such as LEED is ranked 6th with a mean value of 3.65 revealing that the very poor employment of rating systems in the current building industry which is a proof for the availability of very few projects with a LEED certification. The incorporation of recycled materials into building designs is ranked also 6th, showing its minimal integration in the current building practice of Addis Ababa. However, the respondents consider a growing interest by building professionals for such projects which is to be seen as one positive thing, as for the clients in recent times too which can be taken as a great opportunity for the sector. The survey conducted by Nura Mohammedata (2018), in Addis Ababa: also revealed that awareness and education is found to be more of a challenge than economic issues followed by shortage of professional specializing on green building and insufficient education programs, resource or documentation and research on the topic in the current building construction practice of Addis Ababa.

4.4. Analysis on the challenges that project managers face in managing green building construction projects.

This analysis answers the research question raised how the extents of the challenges in green building construction project management process are and tried to meet the study objective of assessing the green building construction project management practice in Addis Ababa. Respondents were asked to rate the extent to which each of the challenges affected them using a 5-point Likert scale (1=not significant at all; 5=most significant) and the result is analyzed and tabulated below.

Table 4.4.1: Analysis on Planning-related Challenges

Category	Challenge	Code	Mean	Standard Deviation (SD)	Coefficient of Variation (CV)	Rank based on Mean	Rank Cross Category
Planning-related	Adoption of different contract forms of project delivery	PL1	3.294	0.985	0.299	6	25
	The design, orientation and structure of the building	PL2	3.470	1.125	0.324	4	15
	Planning of different construction sequence	PL3	3.294	1.16	0.352	6	25
	Planning of different construction technique	PL4	3.764	0.903	0.24	1	3
	Lengthy approval process for new green technologies within the organization	PL5	3.705	1.16	0.313	3	9
	Longer time required during the pre-construction process	PL6	3.352	0.862	0.257	5	23
	Difficulty in comprehending the green specifications in the contract details	PL7	3.764	1.091	0.29	1	3

Source: computed from own survey data, (2021)

Planning of different construction techniques (PL4) is ranked 1st as the most difficult planning-related challenge encountered; with a mean value of 3.764 which is an indicator for the lack of adaptability to new ways of doing things and lack of skill to adopt required new techniques, which can be taken as a hindrance for the progression of green building construction projects. According to (Zhang et al., 2011), Green technologies frequently necessitate complex techniques and construction processes. If complications are not properly handled, the project manager's output will suffer.

Difficulty in comprehending the green specifications in the contract details (PL7) is also ranked 1st with a mean value of 3.764, implying for the presence of a less understanding of the necessary special specifications, this might be due to lack of certified green building consultants as environmental requirements are often complex and assessing compliance may in some cases require technical expertise to draw up technical standards labels.

Lengthy approval process for new green technologies within the organization (PL5) is ranked 3rd with a mean value of 3.705; revealing that organisations lack understanding of their readiness to adopt Green building construction, the lack of organizational structures, and the unavailability of continuous sponsorship for the promotion of such project types within the organization. The survey conducted by Tagaza and Wilson, (2004) shows that the market environment indicates that the planning process will take a long time because allowing the use of emerging green technology and recycled materials can be time consuming. (Pettersen, 1999; Ling, 2003) also indicates that project managers face a difficult task in developing the plan and approving progress payments to contractors and suppliers due to a lengthy approval process.

The design, orientation and structure of the building (PL2) is ranked 4th with a mean value of 3.47, implying that since most green technologies are new to the construction industry and their system efficiency is unknown, the design team may require more time to research the design system performance against the specified green building goals. Furthermore, more effort must be made to ensure that the green features integrated into the design consider outlets for less expensive but still effective green alternatives.

Longer time required during the pre-construction process (PL6) is ranked 5th with a mean value of 3.352. Indicating the need for a detailed and comprehensive design plan, incorporating all the green features required by the construction project. This usually entails further participation and coordination with various stakeholder groups, which may slow down the pre-construction process.

Difficulty in adoption of different contract forms of project delivery (PL1) is ranked 6th with a mean value of 3.294. According to Tagaza and Wilson (2004), the form of contract used to execute the project had a significant impact on the progress of designing and implementing a green design. Green building construction contracts must include all of the specifics of a fully integrated green design. If the design is locked before it is fully formed, this causes a problem. Followed by the challenge encountered in planning of different construction sequence.

The study conducted by B.-G. Hwang, W.J. Ng (2012) also found that most challenges faced by project managers executing green construction projects are planning-related. Where the longer time required for the pre-construction process yielded the highest score, indicating that it is the most frequently encountered challenge. Followed by The difficulty in comprehending green specifications given in the contract details, and the lengthy approval process to approve new technologies. According to Kubba (2010), over time green building projects progressively incorporate more advanced and intricate systems. During design, the impact of the elements on each system must be considered as a whole. A failure to take into account the integration of green technologies and its impact on other building elements results in construction conflicts, leading to delay in order to address such problems.

Table 4.4.2: Analysis on Project-related Challenges

Category	Challenge	Code	Mean	Standard Deviation (SD)	Coefficient of Variation (CV)	Rank based on Mean	Rank Cross Category
Project-related	Difficulty in approving payment disbursement to suppliers and subcontractors	PR1	2.823	1.074	0.381	4	35
	Difficulty in assessing the progress of completion in green construction	PR2	2.764	0.831	0.301	5	36
	Difficulty in the selection of subcontractors in providing green construction service	PR3	3.411	0.871	0.255	1	19
	More time is required to implement green construction practices onsite	PR4	3.235	1.091	0.337	2	29
	More alteration and variation with the design during the construction process	PR5	3.176	1.131	0.356	3	31

Source: computed from own survey data, (2021)

Difficulty in the selection of subcontractors in providing green construction service (PR3) is ranked 1st with a mean value of 3.411 signifying the lack of green building specialized contracting firms in our country Ethiopia, to influence how green a construction project can be, both during construction and after completion.

