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IMPLEMENTATION CHALLENGES OF A LEAN CONSTRUCTION MANAGEMENT SYSTEM IN ADDIS ABABA HOUSING DEVELOPMENT CORPORATION (AAHDC), ETHIOPIA

BY

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ADVISORS' APPROVAL SHEET

I declare that this thesis entitled **‘‘implementation challenges of lean construction Management system in Addis Ababa housing development corporation (AAHDC), Ethiopia’’** is my original work and study that all sources of materials used for the study have been acknowledged.

This thesis has not been presented for any other university and has not previously been submitted for the same academic qualification except for all sources of material used as a reference for this thesis.

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As a master’s research advisor, I hereby certify that the thesis entitled **“**Implementation Challenges of Lean Construction Management System in Addis Ababa Housing Development Corporation (AAHDC), Ethiopia’’ is his original work and prepared under my guidance.

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Student Abinet Sebsibe Wondimu has produced a Thesis entitled **"implementation challenges of lean construction management system in Addis Ababa housing development corporation (AAHDC), Ethiopia''** in a partial fulfillment of the requirement for the award of a Master's Degree in Construction Technology and Management; hence he submits this finalized thesis to the school to resume the remaining research work.

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ABSTRACT

Lean construction is a comparatively new concept in the construction industry, which aims to reduce waste in terms of resources, time, and human labor. Informal implementation and practice of lean construction is a problem to meets project objective. This study focuses on explored the major challenges to implement lean construction in the Addis Ababa housing development corporation (AAHDC) project. To do this study a literature review as well as the use of structured questionnaires survey was conducted. For this questionnaire from a total of 326 population 177 sample size where included from client, consultant and contractor currently were working on the project, out of 177 issued questionnaires 126 replies were gathered. These applied and descriptive study approaches were applying both qualitative and quantitative data and collected data was analyzed through Statistical Package for Social Sciences (SPSS) and frequency scores. In addition, to determine the rate of responses, the relative important index (RII) was employed. According to research results, from the analysis of returned responses implies related to the current level of awareness and practice of lean construction 53.17 percent of the respondents are not familiar with lean. The proposed benefits of lean construction deployment were perceived positively by survey participants, and identified techniques/tools, which are already using in project sites, such as prefabricated materials, kaizen activities, 5S including “sort”, “straighten”, “shine", "standardize” and “sustain, computer assisted design (CAD), and total quality management. The study have also pointed out lack of adequate lean awareness and understanding, lack of knowledge and skill, insufficient training for workers, the lack of support from top management, and lack of management commitments are the major and dominant challenges of implementing a lean construction in this project. Finally, it is concluded that in the AAHDC projects the most stakeholders are not familiar with lean construction due to those 5 major challenges. The research has also suggested some recommendations for the concerning bodies, this study result leads to an increasing need to ensure training programmers to the different parties involved in AAHDC construction projects able to the required skills and knowledge to successfully implement the lean construction and to make effective.

Keywords: lean; lean construction; lean construction management system; Addis Ababa Housing Development Corporation.

TABLE OF CONTENT

ACKNOWLEDGMENT IV

ABSTRACT V

TABLE OF CONTENT VI

LIST OF TABLES IX

LIST OF FIGURES X

LIST OF ACRONYMS XI

CHAPTER ONE: INTRODUCTION ..... - 1 -

1.1 Background of the study ..... - 1 -

1.2 Statement of the problem ..... - 3 -

1.3 Research questions ..... - 4 -

1.4 Objective of the study ..... - 5 -

1.4.1 General objective ..... - 5 -

1.4.2 Specific objectives ..... - 5 -

1.5 Significance of the study ..... - 5 -

1.6 Scope of the study ..... - 5 -

1.7 Limitations of the study ..... - 6 -

1.8 Organization of the thesis ..... - 6 -

CHAPTER TWO: LITERATURE REVIEW ..... - 8 -

2.1 Introduction ..... - 8 -

2.2 Developing housing needs ..... - 9 -

2.2.1 Housing in Addis Ababa ..... - 9 -

2.2.2 Low-cost housing ..... - 9 -

2.3 Definition of lean and lean construction ..... - 9 -

2.4 Implementation of lean construction ..... - 10 -
2.5 Awareness and familiarity with lean concept ..... - 10 -
2.6 Benefits of lean construction ..... - 12 -
2.7 Challenges of lean construction ..... - 13 -
2.8 How lean construction management improves efficiency on projects? ..... - 14 -
2.9 Research gap identification ..... - 14 -
CHAPTER THREE: RESEARCH METHODOLOGY ..... - 16 -
3.1 Introduction ..... - 16 -
3.2 Study area ..... - 16 -
3.3 Research design ..... - 18 -
3.4 Data sources ..... - 19 -
3.5 Study population ..... - 20 -
3.6 Inclusion and exclusion criteria ..... - 23 -
3.6.1 Inclusion criteria ..... - 23 -
3.6.2 Exclusion criteria ..... - 24 -
3.7 Sample size determination and sampling procedures ..... - 24 -
3.7.1 Sample size determination ..... - 24 -
3.7.2 Sampling techniques ..... - 25 -
3.8 Data collection instruments and techniques ..... - 25 -
3.8.1 Questionnaires survey ..... - 25 -
3.9 Validity and reliability ..... - 26 -
3.10 Data analysis method ..... - 27 -
3.11 Ethical consideration ..... - 28 -
3.12 Dissemination of results ..... - 28 -

CHAPTER FOUR: RESEARCH ANALYSIS AND DISCUSSION ..... - 29 -
4.1 Introduction ..... - 29 -
4.2 Reliability and consistency ..... - 29 -
4.3 Questionnaire response rate ..... - 29 -
4.4 Demographic background ..... - 30 -
4.4.1 Educational background ..... - 30 -
4.4.2 Respondent's current position in the organization ..... - 31 -
4.4.3 Years of experience in construction projects & condominium housing ..... - 32 -
4.5 Analysis of the current level of awareness & practice of lean construction tools ..... - 33 -
4.6 Level of use of tools that support the implementation of lean construction ..... - 35 -
4.7Analysis of the major challenges of implementing a lean construction management ..... - 36 -
4.8 Analysis of the benefits coming from implementing lean construction management ..... - 39 -
CHAPTER FIVE: CONCLUSION AND RECOMMENDATION ..... - 41 -
5.1 Conclusion ..... - 41 -
5.2 Recommendation ..... - 43 -
5.3 Recommendations for further studies ..... - 44 -
References ..... - 45 -
APPENDIX ..... - 49 -
APPENDIX A: Questionnaire ..... - 49 -
APPENDIX B: Statistical package for social sciences (SPSS) output ..... - 55 -

LIST OF TABLES

Table 3.1 Study population of client ..... - 20 -
Table 3.2 Study population of consultant ..... - 21 -
Table 3.3 Study population of contractor ..... - 22 -
Table 3.4 Grand total number of study population ..... - 23 -
Table 3.5 Z-Scores for commonly used confidence interval ..... - 25 -
Table 3.6 Cronbach's alpha range ..... - 27 -
Table 4.1 Scale of reliability test ..... - 29 -
Table 4.2 Questionnaire response rate ..... - 30 -
Table 4.3 Respondent's position in the organization ..... - 32 -
Table 4.4 Level of use technologies that support the implementation of lean ..... - 36 -
Table 4.5 Major challenges of implementing a lean construction in the AAHDC ..... - 37 -
Table 4.6 Frequencies of respondents and ranked benefits of lean construction ..... - 39 -

LIST OF FIGURES

Figure 3.1 Map of Addis Ababa city (study area location).....- 17 -
Figure 3.2 Research design.....- 19 -
Figure 4.1 Educational background of the respondent .....- 31 -
Figure 4.2 Years of experience in construction projects& in condominium housing .....- 32 -
Figure 4.3The current level of awareness & practice of lean construction tools in AAHDC ..- 33 -
Figure 4.4 Level of use of the technologies that support the implementation of lean.....- 35 -

LIST OF ACRONYMS

AU - African Union

AAHDC – Addis Ababa Housing Development Corporation

CAD - Computed Aided Design

ECA - Economic Commission for Africa

RII- Relative Importance Index

SPSS -Statistical Package for Social Sciences

TPS - Toyota Production System

TFV - Transformation; Flow; and Value generation

UK - United Kingdom

CHAPTER ONE: INTRODUCTION

1.1 Background of the study

According to the construction industry in Ethiopia report (2018), Ethiopia is the second-most populous country in Africa and registered huge construction industry and infrastructure development. The Ethiopian construction industry is characterized by many micro-entrepreneurs, the majority of who operate in the country's informal economy (1). Construction works need a high-value, and time-bound construction mission with a pre-determined performance objective. In general construction, project objectives are stated in terms of project completion time, budgeted cost, and stipulated quality specifications.

The housing project is one part of the construction industry. The housing problem is the most challenging aspect of the urbanization process in a developing country like Ethiopia. So to solve that problem the city government launched the Addis Ababa housing development project Office in 1996, proclamation No33/1996, and it is also established by the successive proclamation of No. 33/1996 and No. 33/2000 in 1996 E.C. with the vision of to build quality and standardized houses for low and middle in-come residents of Addis Ababa and enable them to be owners of houses by 2020 and set the mission of alleviating house shortage in Addis Ababa city by upgrading an integrated system that involves contractors, counselors, small and micro enterprises, as well as strengthen construction industry by using vast labor power, build up condominium houses and make the residents house owners through fair distribution (2) (3), In different schemes based on the percent of advance payment modalities such as 10/90, 20/80, and 40/60.

But currently, the project office upgrades the name and overall structure of the project office, so the updated name of the office is Addis Ababa housing development corporation (AAHDC) and by merging a classical two project office replace by a new branch name, based on this arrangement 13 branch offices an established and also launched 5 new branch project offices so currently a total number of the branch project site at branch level is 18.In this project numbers of stakeholders are participating such as project owners or clients, contractors, consultation offices, and micro-enterprises in the different working sectors like

electrical installation, metal work, sanitary installation, etc. So to achieve the goal of the project all the above stockholders need a proper managing system. However, the housing deficit is still a problem in Addis Ababa after fifteen years of execution of the program. In the last two registration programs 2005 and 2013, about 974,835 residents were registered for the condominium houses, within 15 years only 233,575 houses are constructed and transferred to beneficiaries. This implies criticism was also made on the affordability of the houses to low-income residents and quality issues. So, need for change and continuous improvement to address these challenges.

The Toyota motor firm established lean concepts after in Japan in order to create a paradigm change in the way the company was operated. The Toyota production system (4) was mentioned as an example of an invention that transformed the firm into a pragmatic problem-solving management style (5). Lean construction entails methods for designing production processes to reduce waste in terms of resources, time, and human labor, with the goal of maximizing cost-effective value (6) (7).

According to (8) study, even though lean construction is not yet practiced in the Ethiopian construction industry, there is some level of awareness among professionals about it, and some researchers, like (8), have discussed lean construction management practice and challenges in the construction industry.

