

ADDIS ABABA UNIVERSITY

COLLEGE OF BUSINESS AND ECONOMICS

SCHOOL OF COMMERCE

GRADUATE STUDIES PROGRAM

DEPARTMENT OF PROJECT MANAGEMENT

Analysis of the Causes of Change Orders and their Impact on Project Budget and Timeline (A case study of the Federal Housing Corporation Construction Projects)

By: Seyoum Chafamo

Advisor: Teklegiorgis Assefa (PhD)

A Thesis Submitted to the Graduate Program in Partial Fulfillment of the Requirements for the Award of Master of Arts Degree in Project Management

July, 2026
Addis Ababa, Ethiopia

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Declaration

I, Seyoum Chafamo, have carried out independently a research work on the topic entitled “Analysis of the Causes of Change Orders and their Impact on Project Budget and Timeline. A case study of the Federal Housing Corporation Construction Projects” in partial fulfillment of the requirement for the Degree of Master of art in Project Management with the guidance and supervision of the research advisor Teklegiorgis Assefa (PhD). This study is my own work that has not been submitted for any degree or Master program in this or any other institutions to the best of my knowledge.

Seyoum Chafamo

Signature: _____

Date: July, 2026

Addis Ababa, Ethiopia

Endorsement

This is to certify that Seyoum Chafamo has carried out this research work on the topic entitled “Analysis of the Causes of Change Orders and their Impact on Project Budget and Timeline”, a case study of the Federal Housing Corporation Construction Projects in Addis Ababa under my supervision. This work is original in nature and it is sufficient for submission for the partial fulfillment for the award of Degree of Master of Art in Project and Management.

Teklegiorgis Assefa (PhD)

Signature: _____

Date: _____

Addis Ababa University School of Commerce

Graduate Program

Thesis for MA in Project Management

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By: Seyoum Chafamo

Approved By Board of Examiners

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Table of Contents

CHAPTER ONE 1
INTRODUCTION 1
1.1 Background of the Study 1
1.2 Construction Project Management in Ethiopia 1
1.3 Federal Housing Corporation (FHC) the Case Organization 2
1.4 Statement of the Problem 3
1.5 Research Questions 4
1.6 Objective of the Study 4
1.6.1 General objectives of the study 4
1.6.2 Specific objectives of the study 4
1.7. Significance of the Study 5
1.8. Scope and Delimitations of the Study 5
1.9 Limitations of the Study 5
1.10 Definition of the Key Terms 6
1.11 Organization of the Research 6
CHAPTER TWO 7
LITERATURE REVIEW 7
2.1 Theoretical Concepts 7
2.1.1 Changes and Change Management Theories 7
2.1.2 Factors Causes Change in Construction Projects 9
2.1.3 The Impact of Change in Construction Projects 10
2.1.4 Project Change Management Process 11
2.2 The Empirical Studies Review of Changes 15
2.2.1 Change Orders Experience in Ethiopian Construction Industry 15
2.3. Summary of Literature Review 17
2.4. Conceptual Framework 18
CHAPTER THREE 19
RESEARCH METHODOLOGY 19
3.1 Introduction 19
3.2 The Research Design and Approach 19

3.3 Target Population, Sample Size and Sampling Technique 19
3.4 Data Type and Collection Method 20
3.5 Data Analysis and Presentation 20
3.6 Validity and Reliability Analysis 21
3.7 Ethical Consideration 21
CHAPTER FOUR 22
DATA ANALYSIS, DISCUSSION AND INTERPRETATION 22
4.1 Introduction 22
4.1 Response Rate of Respondents 22
4.2. Demographic Characteristics 23
4.3. Causes of the Change orders 25
4.3.1. Ranking and RII Computation 25
4.5 Impact of the change orders 27
4.5.1 The Relationship between Variables 28
4.6 The Current Statuses of FHC Projects 33
4.7 Change management strategies 37
4.8 Major Findings of the Analysis 39
CHAPTER FIVE 42
CONCLUSION & RECOMMENDATIONS 42
5.1. Conclusions 42
5.2 Recommendation 43
5.3Suggestions for further study and limitations 44
References 45