The time required to implement green construction practices onsite (PR4) is ranked 2nd with a mean value of 3.235. It is thus an indicator that green construction practices are more time demanding for implementation as they are for planning too, since they need back and forth checkups by onsite engaged professionals so as ensure their prime goal.

More alteration and variation with the design during the construction process (PR5) has got a mean value of 3.176 to be ranked 3rd. This could be because of the special characteristics of green building construction frequent technological advancement, statutory changes or enforcement, change in conditions, geological anomalies, non-availability of specified materials, or simply because of the continued development of the design after the contract has been awarded.

Difficulty in approving payment disbursement to suppliers and subcontractors (PR1) is ranked 4th with a mean value of 2.823. This might be because of green building constructions have a high complication and fragmentation of construction process which involves many different commercial parties operating in a supply chain with a differing range of contractual responsibilities where the payment risks are passed throughout the supply chain. And a high quality expectations which urged clients to stipulate longer defect liability periods and hold higher retentions on contractors. Difficulty in assessing the progress of completion in green construction (PR2) with a mean value of 2.764 is ranked last.

Based on the study conducted by B.-G. Hwang, W.J. Ng (2012), among all the challenges in the category of project related challenges, difficulties associated with the selection of subcontractors who provide green construction had the highest score. Selection of subcontractors for traditional construction projects may be less difficult for experienced project managers who are familiar with the performance of subcontractors with whom they have worked in the past. It is also likely that there is insufficient performance information for subcontractors who are involved in green construction projects. As a result, the selection process becomes tougher and may take more time. Followed by alterations and variations associated with the design during the construction process as a significant issue.

Table 4.4.3: Analysis on Client-related Challenges

Category	Challenge	Code	Mean	Standard Deviation (SD)	Coefficient of Variation (CV)	Rank based on Mean	Rank Cross Category
Client – related	Specific budget specification of the green project	CL1	3.764	1.251	0.332	1	3
	Objective of the building project	CL2	3.235	1.20	0.371	6	29
	Required date of completion	CL3	3.470	1.231	0.355	3	15
	Level of risk the client is willing to take in green technologies	CL4	3.705	1.21	0.327	2	9
	Client uses a lot of time in making decision	CL5	3.411	1.325	0.388	4	19
	Special request from client pertaining to specified green technologies to be used	CL6	3.411	1.23	0.36	4	19

Source: computed from own survey data, (2021)

The highly rated challenge in this category is specific budget specification of the green project (CL1) with a mean value of 3.764 as it demands a relatively complex financial and/or quantitative statement to be established by performing assessment of projected income and expenses through the life of the project in comparison with similar green building projects, funds available, and Pre-design analysis of requirements.

Level of risk the client is willing to take in green technologies (CL4) got a mean value of 3.705 to make it the 2nd highly challenging in the category of client-related challenges. As clients always want to balance the strong case for financial and organizational gain against the risk and possibly higher costs of this new approach to building design and construction, there seems to be a high fear of taking such risks.

Required date of completion (CL3) got a 3rd place with a mean value of 3.47 which is an indicator that green building projects took more time to complete than similar types of traditional projects. It is more difficult for green projects to adhere to their as-planned schedule as it is difficult to accurately estimate duration of the related activities. This might cause contractors in charge of the activities to easily go over the deadlines set by the estimation, resulting in schedule overrun of the entire project which will prevent it from meeting the deadlines set by clients. Special request from client pertaining to specified green technologies to be used, more time used by the client to make a decision and objective of the building project took the least ranking respectively.

B.-G. Hwang, W.J. Ng (2012) found on their study that understanding the objective that the client wants to achieve with the green building is the highly anticipated challenge. In order to achieve the goal, the client should specify the type of green technology to be used although this too may pose a challenge if the specified green technology is not available locally. Also, the level of risk that the client is willing to undertake can be another challenge for the project manager. Project managers are responsible for ensuring that the green technologies applied in the project are safe, especially if the client has a low threshold for risk. In some cases green consultants may try to convince the client to adopt a particular system. The client may need more than the usual amount of time to make decisions on whether or not to implement such a system.

Table 4.4.4 Analysis on Project team-related Challenge

Category	Challenge	Code	Mean	Standard Deviation (SD)	Coefficient of Variation (CV)	Rank based on Mean	Rank Cross Category
Project team related	Conflict with the architect over the type of material to be used	PT1	3.411	1.12	0.329	3	19
	Lack of communication and interest among project team members	PT2	3.176	1.01	0.319	5	31
	Frequent meetings with green specialists	PT3	3.470	1.18	0.34	2	15
	Conflict of interest between consultant and project manager	PT4	3.117	1.27	0.40	6	33
	Green consultant delay in providing information	PT5	3.294	1.213	0.368	4	25
	Specific performance required for green building projects	PT6	3.823	1.015	0.265	1	2

Source: computed from own survey data, (2021)

In the project team related challenge respondents give higher rate for specific performance required for green building projects with a mean value of 3.823. Frequent meetings with green specialists (PT3) is ranked 2nd with a mean value of 3.47. Conflict with the architect over the type of material to be used (PT1) is ranked 3rd with a mean value of 3.411. Green consultant delay in providing information (PT5) is ranked 4th with a mean value of 3.294. Lack of communication and interest among project team members (PT2) is ranked 5th with a mean value of 3.176 and Conflict of interest between consultant and project manager (PT4) is ranked 6th with a mean value of 3.117. The results signify that project members who involve in green building projects need to have appropriate knowledge and experience in green technologies. To select right team members and to organize an optimized project team, rigorous selection procedures with a set of qualification criteria should be developed and implemented even if more time would be taken to tackle

those project team related challenges identified. The two explanations suggested by Eisenberg et al. (2002) are insufficient knowledge or technological experience, as well as unfamiliarity with the products, materials, method, or design. The key difficulty is that green technologies are typically more complex and distinct from traditional technologies (Tagaza and Wilson, 2004) .This was also proven by Zhang et al. (2011).