Although the AAHDC project is a part of the construction industry in Ethiopia, but there are no known studies about lean construction that have been conducted specifically on the Addis Ababa Housing Development Corporation. This and other similar issues prompted the selection of this research title in order to identify the challenges and fill the gaps. As a result, assessing existing levels of understanding and practice of lean construction tools that enable the implementation of lean construction, identifying major challenges to lean implementation on projects, and identifying the benefits of lean construction on the AAHDC project are important. According to (8) study, the most influential barriers that will stymie the implementation of lean construction in Ethiopia's construction industry are a lack of knowledge, a lack of industry support, a lack of sufficient support among project teams, employee resistance, and a lack of standards, and The top five predicted benefits that

Ethiopian construction sector expects to receive from implementing lean construction were found to be increased productivity, better sustainability/reduced waste, outstanding customer satisfaction, decreased project schedule, and good quality building.

As the rational hypothesis suggests, different challenges face on project sites in properly implementing lean construction, but after overcoming those challenges and properly implementing lean construction management system a construction project sites are more effective, because according to (9) reports, implementing lean construction principles enhanced the quality and productivity of construction projects and the stated primary benefits of utilizing lean techniques are creating a waste-free workflow, reducing waste from project operations, improving project quality within budget and time constraints, or even ahead of schedule in some situations, obtaining quality honors and achieving performance excellence, increasing earnings and market share by utilizing lean practices as a competitive advantage, and boosting vendor relations and customer satisfaction through increasing team empowerment and improving safety and worker morale.

1.2 Statement of the problem

Based on (10) study, Lack of sufficient and affordable housing is one of the major problems in Addis Ababa, as well as other cities and towns across the country, so direct government low-cost housing projects and private partnerships are undertaken with varying degrees of success to solve and upgrade citizens' living standards. However, the vast majority are disorganized and tiny in scope in comparison to housing demand, thus they frequently fail to reach their intended low-income recipients. The demands in the 20/80, 10/90, and 40/60 AAHDC schemes pay 20%, 10%, and 40% of the total cost, respectively, before getting a chance to buy a house, and the majority of the people lives in rented houses until they can buy a house, implying that a citizen must pay to both sides (bank and client rental house). In Addis Ababa, there is an issue with the building of these saving houses that requires special care in order to deliver the houses on time.

For example AAHDC project 10 Koye Fecha site, a project that was launched or begun before 7 years, practically all 237 blocks were under construction, but the interest or objective of client (AAHDC) was finished and transferred to beneficiaries within 18 months. This

means that a client, contractors, consulting offices, and micro businesses, as well as all shareholders and active individuals, are all exposed to more waste.

These and other issues widen the gap between housing demand and supply by impeding effectiveness and efficiency in terms of cost, time, and quality by increasing waste. To improve these aspects of the sector, a new technology implemented to change the present traditional construction method into a more advanced, quick, and cost-effective one. The implementation of a lean construction management system is one of these options. However, little previous study related to closing such gaps by implementing a lean construction management system on Ethiopian construction industry and this project office was found during the previous literature review, and there was no sufficient way to learn about the challenges, level of awareness, and current practice of lean construction. After seeing such types of gaps on projects and considering the benefits of a lean construction management system, chose a lean construction concept and were eager to demonstrate the challenges of implementing a lean construction management system in AAHDC in order to reduce waste and increase productivity. So, after conducting this specific research, clients, consultants, contractors, and all stakeholders will have more information about the lean construction management system and techniques on the housing project, as well as identify the challenges to implementing the lean construction management system in this project and the impact of the lean construction management system in Addis Ababa.

1.3 Research questions

The following questions were addressed to investigate the problem:

1. Do the client, consultants, and contractors have a sufficient understanding of lean construction tools and techniques?
2. Which types of lean management techniques/tools is the AAHDC currently using and effective?
3. What are the difficulties and challenges in implementing the lean construction management system in Ethiopian construction, particularly at AAHDC?
4. What are the benefits of implementing a lean construction management system on the AAHDC?

1.4 Objective of the study

The objectives of this study are to confirm the following:

1.4.1 General objective

- To study the implementation of lean construction in the AAHDC, Ethiopia.

1.4.2 Specific objectives

- To describe and rate the challenges to the AAHDC implementation of a lean construction management system.
- To investigate the degree of knowledge of lean construction tools and techniques among clients, consultants, and contractors.
- To investigate the current practice of lean construction management systems in AAHDC projects.
- To determine the benefits of applying lean construction management at the AAHDC.

1.5 Significance of the study

This study will provide project owners, contractors, consultants, vendors, and the government with a clear picture of the level of lean construction implementation in the housing construction industry, as well as an exploration of the major challenges to implementation, tools that support lean construction implementation, and benefits of lean construction in the AAHDC project. This study's findings will be extremely beneficial to the success of the Addis Ababa housing development corporation's initiatives, as well as a valuable contribution to the literature. Perhaps the findings of this study can be used by government policymakers and regulators to gain a better knowledge of how to use and execute contemporary project management in the construction of energy-efficient homes. Furthermore, this study serves as a foundation for further research into lean construction and the promotion of its use in the construction industry in Ethiopia and other countries.

1.6 Scope of the study

The research looked into the challenges of implementing the lean construction management system in Addis Ababa housing development corporation (AAHDC) projects in Ethiopia, as well as the existing practice of lean construction management systems in AAHDC projects.

Furthermore, using a questionnaire survey, this study focuses on identifying the benefits of lean-to completes a project at a time within a certain budget. All 18 project sites took part in the questionnaire survey. Clients, contractors, and consultants who are directly involved in the Addis Ababa housing development company (project branch offices) were surveyed. Due to the complexity of the issue and a lack of time to analyze within the scope of this study effort, the research did not cover suppliers, end-users, or other stakeholders.

1.7 Limitations of the study

It is unthinkable for any research process without limitations or challenges; the situation is similar to this research too. The process was not smoothly accomplished. There are different and many challenges the researcher faced while doing this research, especially at the data collection period. Among them the major limitations are: Absence of well-organized secondary data especially written literatures in AAHDC context, problem of willingness of some respondents, financial and other social problems, and resistance of the office workers to give secondary data.

1.8 Organization of the thesis

This research is organized into five chapters as discussed hereunder.

Chapter One-Introduction: background of the study, statement of the problem, research question, the objective of the study, the significance of the research, scope of the study, limitation of the study, and organization of the thesis.

Chapter Two -Literature Review: this chapter deals introduction, some information about Housing in Addis Ababa, definition of the lean construction management system, degree of lean implementation, awareness and familiarity with lean concept, the benefits of lean construction, challenges or barriers of the lean construction management system to implementation, research gaps identification.

Chapter Three -Research Methodology: deal about the study area, research design, type and source of data used in this research, about the study population, inclusion and exclusion criteria, sample determination and sampling procedures, data collection, reliability and validity, data analysis methods, ethical consideration, and dissemination of results.

Chapter Four - Research Analysis and Discussion: analyze and discuss the data obtained from the questionnaire survey.

Chapter Five - Conclusion and Recommendation: deals with conclusion and recommendation based on the research findings.

CHAPTER TWO: LITERATURE REVIEW

The literature review which is one of the sections of this study comprises a description of some of the different publications which have attempted to document a compendium of relevant information concerning general information about housing, lean construction management, technique/tools of lean, challenges to implementation of lean construction, level of awareness and current practice of lean and benefits of lean on the project.

2.1 Introduction

Construction, according to the (11) definition, is a broad term that refers to the art and science of forming items, systems, or organizations. Buildings, infrastructure, and industrial construction are the three major areas of the construction industry (12). Residential and non-residential constructions are the two most common types of building construction.

The process of erecting structures on land, often known as real estate sites, is known as building construction. Typically, a project is initiated by or in collaboration with the property owner (who may be an individual or an organization); on rare occasions, the owner may be forced to sell land for public use or for private beneficiaries.

The Federal Democratic Republic of Ethiopia, Africa's second-most populous country, is the subject of an (13) study that looks at the construction market and infrastructure development. The construction sector in Ethiopia is characterized by a significant number of micro-entrepreneurs, the majority of whom work in the country's informal economy. Ethiopia's official construction sector includes indigenous and indigenized businesses as well as a slew of big international civil engineering and construction enterprises.

Despite the fact that all contractors must register with the Ethiopian Ministry of Urban Development and Construction, corruption and health and safety concerns continue to be a source of worry. Construction projects, in general, are time-bound operations that need significant money and resource inputs (12). A high-value, time-bound construction mission with a pre-determined performance target is required for construction activity. Construction project goals are often defined in terms of project completion time, projected cost, and quality requirements.

2.2 Developing housing needs

Housing is one of the most necessities for living; all people require appropriate housing at all times. The type of housing, on the other hand, is mostly determined by the country's economic prosperity. Housing has become one of the most complex challenges of our day, and unless quick action is taken to solve the problem at both the regional and national levels, it will generate substantial problems with severe consequences for the economic and social development process (14). While this remark was made at the time, the housing problem still exists today, especially in Ethiopia (Addis Ababa).

2.2.1 Housing in Addis Ababa

According to (15) study, Addis Ababa continues to endure uncontrolled settlement and horizontal growth at a faster rate than it has in the past. Deteriorated living conditions, disorganized land management, unplanned urban expansion, lack of efficient promotional and regulatory frameworks, inadequate basic infrastructure, and uneven population increase are the city's main difficulties.

2.2.2 Low-cost housing

During planning and design, the entire cost of housing should be evaluated, taking into account the initial capital cost of housing construction as well as the recurrent cost of maintenance and repair throughout the course of its economic service life, and the most cost-effective housing should be chosen. As a result, the cost-effective housing initiative provides a timely response to the city's rapidly increasing housing need (14).

2.3 Definition of lean and lean construction

The Toyota motor firm established lean concepts after in Japan in order to create a paradigm change in the way the company was operated. The Toyota production system (4) was mentioned as an example of an invention that transformed the firm into a pragmatic problem-solving management style (5). The new production philosophy was known by numerous distinct titles at the start of the 1990s, including (16) world class manufacturing; (17) lean production; and (18) new production system (19). Lean construction entails methods for designing production processes to reduce waste in terms of resources, time, and human labor, with the goal of maximizing cost-effective value (6) (7). It is concerned with a

comprehensive approach to concurrent and ongoing advances in building project design, construction, activation, maintenance, salvage, and recycling (6).

2.4 Implementation of lean construction

It has been defined as a new paradigm for project management (20). It was also discovered that lean construction stems from recognizing the limitations of current project management and applying new production management techniques to the construction industry, dubbed "lean production." implementation of lean construction is thus primarily an attempt to improve the bad performance of construction projects in order to reduce unhappiness with project outcomes.

In the last ten years, a rising number of construction firms have adopted lean construction methods in an effort to enhance project performance. The majority of businesses, as well as certain studies, have observed positive outcomes from their adoption. However, a more thorough examination of the empirical evidence available is still required to determine the impact of lean construction adoption. Over the previous five years, the authors have investigated the use of the Last Planner System and other Lean Construction techniques in over a hundred construction projects. They've also come up with implementation techniques and tools (21).