List of tables

Table 3.1 Test of Reliability for Measuring Scale…….....20
Table 4.1 Analysis of Response Rate……..……..21
Table 4.2 Characteristics of the Respondents ……...22
Table 4.3 Top ten factors for the causes of changes of FHC projects…….....25
Table 4.4 Average mean score and RII of stakeholders' factors of change orders……...25
Table 4.5: Mean and RII of the effects in FHC projects by change order…….....26
Table 4.6 Mean and standard deviation of Dependent and Independent Variables……..27
Table 4.7 Correlation analysis..…….28
Table 4.8 Multiple Regression Model Summary……...31
Table 4.9 ANOVA test assumption…….…..32
Table 4.10 Selected FHC housing projects and their statuses…….…..34
Table 4.11 Ranking of change control strategies..…….....36

List of figures

Figure 2.1 The conceptual relationship between dependent and independent variables…….……..…..17
Figure 4.1 Histogram of Regression Standardized Residual…….....30
Figure 4.2 Normal P-P Plot of Regression Standardized Residual…….…….31

Abbreviations and Acronyms

BIM------Building Information Modeling

CCCC----Chain Communication Construction Company

CII------Construction Industry Institute

CPM----- Construction Project Management

DBB-----Design-Bid Build

FHC----- Federal Housing Corporation

GDP-----Gross Domestic Product

MS ------Mean Score

PMI----- Project Management Institute

RII -------Relative Importance Index

RHA---- Rental Housing Agency

USD-----United States Dollar

Abstract

A change is any deviation from an agreed upon well-defined scope and schedule. It is any modification to the contractual guidance provided to the contractor by the owner or owner's representative. Changes in construction projects are very common and likely to occur from different sources, by various causes, at any stage of a project, and may have considerable negative impacts on items such as costs and schedule delays. The purpose of this study is to analyze the causes, effect and mitigation strategies in Federal Housing Corporation (FHC) construction projects. Descriptive and explanatory research design and analysis methods were used through quantitative as well as qualitative research approaches. FHC housing construction projects participants were the sources of data and purposive sampling technique were used to collect data through questionnaires, interview and thorough document reviews. Five point Likert scale questionnaire was distributed for 65 respondents and 57 was returned and analyzed using Statistical Package for Social Science (SPSS) software and Microsoft excel. Based on the analysis, materials price fluctuations from external factors with RII of 0.85, change of design modification by owner with RII of 0.83 and work changes by client such as addition, omission and alterations of works with RII of 0.82 were considered as major causes of change orders and in terms of origin of the causes, owner related causes stand as a primary source of causes. Using RII and Mean score ranking methods, the delay of time and cost overrun were highly affected factors by an average of 123% time delay and 62.8% of cost overrun. Understanding of scope and schedule of change work, proper use of work breakdown structure (WBS), effective leadership skill, and identifying potential areas of changes risks are the most strongly agreed and ranked strategies to control the adverse effects of the change orders on construction projects of the corporation. Finally it is recommended that the project management team of the corporation should prepare detail schedule and WBS of work and material specifications in planning phase to reduce the causes of changes and minimize the adverse impacts of the change orders.

Key words*: construction projects, causes, changes, change orders, time, cost overrun.*

CHAPTER ONE

INTRODUCTION

In this chapter the background of the study is presented and the research outline and settings are described. The study focuses on the analysis of the causes of change orders in construction industry, their impacts and mitigation strategies in relation to national and international experiences. Most of the time construction industries are subjected to extended time of projects and termination. In addition it is the source of dispute among the participants. Thus it is important to examine in detail the causes of change orders, their impact and mitigation strategies for the success of projects.