Table 4.4.5: Analysis on Material and equipment-related Challenges

Category	Challenge	Code	Mean	Standard Deviation (SD)	Coefficient of Variation (CV)	Rank based on Mean	Rank Cross Category
Material & equipment related	Related High cost in green material and equipment	ME1	3.529	1.231	0.349	2	14
	Uncertainty with green material and equipment	ME2	3.294	1.213	0.368	4	25
	Availability of green material and equipment	ME3	3.705	1.213	0.327	1	9
	Decision on different green material and equipment	ME4	3.470	1.000	0.290	3	15
	Imported green material or equipment	ME5	3.117	1.054	0.338	5	33

Source: computed from own survey data, (2021)

Availability of green material and equipment (ME3) is ranked 1st with a mean value of 3.705, showing that on developing countries like Ethiopia there isn't ready made material to be incorporated in green constructions though there could be rich raw material to be processed and used. High cost in green material and equipment (ME1) ranked 1st with a mean value of 3.529, which can be a result of the absence of locally available green materials that forces to go on importation resulting in cost rise. The decision making process

on selection of such materials & equipment (ME4) with a 3.47 mean value is ranked 3rd. The uncertainty of green materials and equipment (ME2) ranked 4th with a mean value of 3.294 indicates that it is not be easy to be sure if they can be compatible for local use or not. Imported green material or equipment challenge (ME5) is ranked 5th with a mean value of 3.117, as importation is the one to be dependent on after selecting and making decision on the types, specs and cost of the material and equipment which results in higher cost. Research done by Zhang et al. (2011) argued that using green materials would cost from 3% to 4% more than conventional construction materials. Selection of the green materials has to be cost-conscious in order to prevent budget overruns. Unlike conventional construction materials, the availability of many green materials may not be available locally. Problems arising from imported material may include understanding the legal regulations of the various countries. Furthermore, to ensure that an imported material will be compatible for local use, extensive testing may be required.

Table 4.4.6 Analysis on Labor-related challenge

Category	Challenge	Code	Mean	Standard Deviation (SD)	Coefficient of Variation (CV)	Rank based on Mean	Rank Cross Category
Labor-related	Resistance to change from their traditional practices	LB1	3.764	1.091	0.29	2	3
	Lack of the technical skill regarding green technologies and techniques	LB2	3.941	0.966	0.245	1	1
	Workers' unaware of the correct methods and procedures	LB3	3.764	1.091	0.29	2	3

Source: computed from own survey data, (2021)

In the labor-related challenge, lack of technical skill regarding green technologies (LB2) is ranked 1st by the respondents with a mean value of 3.941, while workers' unaware of the correct methods and procedures

(LB3) and resistance to change from their traditional practices (LB1) are ranked 2nd with a mean value of 3.764. Where the sum of all the three challenges results in undesirable outcome and needs to be of a great concern for future projects. While B.-G. Hwang, W.J. Ng (2012) found on their study that workers' resistance to changing their traditional practices was a critical challenge faced by project managers. Although the project managers might not directly deal with the workers on site, their work plays a significant role in the success of the project. If the workers lack the necessary technical skills or are unaware of the correct procedures, they may have a negative impact on achieving project success.

Table 4.4.7 Analysis on External-related Challenges

Category	Challenge	Code	Mean	Standard Deviation (SD)	Coefficient of Variation (CV)	Rank based on Mean	Rank Cross Category
External related	Government policy	EX1	3.588	1.176	0.327	3	13
	Lengthy BCA approval process for new technologies	EX2	3.764	1.03	0.274	1	3
	More time required for TOP due to green mark certification process	EX3	3.353	1.272	0.38	4	23
	Unforeseen circumstances in green project	EX4	3.647	0.931	0.255	2	12

Source: computed from own survey data, (2021)

Lengthy BCA approval process for new technologies (EX2) is ranked 1st with a mean value of 3.764 which is an indicator that Bureaus of construction authorities lack qualified professionals to deal with green building construction effectively and efficiently. Unforeseen circumstances in green construction project (EX4) with a mean value of 3.647 is the 2nd highly rated; as green construction is new to developing