2.5 Awareness and familiarity with lean concept

In the UK, (22) and (23) observed that adoption of lean construction principles was still restricted more than two decades, and in an earlier research by (24) in Germany, low level of knowledge of lean techniques was noted. Success has been reported in eliminating waste and profiting from the real implementation of the lean principles in construction projects in the United States and India (25).

The study (26) found that practitioners in the Ghanaian construction sector had a poor degree of knowledge with and use of lean construction. According to (27) the degree of understanding about lean construction in Nigeria is quite poor. (28) Who investigated the use of lean construction in the Abu Dhabi construction sector discovered that only 32 percent of the surveyed companies were aware with the idea of lean construction in Abu Dhabi.

The degree of knowledge of lean thinking is improving, but there is a comparably low level of implementation among construction companies, according to research conducted by (29) in five cities from Nigeria's five geopolitical zones. According to research conducted a decade ago by (27), the degree of knowledge of lean construction techniques among construction stakeholders is low. `According to a (8) study, 48 percent of respondents in Ethiopia's construction sector are somewhat aware with the idea of Lean Construction. However, the responses to the majority of other lean construction principles do not reflect this, the results, on the other hand, indicated that most professionals are more familiar with the idea of prefabrication (61 percent familiar and 31 percent practicing), as well as multiple contracts (64 percent familiar and 10 percent). Just in Time (65 percent familiar, 2percent practicing), modular construction (50 percent familiar, 13 percent practicing), and target value (56 percent familiar and 3 percent practicing). Their understanding of prefabrication and modular construction is expected, given that many building projects, particularly those in the housing sector and university construction, use prefabricated concrete slab beams on site. However, from a lean construction standpoint, professional understanding of target value design, just-in-time, and multiple contracts ideas may be lacking (8).

Despite the fact that lean construction is still in its infancy in the Moroccan construction sector, according to (30) survey, 61 percent of respondents are aware with lean construction practices, 35 percent are familiar with lean construction practices but not currently implemented, and 26 percent are familiar with lean construction practices and have implemented. In general, the level of application of lean construction practices in Morocco is low, although professional knowledge is strong. Later studies by (31) in Turkey indicated a low level of awareness of lean construction techniques among practitioners in the construction industries of the country.

According to (32) study that three out of four practitioners are unaware of lean construction techniques, blaming this on a lack of understanding, education, and communication regarding the relevance of the lean concept. According to the (8) Study, the majority of respondents believe that lean construction would be adopted in the Ethiopian construction industry over the next years (100 percent). 17.3 percent believe it will be adopted in the Ethiopian construction industry in the next five years, 39.13percent within ten years, and 15.9 percent

more than ten years. 23.19 percent are completely unaware. The mean is 3.58 and the standard deviation is 1.15, according to statistics. According to the respondents, the adoption of lean construction in the Ethiopian construction sector is likely to take place in the next 5-10 years.

2.6 Benefits of lean construction

When we look at the adoption of lean construction in Ethiopia, (8) research participants were asked to assess the expected advantages and probable hurdles as a consequence of lean construction implementation in the Ethiopian construction sector. As a result, increased efficiency, enhanced sustainability/waste reduction, higher customer satisfaction, a shorter project timetable, and high-quality construction have been suggested as possible advantages. In line with the anticipated advantages, professional understanding of project-specific lean principles revealed that lean construction is defined as a method of waste reduction, efficient construction, and material management. The result of (33) study also classified quality improvement, better health, and safety record, and reduced construction time as key benefits obtained through implementing lean construction principles in the Saudi Arabian construction industry. According to a 2018 research, firms that used the most efficient lean approaches completed 45 percent of projects ahead of schedule and 70 percent under budget (34). Projects are a type of manufacturing system that is only used for a short period of time. Lean projects are defined as ones that are organized to deliver the product while maximizing value and minimizing waste. Lean project management differs from traditional project management not just in terms of the objectives it seeks to achieve, but also in terms of the structure of its stages, the relationships between phases, and the participants in each phase (35).

According to (9) reports, implementing lean construction principles enhanced the quality and productivity of construction projects by around 77 percent, and the stated primary benefits of utilizing lean techniques are creating a waste-free workflow, reducing waste from project operations, improving project quality within budget and time constraints, or even ahead of schedule in some situations, obtaining quality honors and achieving performance excellence, increasing earnings and market share by utilizing lean practices as a competitive advantage, and boosting vendor relations and customer satisfaction through increasing team empowerment and improving safety and worker morale.

2.7 Challenges of lean construction

Lack of support from top management, insufficient training for workers, lack of adequate lean awareness and understanding, inadequate administration of the necessary information to generate a learning cycle and take corrective actions, and lack of involvement and transparency among stakeholders are the most significant challenges facing lean adoption in Jordan. Lack of a long-term philosophy and planning, management resistance to change, lack of incentives and motivation, as well as low professional wages, limited use of design-and-build procurement, and inaccurate and incomplete designs, as well as a failure to apply the concept of design constructability were among the other problems (36).

The obstacles facing the adoption of lean management in the South African construction industry base on (37) study, for example, include a lack of effective policies, the complexity of the lean construction process, and a lack of organizational expertise, among others. Following this (37) research, the researcher concluded that the most important component of lean construction is mindset; as a result, construction industry participants must have a full attitude change and practice lean construction on their everyday tasks In the instance of Ethiopia, respondents were asked to assess the predicted obstacles that would impact the implementation of lean construction in the Ethiopian construction industry from a list of thirteen probable barriers found in the literature, based on (8) results.

According to the findings, the top five most influential barriers to implementing lean construction in Ethiopian construction are a lack of knowledge and skill (74 percent), lack of industry support/understanding of lean (66 percent), lack of sufficient support across project teams (63 percent), employee resistance (57 percent), and lack of standard (56 percent).This finding is consistent with the findings of many other studies on lean construction barriers, such as (38) which identified a lack of adequate understanding of lean, culture and human attitudes, and management commitments as major challenges to overcome for successful lean construction implementation in the UK construction industry.

Despite the fact that (30), the questioned respondents, which consisted of professionals with high managerial level, specified that they are familiar with the majority of lean construction practices, their perceptions regarding the main barriers to lean construction implementation

seemed to be more pessimistic because they also believe that there is a lack of knowledge about lean construction practices among Moroccan construction practitioners. This reflects the fact that the successful implementation of lean construction practices cannot be achieved without having a global awareness covering all those involved in construction projects from top management to the workforce.

2.8 How lean construction management improves efficiency on projects?

Construction teams must discover ways to optimize value and efficiency while minimizing waste, or accomplish more with less, in order to remain competitive and profitable. Applying lean construction management concepts to a project is a technique to continually evaluate ways to remove waste and inefficiencies in order to accomplish the following goals: smoother operation (better continuous flows), increased productivity and higher quality, increased project satisfaction, reduced operational expenses and better risk management, and increased staff participation and responsibility.

According to (8) study, the most influential barriers that will stymie the implementation of lean construction in Ethiopia's construction industry are a lack of knowledge, a lack of industry support, a lack of sufficient support among project teams, employee resistance, and a lack of standards. Finally, this study was conducted on Addis Ababa housing development corporation project sites to examine the following previously reported hurdles or challenges to implementing lean construction management system in Ethiopia, as suggested by different scholars.

2.9 Research gap identification

The Literature is revised about the major challenges to implement, the current level of awareness and practice of lean construction, tools that support the implementation of lean construction, and benefits of lean construction. During the literature review there are worked researches in our country which is related with lean construction lack of knowledge, lack of industry support, lack of sufficient support among project team, employee's resistance and lack of standards as the most identified influential barriers that will hinder the implementation of lean construction and the response revealed that greater productivity, improved sustainability/reduced waste, great customer satisfaction, reduced project schedule

and high quality construction are the top five expected benefits that construction industry expected benefited by implementing lean construction. However, as a research gabs on the existing literature interims of qualitative and quantitative research gabs occurred so there was no evidence or studies directly conducted on Addis Ababa housing development corporation related to the challenges of implementing a lean construction management system, the current practice and level of awareness about lean construction tools and techniques, and the benefits of implementing lean construction at the time of review of previous studies. As a result, this study looked into the key implementation obstacles, present levels of understanding and practice of lean construction tools that enable lean construction implementation, and the benefits of lean construction in the AAHDC project. In addition, the study will also provide recommendations for future deployment and research to make the lean construction management system more successful.

CHAPTER THREE: RESEARCH METHODOLOGY

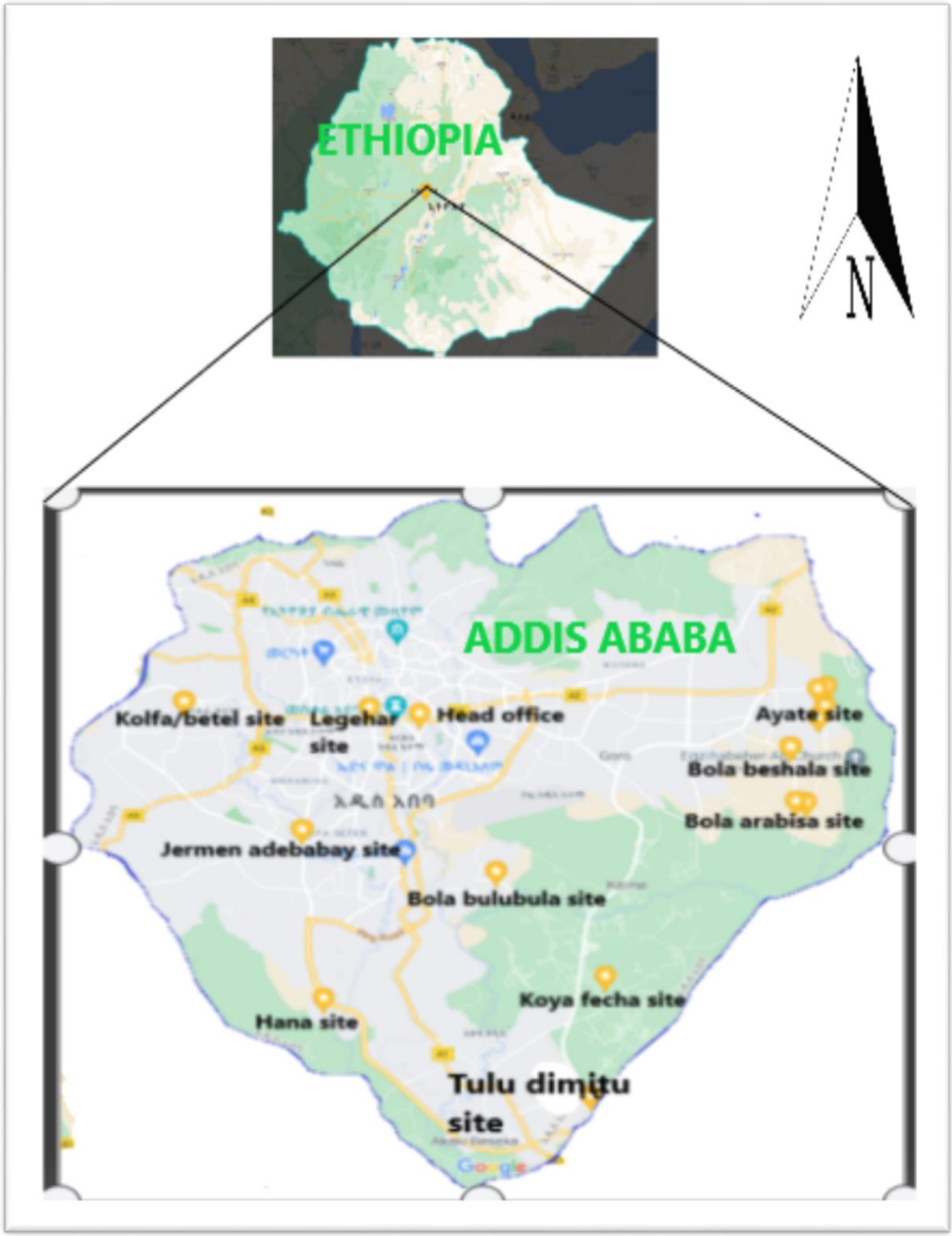
3.1 Introduction

The literature review provides a highlight to the thesis by explaining what had been established by many researchers about the challenges to the implementation of lean construction management systems and about the current practice and benefits of lean construction management system in the construction projects. Therefore, this chapter is tried to show the research process of the study.