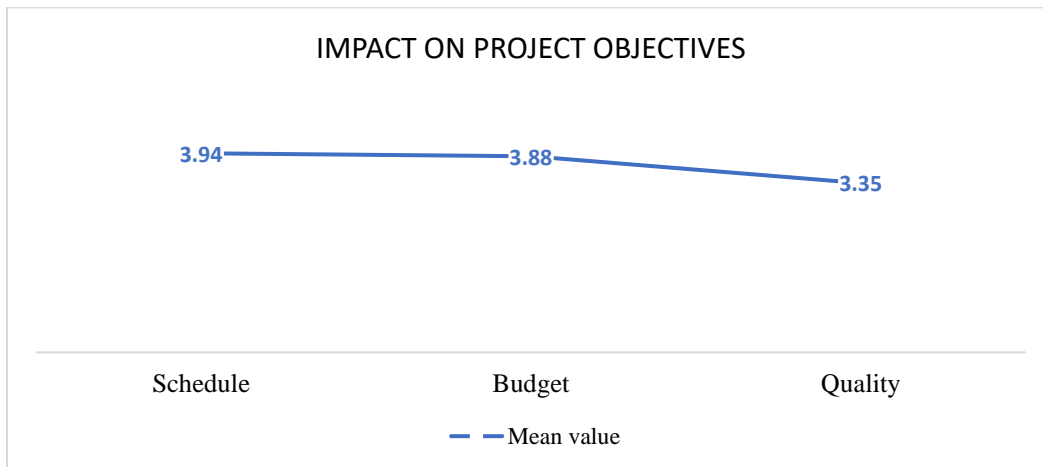
countries especially Ethiopia, project managers are not fully aware of all external circumstances to deal with. Government policy (EX1) and more time required for TOP due to green mark certification process (EX3) are ranked 3rd & 4th respectively. External challenges can impact a project in many ways. Unforeseen circumstances may be even less predictable in green construction projects as compared to conventional construction projects. Understanding governmental policies related to green construction project is also vital. Strict policies and regulations are designed to protect human health and environmental issues and failure to comply may cause project delay, termination and fines. Even if green consultants are involved during most of the green construction project, it is paramount that project managers have a good understanding of the policies.

4.5. Analysis on Impacts of the challenges on Project Objectives

This analysis answers the research question raised how intense the effect of the challenges on project objectives, i.e. Schedule, Budget and Quality of a project are and tried to meet the study objective of assessing its impact on the green building construction project practice.

Respondents were requested to state the extent of effects that these challenges have on the three main objectives in green building projects, which are project schedule, budget and quality of the end product on a scale of 1 to 5, where 1 represents no effect on the objectives at all and 5 represents extremely extensive effect. Here the mean value is tabulated below.

Figure 4.5.1: Analysis on Impacts of the challenges on Project Objectives



Source: computed from own survey data, (2021)

As per the analysis result found: impact on schedule, budget and quality are ranked with a mean value of 3.94, 3.88 and 3.35 respectively. Which shows that schedule and cost over-runs are highly anticipated in green construction projects with all the above challenges encountered while quality can be assured with relatively less impact. B.-G. Hwang and J. S. Tan on their study found that the obstacles have an extensive effect on both the schedule and quality of green building projects. The effects of the obstacles on project budget have a higher mean score, suggesting that the challenges have a very extensive effect on project cost.

4.6. Analysis on knowledge areas to deal with the challenges

This analysis answers the research question raised how the extent of importance of knowledge areas required to meet the challenges are and tried to meet the study objective of assessing the extent of important knowledge areas available for green building construction in Addis Ababa.

Respondents were asked to rate the importance of project manager attributes in responding to the different challenges identified (1=not important at all to 5=most Important). Knowledge areas that project managers need in order to effectively deal with the challenges of green construction. And the result is tabulated below.

Table 4.6.1: Analysis of knowledge areas to deal with the challenges

Management Knowledge Area	Code	Mean	Standard Deviation (SD)	Coefficient of Variation (CV)	Rank based on mean value
Schedule management and planning	MK1	4.53	0.80	0.176	2
Health and safety management	MK2	4.41	0.87	0.197	7
Human resources management	MK3	4.41	0.87	0.197	7
Stakeholder management	MK4	4.588	0.795	0.173	1
Cost management	MK5	4.47	0.624	0.140	4
Communication management	MK6	4.47	0.624	0.140	4
Conflict and dispute management	MK7	4.17	0.727	0.174	9
Risk management	MK8	4.47	0.717	0.160	4
Materials resources management	MK9	4.53	0.624	0.138	2
Claims management	MK10	4.06	0.90	0.220	10

Source: computed from own survey data, (2021)

Stakeholder management (MK4) is found to be the most important knowledge area to address the client-related challenges and ranked 1st with a mean value of 4.588. This result could be explained by the

importance of understanding the client's objectives. Schedule management and planning (MK1) is ranked 2nd with a mean value of 4.53. More time is usually required during the pre-project planning process for green projects. Therefore, project managers must be effective at schedule and planning management to ensure that the project will be completed in time. Cost management (MK5), communication management (MK6) and Risk management (MK8) are all ranked 4th with a mean value of 4.47. Project managers needs to have a good understanding of cost management in order to effectively manage costly green materials and to prevent cost overruns. Communication management is also highly important as everyone in the project team needs to be well informed with the project's goals and objectives in order to prevent errors as green building projects are complex and need to have a more holistic and integrated approach.

Project managers needs to have management knowledge for occupational safety and health (OSH) risks associated with the planning and construction of green buildings, their maintenance, renovation (retrofitting) and demolition, as well as the collection of related construction or demolition waste on site (excluding the subsequent waste treatment and recycling) which is ranked 7th with a mean value of 4.41. Some of these OSH risks are new compared with traditional construction sites and are associated with new green materials, technologies or design. Other risks are well-known to the construction sector (for example working at height), but they arise in new situations or combinations associated with green buildings that demand specific consideration. Project managers needs to know the role of human resource management which is also ranked 7th towards the attainment of sustainable development and adopt performance management in order to boost morale and levels of motivation, help identify suitable candidates for promotion, aid in the setting of organizational goals and identify areas which require training and development.

While dealing with conflict and dispute management and claims management project managers needs to have the knowledge to identify avoidable from necessary claims; and also to reduce arguments resulting from unresolved dispute and allegations in green building projects by properly classifying construction claims, estimating their relative importance in terms of severity and frequency, and identifying the proximate and root causes of significant claims. And, avoid the avoidable and mitigate the unavoidable or un-avoided claims, through controlling the controllable causes. It is also advised that management focus its efforts on preventing the causes of certain allegations and conflicts that are deemed to be significant in terms of effect and/or likelihood of occurrence.

The survey conducted in Singapore by Bon-Gang Hwang & Wei Jian Ng, (2012), has revealed that the most important knowledge areas that are essential to respond to the challenges in GBC projects were found to be schedule management and planning, stakeholder management, communication management, cost management, and human resources management.

4.7. Analysis on Solutions for the Challenges

This analysis answers the research question raised how professionals do perceive as solutions to overcome the challenges and tried to meet the study objective of professionals' observance as solutions in overcoming the challenges of green building construction project management in Addis Ababa.

Respondents were asked to choose solutions that could help to overcome the challenges identified above. Where 1=not important at all to 5=most Important, and the results are tabulated as follows:

Table 4.7.1: Analysis on Solutions for the Challenges

Solutions	Code	Mean	Standard Deviation (SD)	Coefficient of Variation (CV)	Rank based on Mean
Government to provide incentives to offset high premiums	S1	4.00	1.172	0.293	6
Educating owners on the future benefits of green buildings	S2	4.60	0.870	0.190	1
Public and market demand for green buildings	S3	4.00	1.172	0.293	6
Interest free lending schemes provided by government to overcome market and financial barriers.	S4	3.71	1.263	0.341	10
Insistence from client	S5	4.12	1.110	0.270	4
Green Mark Certification to be made mandatory for all new and existing buildings by authority	S6	4.24	0.752	0.178	3
Conduct tool-box meeting for regularly	S7	3.76	1.300	0.345	8
Engaging personnel with green building background	S8	4.30	0.850	0.20	2
Subsidy from government for R&D in green building	S9	4.06	0.827	0.20	5
Bonuses provided for staff if the building is green mark certified or qualified for green mark awards	S10	3.76	0.752	0.20	8

Source: computed from own survey data, (2021)

Educating owners on the future benefits of green buildings (S2) is ranked 1st with a mean value of 4.60. This is an indicator that lack of knowledge and awareness of GBC has become a barrier to its adoption, and this barrier could be overcome by providing related education to raise the knowledge and awareness levels of the client. Thus, it is important to organize educational programs to increase knowledge and awareness among them to drive the adoption of GBC.

Engaging personnel with green building background (S8) is ranked 2nd with a mean value of 4.30. Engaging accredited and skilled green professionals like green professionals such as Green Mark Professionals (GMPs), Green Mark Managers (GMMs), and Green Mark Facilities Managers (GMFM) skilled manpower with green building construction experience will help to assist the adoption of GBC in the construction industry.

Green Mark Certification to be made mandatory for all new and existing buildings by authority (S6) is ranked 3rd with a mean value of 4.24. Creating mandatory policies and regulations for GBC implementation is important for stimulating market interest in GBC, because that motivates, forces, or exerts pressure on the industry practitioners to take relevant actions for GBC adoption in order to avoid fines or penalties for implementing traditional technologies. This promotion strategy is closely related to the provision of incentives in that normally stakeholders are required to fulfill some mandatory or compulsory requirements before benefiting from the incentive schemes. Which is highly linked to Insistence from client (S5) which is ranked 4th with a mean value of 4.12, that grow as client awareness grows.

Subsidy from government for R&D in green building (S9) which is important for the promotion of green building development is ranked 5th with a mean value of 4.06. Public and market demand for green buildings (S3) and government to provide incentives to offset high premiums (S1) are ranked 6th with a mean value of 4.00. It is important for the promotion of green building developments as financial incentives provide a valuable economic support for the industry, particularly individual stakeholders or firms, in the adoption process of GBC which usually involves higher investment than adopting traditional building technologies.

Conducting tool-box meeting regularly (S7) to avoid lack of communication and interest among project team members and providing bonuses for staff if the building is green is also highly important. Interest free lending schemes provided by government would overcome market and financial barriers (S4) and should also be given due prior by concerned bodies for future projects.

Based on the survey conducted by Bon-Gang Hwang and Jac See Tan (2010) in Singapore, to find solutions that can help overcome the obstacles encountered in green building project management, incentivization of green building projects by government is found to be helpful to offset the high cost involved in green building construction. Educating the client on the future benefits of green building is found to be a solution as well. Since green building construction is a fairly new concept in the construction industry, it is important to communicate the green goals and objectives to all stakeholders and project team members in order to achieve successful project execution. Daily tool box meetings should be held to ensure that essential project information is shared, as lack of contact between project participants is an obstacle in green building project management. Personnel with green building experience may also help solve the challenges. A construction tour for the client and the general public could be arranged to educate them on the advantages of green building, pique their interest, and increase market demand for green buildings. Subsidy from government for research and development of green building systems and management is also found essential to provide concrete evidence of how beneficial they are to humans and society as well as the economy.

Chapter Five

Conclusion and Recommendation

5.1. Conclusion

The study revealed that the current green building construction practice in Addis Ababa is at a very low stand as it is found that the public understanding of GBC is poor, financial incentives like green loans are unavailable from financial institutions, there isn't enforcement by local government for GBC and no implementation of green building rating systems such as LEED as there are found to be very few projects with a LEED certification currently which reveals the sector is not given a concern; there isn't a well-documented project management framework for such construction projects to be guided with and which makes it challenging to get sufficient information & training on it. The incorporation of recycled materials into building designs is low, though it is found that there is some degree of interest in GBC by building practitioners and clients which is to be appreciated and should be taken as an opportunity for the growth of GBC projects in Addis Ababa.