This chapter provides how to do the research with appropriate methods, which includes the research approach, method, sampling design, sources of data, how to collect data from the target population, analyze and present the analyzed data.

3.2 Study area

The location where Addis Ababa, as it is where the research subjects are located, Addis Ababa is the capital city of Ethiopia. It is also the nominated capital of the African Union (AU) and the United Nations Economic Commission for Africa (ECA). Addis Ababa lies at an elevation of 2,355 meters (7,726 ft.) and is a grassland biome, located at is grassland biome, located at 9°1′48″N 38°44′24″E. The city lies at the foot of the Entoto Mountains and forms part of the watershed for the Awash. From its lowest point, around Bole international airport, at 2,326 meters (7,631 ft.) above sea level in the southern periphery, Addis Ababa rises to over 3,000 meters (9,800 ft.) in the Entoto Mountains to the north. As of the latest 2007 population census conducted by the Ethiopian national statistics authorities, Addis Ababa has a total population of 2,739,551 urban and rural inhabitants. For the capital city, 662,728 households were counted living in 628,984 housing units, which results in an average of 5.3 persons to a household. Although all Ethiopian ethnic groups and religions are represented in Addis Ababa because it is the capital of the country, (39), according to the 2015 census Addis Ababa has3,273,000 Population 527 km² Area with 6,211/km² Population Density and population change from 2007 to 2015 was 2.22% (40). The whole city seems to be under construction for buildings, roads, and other similar utilities.



Source; Google map

Figure 3.1 Map of Addis Ababa city (study area location)

As seen in figure 3.1 above this study area location makes the research highly relevant; the research was focus on lean Construction management system for Addis Ababa housing development corporation on currently active project site at branch level which is located in Addis Ababa.

3.3 Research design

This study classified as both applied and descriptive, because a study was conducted to determine if Addis Ababa housing development corporation (AAHDC) is formally managed according to lean principles or not. Furthermore, it is descriptive since the difficulties to the implementation of the lean construction management system were detailed, as well as the application and implementation guideline for the lean construction management system in AAHDC based on client, consultant, and contractor answers.

The research strategy includes a literature review as well as the use of structured questionnaires, which were shown to be the most effective method for reaching the study's study population in a short amount of time and from a distance. The purpose of the literature review was to extract the variables for the evaluation and to get a conceptual understanding of the issue.

The questionnaire is then created to know respondent profiles, current levels of awareness and practice of lean construction techniques, major challenges of implementing a lean construction management system, and potential benefits of implementing lean construction management in AAHDC, and it is then checked reliability and consistency were assessed using Cronbach's alpha coefficient.

Then the questionnaire was distributed to three groups: clients, contractors, and consultants, in order to obtain their feedback on the challenges of implementing a lean construction management system, as well as the current practice and awareness of lean construction management systems and their value in AAHDC.

Following that, Statistical Package for Social Sciences (SPSS) was used to do data analysis. The mean and frequency scores are the most common statistical approaches used in data analysis. In addition, to determine the rate of responses, the relative important index (RII) and

conventional statistical formula technique are employed. In general, this research design is displayed in figure 3.2.

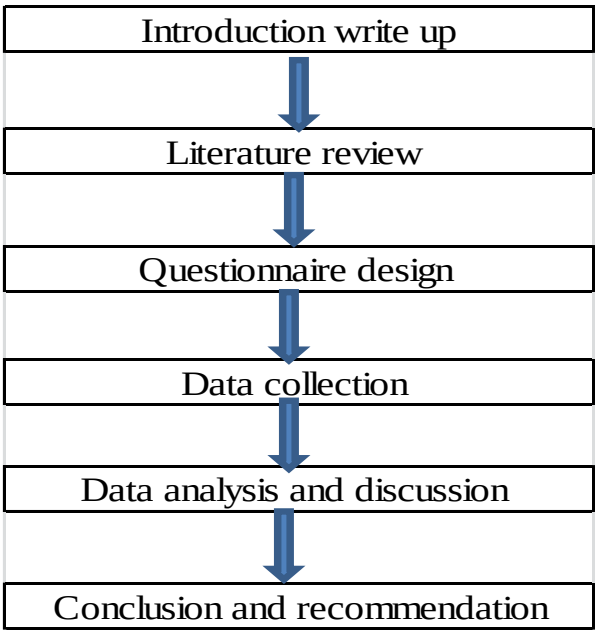


Figure 3.2 Research design

3.4 Data sources

Primary and secondary data sources were used in this investigation. Questionnaires were collected from clients, consultants, and contractors in order to identify implementation challenges of the lean construction management system in Addis Ababa housing development corporation (AAHDC) and to study the current practice and benefits of lean construction management systems in these projects.

The majority of the information gathered from questionnaire surveys is ordinal, and it is utilized to rank issues in order of importance in order to discover additional factors not identified in the literature study. Secondary sources, on the other hand, included books, references, journals, websites, newspapers, and other published documents related to the research subject, all of which needed to be reviewed in order for the study to be successful. The study's objectives were addressed using both quantitative data in terms of questionnaires and qualitative data in terms of archival documents review.

3.5 Study population

According to data collected about study population from AAHDC, 18 project locations are currently under construction. Clients, consultants, and contractors' professionals were considered at the branch level (project site) of AAHDC actively accessible during the study period. The study population is shown in table 3.1, table 3.2 and table 3.3.

Table 3.1 Study population of client

Project	Site location	Client					
		Position					
		Project manager	Director of construction & contract administration	Resident Engineer	Site Engineer	Office Engineer	Study populations
Project 1	Bola Bulibula	1	1	2	3	0	7
Project 2	Ayate(49 mazoria)	1	1	1	4	0	7
Project 3	Bola Beshala	1	1	2	2	0	6
Project 4	Ayate(49 mazoria)	1	1	2	3	0	7
Project 5	Ayatetsebel	1	1	1	2	0	5
Project 6	Hana furi	1	1	2	3	0	7
Project 7	Bola Arabisa	1	1	2	2	0	6
Project 8	KoyaFecha	1	1	3	3	0	8
Project 9	KoyaFecha	1	1	2	3	0	7
Project 10	KoyaFecha	1	1	3	3	1	9
Project 11	KoyaFecha	1	1	1	4	1	8
Project 12	Bola Arabisa	1	1	2	2	0	6
Project 13	Bola Arabisa	1	1	1	5	0	8
Project 14	Legehar	1	1	3	5	0	10
Project 15	Kolfa/Betel	1	1	1	2	0	5

Project 16	Tulu dimitu	1	1	0	1	0	3
Project 17	Head office	1	1	0	2	0	4
Project 18	Geremenadeb abay	1	1	2	4	1	9
Total sum		**18**	**18**	**30**	**53**	**3**	**122**

Table 3.2 Study population of consultant

Project	Site location	**Consultant**				
		Position				
		Project coordinator	Resident Engineer	Site Engineer	Office Engineer	Study populations
Project 1	Bola Bulibula	1	1	0	1	3
Project 2	Ayate(49 mazoria)	1	1	0	1	3
Project 3	Bola Beshala	1	1	0	1	3
Project 4	Ayate(49 mazoria)	1	1	0	1	3
Project 5	Ayatetsebel	1	1	0	1	3
Project 6	Hana furi	1	1	2	1	5
Project 7	Bola Arabisa	1	1	0	0	2
Project 8	KoyaFecha	1	1	0	0	2
Project 9	KoyaFecha	1	1	0	0	2
Project 10	KoyaFecha	1	1	2	1	5
Project 11	KoyaFecha	0	0	0	0	0
Project 12	Bola Arabisa	1	1	0	0	2
Project 13	Bola Arabisa	1	0	0	0	1
Project 14	Legehar	1	2	6	2	11
Project 15	Kolfa/Betel	1	3	9	2	15

Project 16	Tulu dimitu	0	0	0	0	0
Project 17	Head office	0	0	0	0	0
Project 18	Geremenadebabay	1	1	8	2	12
Total sum		**15**	**17**	**27**	**13**	**72**

Table 3.3 Study population of contractor

Project	Site location	**Contractor**					
		Position					
		Owner of organization	Project manager	Resident Engineer	Site Engineer	Office Engineer	Study populations
Project 1	Bola Bulibula	0	0	1	2	0	3
Project 2	Ayate(49 mazoria)	0	0	1	1	1	3
Project 3	Bola Beshala	0	0	1	1	1	3
Project 4	Ayate(49 mazoria)	0	0	1	2	0	3
Project 5	Ayatetsebel	0	0	1	0	0	1
Project 6	Hana furi	1	1	2	5	1	10
Project 7	Bola Arabisa	0	0	0	2	0	2
Project 8	KoyaFecha	0	0	0	0	0	0
Project 9	KoyaFecha	0	0	0	0	0	0
Project 10	KoyaFecha	7	5	2	6	1	21
Project 11	KoyaFecha	0	0	1	5	0	6
Project 12	Bola Arabisa	0	0	1	1	1	3
Project 13	Bola Arabisa	0	1	1	4	0	6
Project 14	Legehar	1	7	7	7	7	29

Project 15	Kolfa/Betel	2	5	7	3	5	22
Project 16	Tulu dimitu	0	0	0	0	0	0
Project 17	Head office	0	0	0	0	0	0
Project 18	Geremenadeb abay	3	5	5	6	1	20
Total sum		**14**	**24**	**31**	**45**	**18**	**132**

Table 3.4 Grand total number of study population

Total number of study population of client	122
Total number of study population of consultant	72
Total number of study population of contractor	132
Grand total number of study population	**326**

Source: filed surveys 2021

The study population consists of contractors, consultants, and clients who are presently working on an active chosen project site of the Addis Ababa housing development corporation and who meet the inclusion criteria. This research looks at the AAHDC developments from project 1 to project 18 branch sites. Such projects have not yet been finished, which was discovered to be a valid justification for choosing such branch projects in (AAHDC) for this study. Unfinished projects provide an excellent chance for researchers to gain access to clients, contractors, and consultants before they transfer the project and leave the site, allowing them to identify construction issues. Therefore, the total population of this research study is 326.

3.6 Inclusion and exclusion criteria

3.6.1 Inclusion criteria

During the research period, AAHDC included selected clients, consultants, and contractors' professionals at branch level (project sites), who are directly involved construction professionals in the project.

3.6.2 Exclusion criteria

At the time of data collection, due to the complexity of the issue and a lack of time to analyze within the scope of this study effort the Addis Ababa housing development corporation head office, other stakeholders, and small businesses were excluded.

3.7 Sample size determination and sampling procedures

3.7.1 Sample size determination

According to the AAHDC, 18 project sites are currently under construction. The overall population of the study was large, and due to time and budget constraints, studying all the populations was difficult. When choosing a sample size, great care is taken to ensure that the sample is as representative of the population as feasible. The sample size was calculated using equation 3.1 the sample size determination formula proposed by (41): -

$$n = \frac{Z^2 pqN}{e^2(N-1) + z^2 pq} \quad \text{..... Equation 3.1}$$

Where:

n= sample size required

N= population size

Z= the reading result from the Z chart is 1.96, and the degree of confidence is 95 percent

p = sample proportion

q = 1 – p

e = Sampling error which shows precision taken 5 percent.

After that, taking into account the population and confidence level, estimate the number of questionnaires to be delivered to respondents based on the response rate. As a result, the confidence level for this study is 95%, the associated Z-score is 1.96, and the sampling error is 5%. The constant value of the frequently used Z-score (where z=the statistical value for the confidence level employed) is provided in the table 3.5.

Table 3.5 Z-Scores for commonly used confidence interval

Desired confidence interval	Z- score
90%	1.645
95%	1.96
99%	2.576

$$n = \frac{1.96^2 * 0.5 * 0.5 * 326}{0.05^2(326 - 1) + 1.96^2 * 0.5 * 0.5} = 177$$

The population percentage (P) is calculated using a cautious value of 0.5 (41), and the population size (N) of chosen clients, consultants, and contractors' experts at the branch level (project site) of AAHDC actively available during this time is 326. By entering the values of these factors into the sample size determination algorithm above, and then calculating, the needed sample size is 177. The 177 questionnaires were assigned to respondents depending on their response rate at the Addis Ababa housing development corporation's active project site (branch office) personnel.

3.7.2 Sampling techniques

In this study, a simple random methodology was used to find possible respondents among clients, contractors, and consultants through referral networks in order to accurately answer to surveys. Random sampling or chance sampling are other terms for probability sampling. The implications of random sampling (or simply random sampling) are that it provides each element in the population an equal chance of getting into the sample; and that all selections are independent of one another and that it gives each potential sample combination an equal chance of being picked (42).

3.8 Data collection instruments and techniques

3.8.1 Questionnaires survey

A questionnaire is a research instrument consisting of a series of questions (or other types of prompts) for the purpose of gathering information from respondents through survey or statically study (43), the data for this study was gathered using this method.

These study questionnaires were constructed in the form of a Likert–scale type, with the lowest scale representing no importance and the highest scale representing very significance (44). This study questionnaire was designed under the supervision of advisor. The questionnaire has two parts: the first part of the questionnaire is describing the background information about organization and respondents.

The second part of the questionnaire is describing about lean construction management implementation challenges, degree of awareness, current practice and benefits. For each part, both open-ended and cloth ended questions are going to be used to extract the required data from respondents .In the cause of questionnaire measurements, these study questionnaires were used nominal, ordinal, interval and ratio methods. Then, the questionnaire was distributed to the client, consultant and contractor professionals.

3.9 Validity and reliability

One of the methods to test validity of a research is content validity, which refers to whether or not the content of the apparent variables (questionnaire) is right to measure the concept that the researcher is trying to measure (45).

The content validity of the questionnaire was addressed by obtaining the feedback from the advisor the study. The questionnaires have been reviewed by the advisor to evaluate the procedure of questions and the method of analyzing the results. The comments and concerns raised by the advisor during this review process have been acknowledged and incorporated to improve the questionnaire instrument for use in data collection stage. Finally it was agreed that the questionnaire was valid and suitable enough to measure the purpose that the questionnaire is designed for.

The quality of the data was ensured by creating a data extraction tool that included all the research variables. The questionnaire survey's reliability and consistency were assessed using Cronbach's alpha coefficient. Cronbach's alpha is a simple measure for determining a composite score's dependability, or internal consistency (46). Cronbach’s alpha varies from 0 to 1 and scores are expected to be 0.7 to 0.9. Below is a commonly accepted rule of thumb for interpreting Cronbach’s alpha is listed in table 3.6 (47).

Table 3.6 Cronbach's alpha range

Cronbach's alpha	Internal consistency
$\alpha \geq 0.9$	Very high consistency
$0.8 \leq \alpha < 0.9$	Good
$0.7 \leq \alpha < 0.8$	Acceptable
$\alpha < 0.7$	Poor internal consistency

3.10 Data analysis method

As a result, raw data had to be summarized, processed, and analyzed after data collection. In this study the collected data was analyzed using the statistical package for the social Sciences SPSS version 20 and Microsoft excel spreadsheet and relative important index to rank the level of awareness on lean construction management and to identify the potential benefits and challenges of implementing lean construction management. The processed data's output was then given in text form, tables, graphs, and basic percentages for additional interpretation and discussion (48).The mean, standard deviation, and frequency scores were the most important statistics generated during the data analysis. The five-point scale will be converted into a relative importance index for each of the variables that the respondents encountered problems and profits with. According to (49), Relative Importance Index (RII) is determined by the following equation 3.2 empirical formula was used for analysis:

$$RII = \frac{1n1+2n2+3n3+4n4+5n5}{A*N} \quad \text{..... Equation 3.2}$$

Where, n1 = number of respondents to Very low

n2 = number of respondents to Low

n3 = number of respondents for Neutral

n4 = number of respondents for High 4 =

n5= number of respondents for Very high

N= Total number of respondents.

A= heights weight = 5

$$\% = \frac{\alpha * 100}{\sum \mu} \text{.....Equation 3.3}$$

Where. α = numbers of times mentioned (respondent frequency)

∑ μ = total respondents (in this case 126 respondents)

3.11 Ethical consideration

Addis College's school of graduate studies granted ethical approval. A letter of collaboration was addressed to the management unit of the Addis Ababa housing development corporation. The confidentiality of the data was maintained throughout the investigation by removing names from the data extraction tool as a means of identification, and the tool was only utilized for the planned study. Except for the primary investigator, no one else had access to the data.

3.12 Dissemination of results

The study's findings are presented and submitted to Addis College's school of graduate studies in partial fulfillment of the master of construction technology and management degree requirements. The results will also be sent to the headquarters and branch offices of the AAHDC. In addition, the findings will be presented at scientific seminars and conferences, and will be published in peer-reviewed scientific publications if possible.

CHAPTER FOUR: RESEARCH ANALYSIS AND DISCUSSION

4.1 Introduction

This chapter deals with the analysis and discussion results of the questionnaire survey. Hence, this chapter is fundamentally focused on the analysis of data discussion and presentation of the research findings. In the beginning, the background information of respondents and the questionnaire response rate are presented. A total of 177 questionnaires were sent to respondents who were chosen at random, out of this questionnaire, 126 questionnaires were returned. Then, the questionnaire survey is checked for reliability using Cronbach's alpha coefficient. After checking the reliability, analyzed using the statistical package for social sciences (SPSS V20 for Windows) and rank identified the major challenges to implement the lean construction management system in Addis Ababa housing development corporation and rank the benefits of implementation of lean in the construction industry using relative importance index (RII). Tables and pie charts are used to make the presentation.

4.2 Reliability and consistency

The questionnaire survey's reliability and consistency were assessed using Cronbach's alpha coefficient. After calculating using SPSS, the reliability values for client, consultant, and contractor responses were 0.911. The questionnaire surveys are trustworthy or consistent since the -values are more than 0.9, which is the very high consistency. The value of scale reliability test is displayed in Table 4.1 below.

Table 4.1 Scale of reliability test

Dimensions	Cronbach's Alpha	N of Items
Overall scale reliability	0.911	39

Source: filed survey 2021

4.3 Questionnaire response rate

The questionnaire was created and delivered to three contractual parties, namely contractors, clients, and consultants, who are currently working on the 18 AAHDC sites. From the total of a total of 177 generated questionnaires; 48 questionnaires were delivered to contractors'

professionals, 51 questionnaires were distributed to consulting firms' professionals, and 78 questionnaires were distributed to clients' professionals working on active sites having in-person contact by going to all the project sites at random. However, 126 questionnaires were returned, while the remaining 43 questionnaires were not returned due to respondents' failure to complete the questionnaire on time or their negative attitude toward the research, and 8 questionnaires were rejected because the respondents' answers were incomplete and irrelevant to the analysis. The research used the rest of the questions. The return percentage of 70.85% indicates that a usable questionnaire has been discovered. The sample questionnaire may be found in the appendix section. The distribution and collecting of the questionnaires took one week, and the response rate is displayed in Table 4.2 below.

Table 4.2 Questionnaire response rate

Contractual Parties	Questionnaire distributed	Questionnaire responded	Response Rate
Contractor	48	34	70.83 %
Consultant	51	35	68.63 %
Client	78	57	73.08%
Total	177	126	70.85%