The study has tried to find out the challenges encountered in the course of GBC project management in Addis Ababa, by setting out seven main categories as planning- related, project-related, client-related, project team related, material and equipment, labor-related and external related. And found out top 10 ranked challenges encountered across their category, which are Planning of different construction technique, Difficulty in comprehending the green specifications in the contract details, Lengthy approval process for new green technologies within the organization, Specific budget specification of the green project, Specific performance required for green building projects, Availability of green material and equipment, Lack of the technical skill regarding green technologies and techniques, Resistance to change from their traditional practices, Workers' unaware of the correct methods and procedures and Lengthy BCA approval process for new technologies. Thus working vigorously and dedicating a high effort on these critical challenges identified by the study is crucial, while it would be vital to work on the other challenges simultaneously. The extent of effects that these challenges have on the three main objectives in green building projects which are project schedule, budget and quality are also distinguished.

The study has also pinpointed the project management knowledge areas needed to deal with the challenges where Stakeholder management, Schedule management and planning, Materials resources management, Cost management, Communication management and Risk management are identified to be highly important. After studying the challenges and their impact on GBC projects, the study has also identified solutions that could aid in overcoming the challenges and their likely impact.

5.2. Recommendation

Based on the findings of the study, the following recommendations are drawn:

Educating owners on the long-term advantages of green buildings and delivering related education to increase the client's knowledge and understanding is highly important. As a result, it is critical to organize educational programs (using mass-media, social-media, magazines and face-to-face trainings) to increase knowledge and awareness among them in order to encourage GBC adoption.

It is important to promote project management awareness areas in order to cope with the difficulties that GBC projects face. Given the importance of project managers in the performance of construction projects, it is crucial to recognize the critical knowledge and skills that a project manager requires to successfully implement a green construction project. In doing so, project managers would be able to strengthen their competency in handling green construction projects as a result, enhancing the likelihood of a successful green construction project.

Building construction projects needs collaboration with financial institutions to obtain financial incentives such as green loans. Applying locally applicable approach to determine if a loan is "green" will assist banks and financial institutions in tracking the green share of their lending portfolio in relation to their sustainability objectives, transferring resources to achieve targets, and even considering divesting in assets that are vulnerable to climate events.

Government needs to provide incentives to offset high premiums of Green building construction projects by implementing policies for green loans and tax reduction. Financial incentives are important for the promotion of green building innovations because they provide valuable economic support for the industry, especially individual stakeholders or firms, in the adoption phase of GBC, which typically requires more investment than conventional building technologies.

Engaging certified and trained green professionals with green building construction expertise, such as Green Mark Professionals (GMPs), Green Mark Managers (GMMs), and Green Mark Facilities Managers

(GMFM), will aid in the adoption of GBC in the building construction industry. It's also important to organize continuous trainings for workers to improve their awareness and technical skills.

Addis Ababa Construction Bureau needs to make green mark certification mandatory for all new and existing buildings in the near future. Creating mandatory policies and regulations for GBC implementation is critical for raising consumer interest in GBC because it motivates, pressures, or places pressure on industry practitioners to take relevant GBC adoption measures in order to avoid fines or penalties for using conventional technologies. This promotion approach is linked to the provision of rewards in the sense that most reward programs require stakeholders to meet such mandatory or mandatory conditions before they can gain. Thus, establishing a national/city-level rating and certification system authority or allowing non-governmental certifying organizations to manage and organize issues related to green building projects is highly important.

Consequently, the findings and implications of this study can be beneficial for policy makers and practitioners, though it has limitations that warrant future research attention. Nevertheless, it still creates a foundation for launching further specific studies on the promotion of green building construction project management in Addis Ababa's construction market which I hope propagates to the country-sides too in the near future. The construction industry can gain an understanding of the qualities of a competent project manager in relation to green construction projects based on the findings of this study. In addition, the value level of the attributes may be used by companies and educational institutions to establish training syllabi that target and concentrate on the most important attributes.

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Annex

Questionnaire

Dear Sir/Madam,

This questionnaire is prepared by a Master's Program student in Addis Ababa University, department of Project Management for a research project work. This study entitled — '**Assessment of Green Building Construction Project Management Practice in Addis Ababa**' is designed to assess the green building project management practice in Addis Ababa so as to find the challenges and opportunities and fill the gap by raising serious concern to take the necessary actions for green building development and providing a project management framework for future projects.

It aims to collect information related to the green building construction project management practice in Addis Ababa. The information given is for academic purpose only and will be treated as very confidential. Any form of support is greatly appreciated.

Thank you in advance for taking your precious time to fill this questionnaire. Please try to answer all the questions openly, as your answers will have an influence on the outcome of the research. Your 15 minutes or less will greatly contribute to the growth and advancement of Green Building construction in Ethiopia.

If you have any questions or comments, please don't hesitate to contact me. You can reach me by;

- Cell phone: +251909-921606 , +251911-106247
- e-mail: abigizaw@yahoo.com

Section 1: General Profile of the Respondent

Name of Company: _____

Project Name: _____

Location: _____

Respondent's profession/Job title: _____

Professional Experience

A. Below 5 B. 6 - 10 C. 11 - 15 D. 16 - 20 E. over 20

On a scale of one to five how familiar are you with the concept 'green building'?