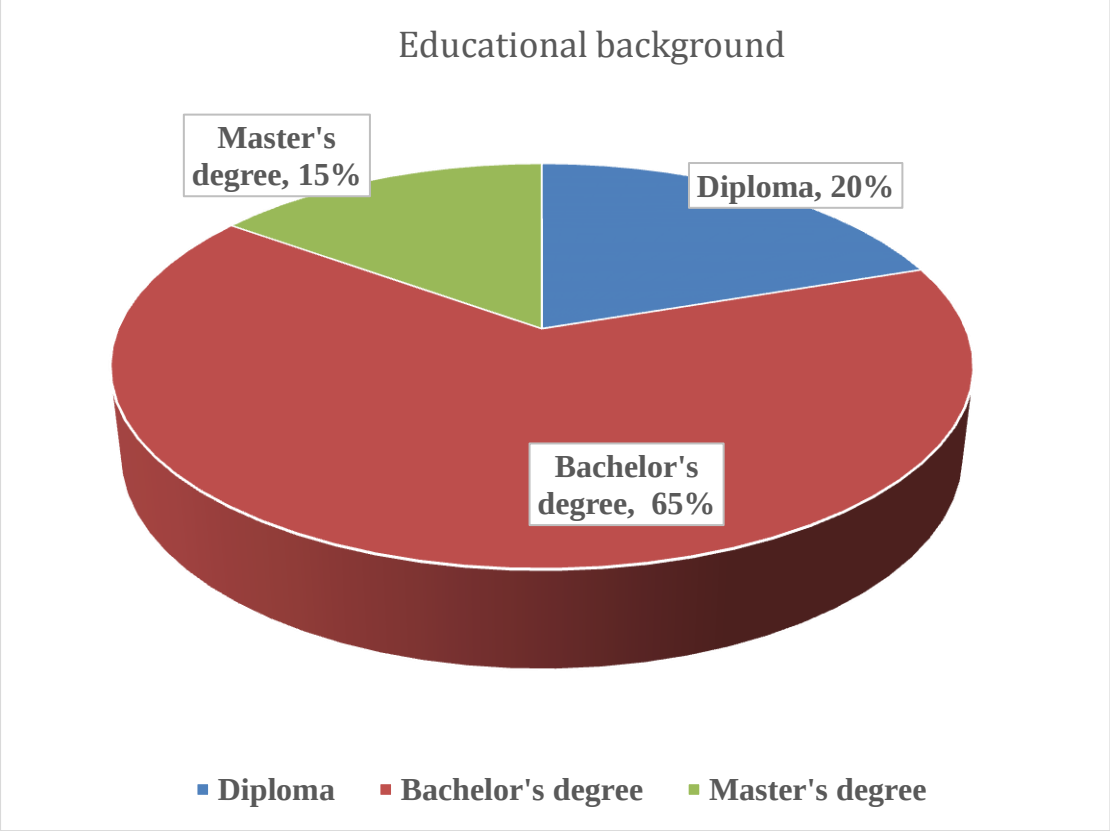
Source: filed survey 2021

4.4 Demographic background

This section describes that the characteristics of respondents (contractor, consultant, and client) who found in Addis Ababa housing development corporation actively participate and worked in this construction industry in terms of education, the position of the respondents in their company, work experience in the construction project and also condominium housing construction.

4.4.1 Educational background

This piece of background information aids in determining the respondents' educational level, allowing them to complete the questionnaire without difficulty.



Source: filed survey 2021

Figure 4.1 Educational background of the respondent

In terms of educational levels, 20 percent of contractors, consultants, and client respondents had a diploma, 65 percent had a bachelor's degree, and 15 percent had a master's degree.

4.4.2 Respondent's current position in the organization

As a result, in the table 4.3 and figure 4.2shown within the AAHDC projects, the proportions of owner of organization 2.4 percent, project managers 16.7 percent, resident engineer 23.8 percent, site engineer 33.3 percent, and office engineers 23.8 percent who responded to the questionnaire, this means site engineers, resident engineer and office engineers made up the majority of the responders.

As a result, the questionnaire responses' reliability was approved since it aids the study's accuracy in the event of their scope of work being on the site; and they have specific experience and competence.

Table 4.3 Respondent's position in the organization

Current position in the organization	Frequency	Percent
Owner of organization	3	2.4%
Project manager	21	16.7%
Resident Engineer	30	23.8%
Site Engineer	42	33.3%
Office Engineer	30	23.8%
Total	126	100.0%

Source: filed survey 2021

4.4.3 Years of experience in construction projects & condominium housing

Source: filed survey 2021

Figure 4.2 Years of experience in construction projects& in condominium housing

According to the result, 16.7 percent of respondents have 1-5 years of experience in construction projects, 20.6 percent have 6-10 years of experience, 29.4 percent have 11-15 years of experience, 25.4 percent have 16-20 years of experience, and 7.9 percent have 16-20 years of experience. Out of the total years of experience of the respondents, 31.7 percent have 1-5 years of experience, 52.4 percent have 6-10 years of experience, and 15.9 percent have 11-15 years of experience in condominium housing construction. However, no responders with 16-20 years of experience or more than 20 years of experience in condominium building development were found.

4.5 Analysis of the current level of awareness & practice of lean construction tools

The questions in this part are intended to provide a general overview of the present degree of awareness and use of lean construction techniques at the Addis Ababa housing development corporation's project site. On the topics of not familiar with, familiar with but not currently implemented and familiar with and implemented, respondents were asked to rate the level of familiarity and express their agreement or disagreement. With the accompanying theory, this approach is utilized to assess the level of awareness and application of lean construction practices in AAHDC projects. As seen in figure 4.3 below, the professional's reaction was as follows:

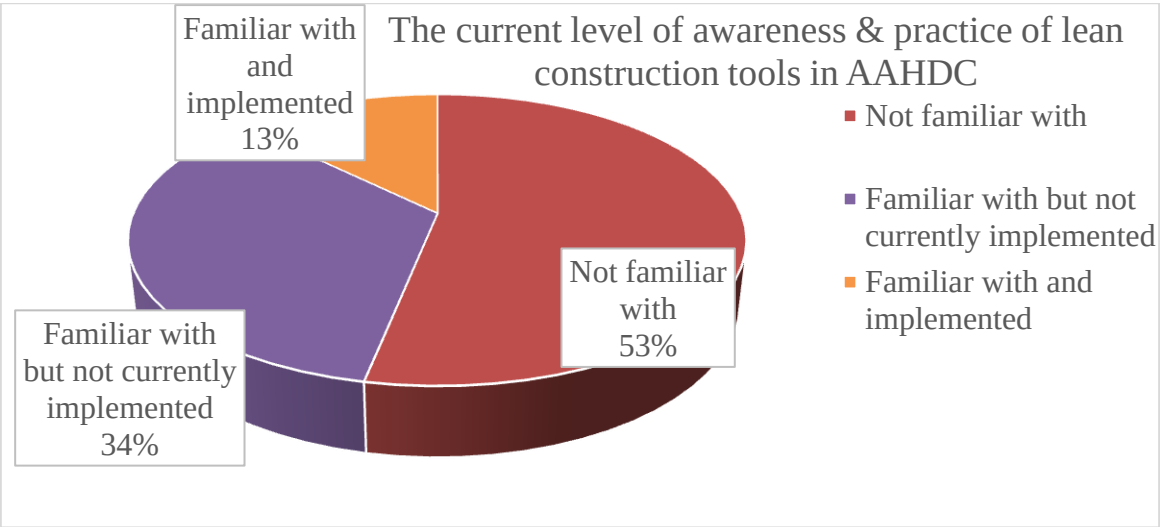


Figure 4.3 The current level of awareness & practice of lean construction tools in AAHDC

According to the output of SPSS V.20 software, according to the professional's response as indicated in the above figure 4.3, 13 percent of respondents are familiar with lean construction practices and are using them in their projects, 34 percent of respondents are familiar with lean construction practices but have not yet implemented them in their projects and 53 percent of the respondents are not familiar with any lean construction practices. This study's findings are connected to the current degree of lean construction awareness and practice at AAHDC project sites, where most of the time the lean construction management system is unfamiliar, and the implementation process is not official. So the results obtained are consistent with previous studies that the adoption of lean/techniques in the construction industry is taking a time.

According to study (28) and according to (26) there is a limited degree of knowledge of lean construction among Ghanaian construction practitioners, and just a few lean approaches such as "just-in-time" and "prefabricated components" have been applied in Ghanaian building projects. And also, (27) study stated that there are only two out of the 10 respondents who have heard about lean construction, which explained a low level of familiarity with lean construction among practitioners in Nigeria.

Later studies by (31) in Turkey, and (8) in Ethiopia, indicated a low level of awareness of lean construction techniques among practitioners in the construction industries of the countries. (32) Reported that 3 out of 4 practitioners do not know about lean construction practices, and this situation was blamed on lack of knowledge, education, and communication on the importance of the lean concept. The degree of knowledge of lean thinking is improving, but there is a comparably low level of implementation among construction companies, according to research conducted by (29) in five cities from Nigeria's five geopolitical zones. As stated in the literature section, the majority of the implementation of lean construction management systems has a negative impact on the success of construction projects due to improper lean construction management. As a result, may conclude that some issues encountered in Addis Ababa housing development corporation projects are due to the stakeholders' failure to adequately or formally implement lean construction management systems, namely the client, contractors, and consultants. As a result, the key challenges to formalizing the application of lean construction management systems/tools in AAHDC projects were discovered in this study.

4.6 Level of use of tools that support the implementation of lean construction

Even though it has been shown that lean construction techniques/tools are critical for obtaining positive outcomes, it is critical to comprehend the various degrees of application of these approaches. Table 4.4 and figure 4.4 illustrates how frequently certain lean techniques/tools are used at the current project site of Addis Ababa's housing development corporation.

The replies were compared for similarity and the number of times they were stated by respondents. As a result, the analysis is carried out using the basic statistical formula by considering 13 percent (16 respondents) from total of 126 respondents because they are familiar with lean construction and implemented. The responses of respondents to the question of which type of lean management technique/tools have you used were provided.

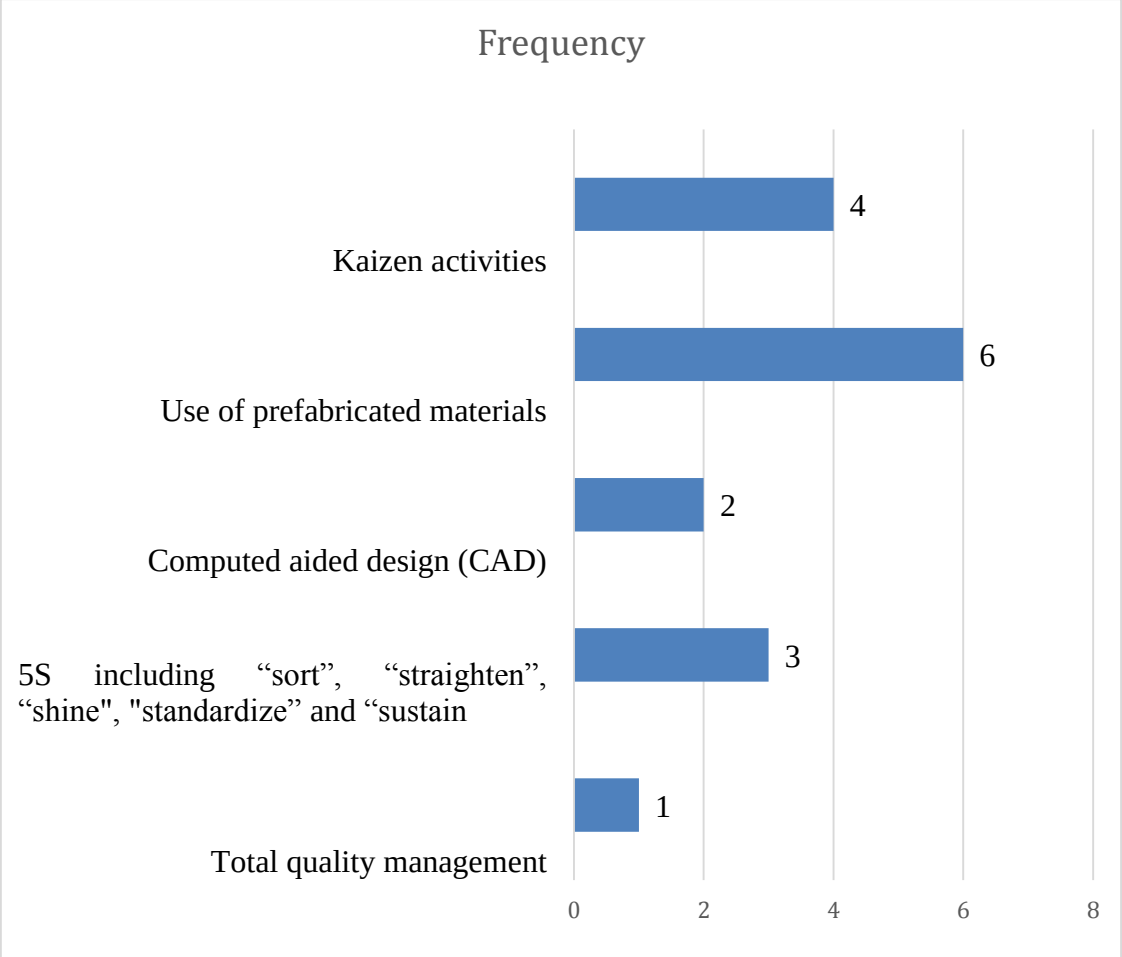


Figure 4.4 Level of use of the technologies that support the implementation of lean

Table 4.4 Level of use technologies that support the implementation of lean

Technique/tools	Respondent frequency	Percent (%)	Rank
Use of prefabricated materials	6	37.5%	1
Kaizen activities	4	25%	2
5S including “sort”, “straighten”, “shine", "standardize” and “sustain	3	18.8%	3
Computed aided design (CAD)	2	12.5%	4
Total quality management	1	6.3%	5

As a result, a conventional statistical formula was used to determine that five tools/techniques are crucial for enabling the implementation of lean construction in the construction industry at the AAHDC project sites, based on responder frequency. According to the result, certain approaches are already being used by respondents, such as the usage of prefabricated materials (37.5 percent), kaizen activities (25 percent), 5S including “sort”, “straighten”, “shine", "standardize” and “sustain(18.8 percent), computer assisted design (CAD) 12.5 percent), and total quality management(6.3 percent).

Therefore, respondents utilize those 5 tools/techniques often, making them critical for supporting the implementation of lean construction in the AAHDC construction projects. Furthermore, their awareness of techniques such as the use of prefabricated materials is expected, as many construction firms, particularly in the housing sector, use prefabricated beams on site for the concrete slab of condominium house construction, and this was known even before the AAHDC construction industry adopted the lean construction approach.

4.7Analysis of the major challenges of implementing a lean construction management

The findings of the questionnaire survey, which outlined the major challenges of implementing a lean construction management system at the Addis Ababa Housing Development Corporation, were listed in table 4.5.

Table 4.5 Major challenges of implementing a lean construction in the AAHDC

S. N	The major challenges of implementing a lean construction management system are:-	Frequencies of respondents					RII	Rank
		1	2	3	4	5		
1	Lack of adequate lean awareness and understanding	2	4	4	39	77	0.894	1
2	Lack of knowledge and skill	2	4	8	40	72	0.879	2
3	Insufficient training for workers	4	7	11	39	65	0.844	3
4	The lack of support from top management	5	8	13	38	62	0.829	4
5	Lack of management commitments	5	8	17	41	55	0.811	5
6	Culture & human attitudes	5	10	19	45	47	0.789	6
7	Management resistance to change	6	14	22	44	40	0.756	7
8	Employees' resistance	7	15	26	46	32	0.729	8
9	Lack of standard	9	21	27	43	26	0.689	9
10	Lack of good policies	10	23	26	43	24	0.676	10
11	Lack of sufficient support across the project team	10	25	26	43	22	0.667	11
12	Lack of industry support/understanding of lean	13	28	28	36	21	0.638	12
13	Inadequate administration of the necessary information to generate a learning cycle and take corrective actions	16	29	29	34	18	0.614	13
14	The lack of involvement and transparency among stakeholders	21	31	26	35	13	0.581	14
15	Lack of a long-term philosophy and planning	25	29	28	32	12	0.563	15
16	Poor organization knowledge among others	32	35	27	24	8	0.506	16
17	Complexity of lean construction process,	35	37	28	21	5	0.479	17

18	Lack of incentives and motivation and poor professional wages	38	42	26	17	3	0.449	18
19	Lack of applying the concept of design constructability	42	43	25	14	2	0.427	19
20	Inaccurate and incomplete designs	45	47	23	10	1	0.402	20
21	Lack of adequate understanding of lean	52	48	20	5	1	0.37	21

Source: filed survey 2021

The results of the analysis of 126 returned responses about major challenges of implementing a lean construction management system in the AAHDC are shown in Table 4.5. The first major dominated challenge of implementing a lean construction management system in the project sites is a lack of adequate lean awareness and understanding (RII = 0.894). Lack of knowledge and skill (RII = 0.879), insufficient training for workers (RII = 0.844), lack of support from top management (RII = 0.829), and lack of management commitments (RII = 0.811) are the second, third, fourth, and fifth most critical problems, respectively. The table above show the other challenges, which range from six to twenty-one in rank, to implement lean construction.

According to the (38) research, the significant problems are those with a frequency of more than 50% of the three barriers reported. From these three challenges, 283 respondents chose lack of understanding regarding lean construction practices, indicating the greatest frequency of replies (85.8 percent); followed by untrained human resources, which was chosen by 222 respondents, indicating the second-highest number of responses (67.3 percent). The third challenge was related to a lack of financial resources, which was chosen by 187 respondents, with a frequency of 56.7 percent. Meanwhile, time and commercial pressure, as well as fragmentation and subcontracting, received the least number of replies (41.5 percent and 35.2% respectively).These three issues (lack of knowledge regarding lean construction techniques, untrained human resources, and limited financial resources) appear to be of primary concern to Moroccan construction professionals and require organizational attention. In addition to the questions above, respondents' responses reveal their views on how the workers reacted to the change.

Workers have gaps in their knowledge of lean management so, the majority of workers do not respond positively to change. In addition, respondents' responses provide their thoughts on whether the firm has attempted to address these issues. According to some responses, a firm attempted to address these issues by addressing a lack of appropriate understanding of lean by providing training on the tools, such as Kaizen activities interims of reducing wastage and cooperating with one another. The remaining members of the sample felt that a firm attempted to address these issues by bringing all employees together and encouraging excellent work practices.

4.8 Analysis of the benefits coming from implementing lean construction management

In the analysis of the benefits coming from implementing lean construction management is by considering 47 percent from the total of 126 respondents or take 59 respondents, which means 13 percent (16 respondents) are familiar with lean construction and implemented and 34 percent (43respondent) are familiar with lean construction but not currently implemented. The results of the analysis of 59 returned responses reducing waste from project activities (RII =0.427), improving project quality within proper cost and time (RII = 0.3968), creating a smooth workflow without waste (RII = 0.3921), increasing profit and market share (RII = 0.3778), and delivering projects on time or ahead of schedule (RII = 0.3651) are the five highest ranked benefits. Other advantages, such as the 6 to 11 rank of benefits are listed in the table 4.6 below.

Table 4.6 Frequencies of respondents and ranked benefits of lean construction

benefits coming from using of implementing lean construction management	Frequencies of respondents					RII	Rank
	1	2	3	4	5		
Reducing waste from the project activities	2	0	0	18	39	0.427	1
Improving the project quality within proper cost and time	2	2	5	21	29	0.3968	2
Creating a smooth workflow without	3	2	3	24	27	0.3921	3

waste							
Increasing profit and market share	3	3	7	22	24	0.3778	4
Delivering projects on time or in some cases ahead of schedule	4	5	9	16	25	0.3651	5
Quality control	6	7	10	15	21	0.3413	6
Achieving performance excellence & quality awards	7	8	9	15	20	0.3333	7
Improving relations with vendors and improving customer satisfaction	10	11	10	12	16	0.3019	8
Increasing team empowerment and improving safety and workers morale	7	15	10	15	12	0.2968	9
Having lean as a competitive advantage	9	16	10	13	11	0.2825	10
Top Management Commitment and Support	11	18	14	11	5	0.2508	11

Generally, these findings agreed with the results of many studies; (8) study respondents were asked to rate the expected benefits and potential barriers as a result of implementing lean construction in Ethiopian construction industry. The response revealed that greater productivity (89%), improved sustainability/reduced waste (87%), great customer satisfaction (85%), reduced project schedule (77%) and high quality construction (75%) are the top five expected benefits that Ethiopian construction industry by implementing lean construction. (28) concluded in his study of assessing the benefits of adopting lean construction in Abu Dhabi that this philosophy could bring several improvements such as achieving performance excellence and quality awards, improving safety and worker satisfaction and delivering projects without schedule delay, the result of (33) study also classified quality improvement, better health, and safety record, and reduced construction time as key benefits obtained through implementing lean construction principles in the Saudi Arabian construction industry and (50) (51) also pointed out that lean construction can bring revolutionary changes and great benefits on the three dimensions of sustainable development (environment, economy, and society).

CHAPTER FIVE: CONCLUSION AND RECOMMENDATION

Based on the research result and review of relevant literature, this chapter describes the conclusion and recommendation part of the study.

5.1 Conclusion

Lean construction is a relatively recent idea in the construction industry that attempts to improve the efficiency of construction. The goal of this study was to determine the major challenges of implementing a lean construction management system in the Addis Ababa housing development corporation project in Addis Ababa, as well as the current level of awareness and practice of lean construction tools that support lean construction implementation and the benefits of lean construction in the AAHDC project.

The report will also provide recommendations for future deployment and research to make the lean construction management system more successful. Following the questionnaire survey, a total of 126 valid replies were gathered from the contractors, consultants, and clients presently engaged on the project, out of 177 questionnaires issued.

The following is a summary of the research findings:

- According to the results of the SPSS V.20 software analysis of the professional's responses related to the current level of awareness and practice of lean construction techniques, 13 percent of respondents are familiar with lean construction practices and are using them in their projects, 34 percent are familiar with construction practices but have not yet implemented them in their projects, and 53 percent of the respondents are not familiar with any lean construction practices. Most of the time, the lean construction management system is not familiar and there is no formal implementation procedure at the AAHDC project sites, according to the findings of this study.
- In terms of techniques/tools, those who are lean tools are already using them, such as prefabricated materials (37.5 percent), kaizen activities (25 percent), 5S including "sort", "straighten", "shine", "standardize" and "sustain (18.8 percent), computer assisted design (CAD) 12.5 percent), and total quality management(6.3

percent). Respondents utilize these five tools/techniques often, making them critical for supporting the adoption of lean construction in the construction sector at the AAHDC.

- The AAHDC construction practitioners recognize reducing waste from project activities (RII =0.427), improving project quality within proper cost and time (RII = 0.3968), creating a smooth workflow without waste (RII = 0.3921), increasing profit and market share (RII = 0.3778), and delivering projects on time or ahead of schedule (RII = 0.3651)as potential benefits of implementing lean construction management.
- According to the results, Lack of adequate lean awareness and understanding (RII = 0.894), lack of knowledge and skill (RII = 0.879), insufficient worker training (RII = 0.844), lack of top management support (RII = 0.829), and lack of management commitments (RII = 0.829) are the five major and dominated challenges of implementing a lean construction management system on the Addis Ababa Housing Development Corporation.