Where 1= Not Familiar to 5= Completely Familiar

A. 1 B. 2 C. 3 D. 4 E. 5

Has your company ever been involved in a green building project?

A. Yes B. No C. I'm not sure

Section 2: Current Green Building Construction Project Practice in Addis Ababa

Respondents are required to rate the following statements, on a scale of 1 to 5, according to the best of their knowledge. 1 represents 'I fully agree' 2 = Agree, 3= Neutral, 4= Disagree and 5 represents 'I fully disagree'.

GBC project Practice in Addis Ababa	1	2	3	4	5
There is more interest in green building by clients in recent times					
Information and training about green building is readily available					
There is an interest in green building by building practitioners (e.g. town planners, builders, etc.)					
Recycled materials are being incorporated into building designs					
There is an improved enforcement by local governments for GBC					
Financial incentives e.g. green loans etc. are available					
green building rating system such as LEED is being implemented					
There is a developed GBC project management framework					
There is a good understanding and public awareness of GBC projects					

Section 3: The challenges that project managers face in managing green building construction projects.

Respondents are asked to rate the extent to which each of the challenges affected them using a 5-point Likert scale (1=not significant at all; 5=most significant)

Category	Challenge	1	2	3	4	5
Planning- related	Adoption of different contract forms of project delivery					
	The design, orientation and structure of the building					
	Planning of different construction sequence					
	Planning of different construction technique					
	Lengthy approval process for new green technologies within the organization					
	Longer time required during the pre-construction process					
	Difficulty in comprehending the green specifications in the contract details					
Project-related	Difficulty in approving payment disbursement to suppliers and subcontractors					
	Difficulty in assessing the progress of completion in green construction					
	Difficulty in the selection of subcontractors in providing green construction service					
	More time is required to implement green construction practices onsite					

	More alteration and variation with the design during the construction process					
Client-related	Specific budget specification of the green project					
	Objective of the building project					
	Required date of completion					
	Level of risk the client is willing to take in green technologies					
	Client uses a lot of time in making decision					
	Special request from client pertaining to specified green technologies to be used					
Project team related	Conflict with the architect over the type of material to be used					
	Lack of communication and interest among project team members					
	Frequent meetings with green specialists					
	Conflict of interest between consultant and project manager					
	Green consultant delay in providing information					
	Specific performance required for green building projects					
Material and equipment related	Related High cost in green material and equipment					
	Uncertainty with green material and equipment					

	Availability of green material and equipment					
	Decision on different green material and equipment					
	Imported green material or equipment					
Labor-related	Resistance to change from their traditional practices					
	Lack of the technical skill regarding green technologies and techniques					
	Workers' unaware of the correct methods and procedures					
External	Government policy					
	Lengthy BCA approval process for new technologies					
	More time required for TOP due to green mark certification process					
	Unforeseen circumstances in green project					

Section 4: Impacts of the challenges on Project Objectives (i.e. Schedule, Budget & Quality of the project)

Respondents are requested to state the extent of effects that these challenges have on the three main objectives in green building projects, which are project schedule, budget and quality of the end product.

Please rate the extent of effects on a scale of 1 to 5, where 1 represents no effect on the objectives at all and 5 represents extremely extensive effect.

Impacts of the challenges on Project Objectives	1	2	3	4	5
Schedule					
Budget					
Quality					

Section 5: Analysis of knowledge areas to deal with the challenges

Respondents are required to rate the importance of project manager attributes in responding to the different challenges identified in section three of the survey (1=not important at all to 5=most Important). Knowledge areas that project managers need in order to effectively deal with the challenges of green building construction projects.

Management Knowledge Area	1	2	3	4	5
Schedule management and planning					
Health and safety management					
Human resources management					
Stakeholder management					
Cost management					
Communication management					
Conflict and dispute management					
Risk management					
Materials resources management					
Claims management					

Section 6: Solutions for the Challenges

Respondents are asked to choose solutions that could help to overcome the challenges identified above.

(1=not important at all to 5=most Important).

Solutions	1	2	3	4	5
Government to provide incentives to offset high premiums of green building projects					
Educating owners on the future benefits of green buildings					
Public and market demand for green buildings					
Interest free lending schemes provided by government to overcome market and financial barriers.					
Insistence from client					
Green Mark Certification to be made mandatory for all new and existing buildings by authority					
Conduct tool-box meeting for regularly					
Engaging personnel with green building background					
Subsidy from government for R&D in green building systems and management					
Bonuses provided for staff if the building is green mark certified or qualified for green mark awards					

Appendix

BUILDING RATING OR CERTIFICATION SYSTEM	SINGLE- OR MULTI-ATTRIBUTE	TYPE OF STANDARD OR CERTIFICATION	MANAGING ORGANIZATION	ISSUES / AREAS OF FOCUS
<u>Building Research Establishment Environmental Assessment Method (BREEAM)</u>	Multi-Attribute	Green building rating and certification system through on-site independent third-party verification for: <ul style="list-style-type: none"> • New Construction • In-Use • Refurbishment & Fit Out Communities Infrastructure	BRE Global	Performance in: <ul style="list-style-type: none"> • Energy • Health & Well-being • Transport • Water • Materials • Waste • Land Use & Ecology • Management • Pollution No prerequisites for In-Use
<u>Leadership in Energy and Environmental Design (LEED)</u>	Multi-Attribute	Green building rating and certification system through independent third-party verification for: <ul style="list-style-type: none"> • New Construction (NC) • Existing Buildings, Operations & Maintenance (EB O&M) • Commercial Interiors (CI) • Core & Shell (CS) • Schools (SCH) • Retail • Healthcare (HC) • Homes • Neighborhood Development (ND) 	U.S. Green Building Council	Performance in: <ul style="list-style-type: none"> • Sustainable Sites • Water Efficiency • Energy & Atmosphere • Materials & Resources • Indoor Environmental Quality • Locations & Linkages • Awareness & Education • Innovation in Design • Regional Priority through a set of prerequisites and credits
<u>Green Globes</u>	Multi-Attribute	Green building guidance and assessment program for: <ul style="list-style-type: none"> • Existing buildings • New construction 	Green Building Initiative in the U.S. BOMA Canada	Environmental assessment areas to earn credits in: <ul style="list-style-type: none"> • Energy • Indoor Environment • Site • Water • Resources • Emissions