Finally, at the time of this study's conclusion, most of professionals are no familiar with lean construction management system in the case of Addis Ababa housing development corporation projects, and they are not using a formal lean management system as a management tool, so a lean construction management system is not successfully implemented in the AAHDC project sites due to the five major challenges to implementation lean construction management system, which include a lack of adequate lean awareness and understanding, a lack of knowledge and skill, insufficient training for workers, the lack of support from top management and lack of management commitments. The significance of this study is to provide project owners, contractors, consultants, vendors, and the government with a clear picture of the level of lean construction implementation in the housing construction industry, as well as an exploration of the major challenges to implementation, tools that support lean construction implementation, and benefits of lean construction in the AAHDC project and fill the gabs.

5.2 Recommendation

On above results, the study made the following recommendations to the relevant bodies in order to make the lean construction management system more successful.

- The lean construction management approach needs sacrifice in order to adapt, so the project office will be anticipating such scarification in order to effectively apply the lean construction management system in the project.
- As a consequence of the findings of this study related to challenges, there is a greater need for training programs to guarantee that all parties engaged in AAHDC building projects have the necessary skills and knowledge to properly implement the lean construction management system.
- Companies and researchers in the Ethiopian construction industry concentrate their efforts, knowledge, and resources on the critical issues in order to help develop appropriate strategies to address the following challenges: a lack of adequate lean awareness and understanding, a lack of knowledge and skill, insufficient worker training, a lack of top-level support and a lack of management commitments.
- Knowing the advantages of lean construction can help construction organizations implement the idea as part of their policies and culture in project delivery, and construction shareholders should hire specialists who are familiar with the lean construction management system.
- Another recommendation based on the findings related to awareness and practice is that government legislation enforcing the use of the lean construction approach on public and large projects, as well as sufficient monitoring and enforcement, is necessary.
- This research will assist construction company executives in deciding whether to implement the lean technique.

In general, all project stockholders should coordinate their efforts to ensure timely delivery of houses and the long-term viability of the housing program by formalizing the implementation of a lean construction management system and reducing time and cost overruns to the client, contractor, and end-users.

5.3 Recommendations for further studies

The goal of this study was to identify the key challenges that the Addis Ababa housing development corporation faced in implementing a lean construction management system, the current level of awareness and practice and the benefits of lean construction in the AAHDC project.

The study was performed with experts working in AAHDC project sites for specific times. So, in comparison to local and other countries construction companies participating in the Ethiopian construction industry, more research can be done to determine the results of such major challenges to implement, tools that support the implementation of lean construction, and benefits of lean construction in the AAHDC project. Other approaches, including as interviews, meetings, seminars, and observations, can be used to achieve more representative results.

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APPENDIX

APPENDIX A: Questionnaire

Date _____

To: _____

Dear Respondent,

Greetings!

At present, I am working on research entitled "implementation challenges of lean construction management system in Addis Ababa housing development corporation (AAHDC)" for the partial fulfillment of the requirements for the degree of Master of Science (MSc) in Construction Technology and Management at Addis College, department of construction management and technology. The main objective of this research is to identify the challenge to the implementation of a lean construction management system in the AAHDC.

We see you as a professional with vast experience in the construction industry. We request you to kindly fill up this questionnaire, which will be of enormous help in our study. To save your precious time all questions are framed in multiple-choice formats and some technical writing questions. Kindly place a tick sign (√) in the relevant box and write your valuable answer in the given space. The legend is provided with the questionnaire for your convenience. We assure you, this study is only intended for academic purposes and the confidentiality of your response is guaranteed. Please, fill out this questionnaire and return it as soon as possible, but we would respectfully ask you to do it within one week.

With Regards,

Note: Please consider each question in terms of your organization's experience and your knowledge of lean construction

If you have any difficulties, please do not hesitate to contact me via email/ phone

Phone no.: -09-10-88-71-54 or E-mail: -Abinetsebsibe92@gmail.com

Part 1Background information about organization and participants

1. What is the name of the Project Site?

_____

2. What is the type of organization you are working in now? (Please tick as appropriate).

□Client □Consultant □Contractor

3. Name of your organization (Optional)

_____

_____

4. What is the highest level of education you have completed?

□ Diploma □ Bachelor's degree □ Master's degree

if other, please specify_____

5. What is your position in the organization? (Please tick as appropriate).

□Owner of organization □Project manager □Resident Engineer
□Site Engineer □Office Engineer

□Other, _____

_____

6. What is your work experience in construction projects? (Please tick as appropriate).

□1-5Year □6-10Year □ 11-15 Year □ 16-20 Year □ above 20year

7. What is your work experience in condominium housing construction? (Please tick as appropriate).

□1-5Year □ 6-10Year □ 11-15 Year □16-20 Year □Above

Part 2 About Lean Construction Management

1. What is the current level of awareness and practice of lean construction techniques in Addis Ababa Housing Development Corporation? (Please tick as appropriate).

☐Not familiar with ☐ Familiar with but not currently implemented

☐Familiar with and implemented

2. If your answer for question no. 1 is familiar with and implemented please specify which type of lean management technique/tools have you implemented, (Please tick as appropriate).

☐ Value Stream mapping ☐Computed aided design (CAD)

☐Preventative maintenance ☐Safety improvement program

☐Continuous improvement program ☐Use of prefabricated materials

☐Total quality management ☐ Daily huddle meetings

☐Visual inspection ☐Kaizen activities

☐ 5S including “sort”, “straighten”, “shine", "standardize” and “sustain

Please specify if there are any other types of lean management technique/tools have you implemented

_____

_____

3. Which of the following are the major challenges of implementing a lean construction management system in the Addis Ababa housing development Corporation? Please rate by tick where appropriate based on a five-point Likert scale (1 = Very low, 2 = Low, 3 = Neutral, 4 = High 5 = Very high).

No	The major challenges of implementing a lean construction management system are:-	1	2	3	4	5

1	The lack of support from top management					
2	Insufficient training for workers					
3	Lack of adequate lean awareness and understanding					
4	Inadequate administration of the necessary information to generate a learning cycle and take corrective actions					
5	The lack of involvement and transparency among stakeholders					
6	Lack of a long-term philosophy and planning					
7	Management resistance to change					
8	Lack of incentives and motivation and poor professional wages					
9	Inaccurate and incomplete designs					
10	Lack of applying the concept of design constructability					
11	Lack of good policies					
12	Complexity of lean construction process,					
13	Poor organization knowledge among others					
14	Lack of knowledge and skill					
15	Lack of industry support/understanding of lean					
16	Lack of sufficient support across the project team					
17	Employee's resistance					
18	Lack of standard					
19	Lack of adequate understanding of lean					
20	Culture & human attitudes					
21	Lack of management commitments					

4. Please explain as thoroughly as possible the challenges that your company (has) faced during the process of implementing lean management techniques and tools

_____

_____

5. What made the company decide to implement a lean construction management system?

_____

_____

6. How did the workers respond to the change?

_____

_____

7. Has it been difficult to maintain lean? If yes, in what ways? Please elaborate

_____

_____

8. Has the company tried to solve these challenges? If yes, in what ways has the company tried to solve these challenges?

_____

_____

9. Please level of benefits coming from using of implementing lean construction management in the Addis Ababa housing development Corporation? Please rate by tick where appropriate based on a five-point Likert scale (1 = Very low, 2 = Low, 3 = Neutral, 4 = High 5 = Very high).

No	benefits coming from using of implementing lean construction management	1	2	3	4	5
1	Creating a smooth workflow without waste					
2	Improving the project quality within proper cost and time					

3	Reducing waste from the project activities					
4	Achieving performance excellence & quality awards					
5	Delivering projects on time or in some cases ahead of schedule					
6	Increasing profit and market share					
7	Having lean as a competitive advantage					
8	Increasing team empowerment and improving safety and workers morale					
9	Improving relations with vendors and improving customer satisfaction					
10	Quality control					
11	Top Management Commitment and Support					

Please specify if any other benefits are coming from using of implementing lean construction management in the Addis Ababa housing development Corporation.

_____

_____

Thank you!

APPENDIX B: Statistical package for social sciences (SPSS) output

The major challenges of implementing a lean construction management system

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
The lack of support from top management	126	1.00	5.00	4.1429	1.09336
Insufficient training for workers	126	1.00	5.00	4.2063	1.03782
Lack of adequate lean awareness and understanding	126	1.00	5.00	4.4683	.83605
Inadequate administration of the necessary information to generate a learning cycle and take corrective actions	126	1.00	5.00	3.0714	1.25971
The lack of involvement and transparency among stakeholders	126	1.00	5.00	2.9048	1.26762
Lack of a long-term philosophy and planning	126	1.00	5.00	2.8175	1.28000
Management resistance to change	126	1.00	5.00	3.7778	1.15162
Lack of incentives and motivation and poor professional wages	126	1.00	5.00	2.2460	1.10045
Inaccurate and incomplete designs	126	1.00	5.00	2.0079	.96744
Lack of applying the concept of design constructability	126	1.00	5.00	2.1349	1.05340
Lack of good policies	126	1.00	5.00	3.3810	1.21232
Complexity of lean construction process,	126	1.00	5.00	2.3968	1.17357
Poor organization knowledge among others	126	1.00	5.00	2.5317	1.23733

Lack of knowledge and skill	126	1.00	5.00	4.3968	.86791
Lack of industry support/understanding of lean	126	1.00	5.00	3.1905	1.25037
Lack of sufficient support across the project team	126	1.00	5.00	3.3333	1.20665
Employee's resistance	126	1.00	5.00	3.6429	1.14866
Lack of standard	126	1.00	5.00	3.4444	1.19703
Lack of adequate understanding of lean	126	1.00	5.00	1.8492	.88605
Culture & human attitudes	126	1.00	5.00	3.9365	1.10812
Lack of management commitments	126	1.00	5.00	4.0556	1.09036
Valid N (list wise)	126				

Benefits coming from using of implementing lean construction management descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Creating a smooth workflow without waste	16	2.00	5.00	4.2500	.85635
Improving the project quality within proper cost and time	16	2.00	5.00	4.1250	.88506
Reducing waste from the project activities	16	4.00	5.00	4.8125	.40311
Achieving performance excellence & quality awards	16	1.00	5.00	3.7500	1.34164

Delivering projects on time or in some cases ahead of schedule	16	1.00	5.00	3.8750	1.25831
Increasing profit and market share	16	2.00	5.00	4.0000	1.09545
Having lean as a competitive advantage	16	1.00	5.00	3.1250	1.25831
Increasing team empowerment and improving safety and workers morale	16	1.00	5.00	3.2500	1.23828
Improving relations with vendors and improving customer satisfaction	16	1.00	5.00	3.5000	1.46059
Quality control	16	1.00	5.00	3.7500	1.34164
Top Management Commitment and Support	16	1.00	4.00	2.3750	.88506