				<ul style="list-style-type: none"> • Project/Environmental Management No prerequisites
<u>Living Building Challenge</u>	Multi-Attribute	<p>Performance-based standard, and certification program for:</p> <ul style="list-style-type: none"> • Landscape and infrastructure projects • Partial renovations and complete building renewals • New building construction • Neighborhood, campus and community design 	International Living Future Institute	<p>Performance areas include:</p> <ul style="list-style-type: none"> • Site • Water • Energy • Materials • Health • Equity • Beauty <p>All areas are requirements.</p>
<u>NZEB</u>	Multi-Attribute	<p>Certification program using the structure of the Living Building Challenge which can be applied to any building type.</p>	International Living Future Institute	<p>One hundred percent of the project's energy needs must be supplied by on-site renewable energy on a net annual basis, without the use of on-site combustion. NZEB certified buildings must also meet the following requirements of the Living Building Challenge:</p> <ul style="list-style-type: none"> • the first half of Imperative One, Limits to Growth, dealing with appropriate siting of buildings • Imperative 19, Beauty and Spirit • Imperative 20, Inspiration and Education
<u>Passive House Institute US</u>	Multi-Attribute	<p>Performance based passive building standard</p> <ul style="list-style-type: none"> • Third-party RESNET approved quality assurance/quality control • Earns U.S. DOE Zero Energy Ready Home status 	Passive House Institute US	<p>Any type of building.</p> <p>New focus areas include:</p> <ul style="list-style-type: none"> • air tightness requirement • source energy limit • space conditioning criteria

		<ul style="list-style-type: none"> Includes HERS rating 		
<u>SITES</u>	Multi-Attribute	Third party verified rating system for development projects located on sites with or without buildings.	Administered by GBCI	<p>Performance criteria in the areas of:</p> <ul style="list-style-type: none"> Water Wildlife Habitat Energy Air Quality Human Health Outdoor recreation opportunities
<u>WELL Building Standard</u>	Multi-Attribute	<p>Performance based standard and certification program for</p> <ul style="list-style-type: none"> New and Existing Buildings New and Existing Interiors Core and Shell Retail Education Facilities Restaurant Commercial Kitchen Multifamily Residential 	Administered by the International WELL Building Institute™ (IWBI)	Measures attributes of buildings that impact occupant health by looking at seven factors: Air, Water, Nourishment, Light, Fitness, Comfort, Mind

INTERNATIONAL PROGRAMS

<u>BCA Green Mark Scheme</u> (Singapore)	Multi-Attribute	Benchmarking scheme that aims to achieve a sustainable built environment by incorporating best practices in environmental design and construction, and the adoption of green building technologies.	Building and Construction Authority (BCA)	<p>Rates buildings according to five key criteria:</p> <ul style="list-style-type: none"> Energy efficiency Water efficiency Environmental protection Indoor environmental quality, and Other green and innovative features that contribute to better building performance.
<u>Beam</u> (Hong Kong)	Multi-Attribute	Comprehensive standard and supporting process covering all building types, including mixed use complexes, both new and existing to assess, improve, certify, and label the environmental performance of buildings	Business Environment Council	<p>Performance and assessment in:</p> <ul style="list-style-type: none"> Site aspects Material aspects Water use Energy use

				<ul style="list-style-type: none"> Indoor environmental quality Innovations and additions
<u>CASBEE</u> (Japan)	Multi-Attribute	Building assessment tools for <ul style="list-style-type: none"> Pre-design New Construction Existing Building and Renovation 	JSBC (Japan Sustainable Building Consortium) and its affiliated sub-committees	Assessment areas include: <ul style="list-style-type: none"> Energy efficiency Resource efficiency Local environment, and Indoor environment
<u>EDGE</u>	Multi-Attribute	A universal standard and a certification system for residential and commercial structures.	International Finance Corporation (IFC), a member of the World Bank Group	Assessment areas include: <ul style="list-style-type: none"> Energy Water Materials
<u>Green Star SA</u> (South Africa)	Multi-Attribute	Green building rating system for: <ul style="list-style-type: none"> Office Retail Multi-unit residential 	Green Building Council of South Africa administers program Independent assessors to assess and score projects	Categories assessed in: <ul style="list-style-type: none"> Management Indoor Environmental Quality Energy Transport Water Materials Land Use & Ecology Emissions Innovation
<u>Pearl Rating System for Estidama</u> (UAE)	Multi-Attribute	Green building rating system for: <ul style="list-style-type: none"> Community Buildings Villas Temporary Villas and Buildings 	Abu Dhabi Urban Planning Council	Assessment of performance in: <ul style="list-style-type: none"> Integrated Development Process Natural Systems Livable Communities Precious Water Resourceful Energy Stewarding Materials Innovating Practice

Appendix: Summary of Green Building Rating and Certification Systems