1.1 Background of the Study

Ethiopia's rapid economic expansion has been fueled by large-scale public and private investments in infrastructure and other construction projects over the last decade. Since 2010, Ethiopia has routinely invested more than 30% of GDP in gross fixed capital formation, expenditure, making it one of the world's fastest-growing economies. The construction industry is making a significant contribution to the country's economic growth and currently valued at over USD 7 billion in market capitalization. Construction activities contributed to 15.9% of GDP at 2015/16, African Economic Outlook (2017), & 20.5 percent to the GDP growth and 73.9 percent to industrial sector growth, National Bank of Ethiopia (2023). Thus, currently, the sector is the leading sub sector in the industry due to expansion of roads, dams and housing infrastructures. Ethiopia's construction industry is predicted to grow at a rapid pace during the next few years.

As the intensive construction in Ethiopia today becomes more complex, the demand for housing and project management services is increasing and the application of project management, the progress against time, cost against tender or budget, quality against specifications are confusing for all parties involved in the construction process. Ethiopia is changing and this change is nowhere more apparent than in the rapidly growing construction industry. The industry is being forced to change at an unprecedented pace. Having this the rapid construction sectors growth in mind, this thesis set to analyze the changes and change orders management in construction projects and their impacts on budget and timeline of the Federal Housing Corporation housing construction projects.

1.2 Construction Project Management in Ethiopia

Ethiopia's construction sector plays a vital role in driving national transformation, industrialization, and urban development. It has important contributions to economy, to the generation of revenue for the government and creating employment opportunities especially in urban areas is becoming visible. Currently the Ethiopian government has implemented various initiatives and policies to attract both domestic and foreign investment in construction sector. These initiatives focus on improving

transportation networks, expanding housing options, and developing commercial and industrial zones. As a result, cities of the country have seen a significant increase in construction projects to accommodate the growing demand for housing, infrastructure, and commercial spaces. Many public infrastructure and building projects suffer from significant delays and budget overruns. With the increasing population in urban areas of the country, there have been growing demands for housing and both public and private sectors have been involved in the construction of housing projects, including low-cost residential housing schemes.

1.3 Federal Housing Corporation (FHC) the Case Organization

The government of the Ethiopia to cop up the high demand of housing and infrastructures, focused on the strengthening and reestablishment of different sectors which have been experiences in construction industry. Federal Housing Corporation (FHC) is one of the state-owned enterprises which was re-organized by the Council of Ministers Regulation No. 398/2009. It had been operating for more than 40 years under different company names and responsibilities until March 2017. The company was originally established by the proclamation No. 59/1968 by following the declaration of proclamation No. 47/1974. This proclamation was declared to nationalize the urban land and extra housing by government which was owned and rented by the private. The name of the organization was Rental Housing Administration Agency (RHAA) at that time. From 1998 E.C. to December 3/2000E.C. the organization was organized by the proclamation No. 471/1998 and the name was Rental Housing Agency (RHA). From 2000 to 2009e.c. the company was reorganized by the name Governmental Housing Agency and its responsibility was limited on renting only the existing houses. Currently it has head office in Addis Ababa and six branch offices (Five in Addis Ababa and One in Dire Dawa). A long term objective of the corporation is to stabilize the rental housing market in the cities and it has mandate and responsibility to construct, cause to contract, rent out, sell or buy up on special decision houses that may be used for different services. Moreover, it devises modern management systems which enable effective administration of federal government houses and implement them. The Corporation currently administering more than 20,000 Government Houses which comprise of highly diverse set of real properties distributed all over Addis Ababa and Dire Dawa Cities. The type of housing units include multistory residential and commercial properties, warehouses, market stalls, shopping malls, residential villas, partitioned dwellings and commercial spaces, garages, offices and more. (https//:www.fhc.gov.et).

The Market Value of the Corporation's properties, as of 2022, is estimated to be more than ETB 200 billion. Moreover, the Corporation owns sizable plots of land in prime areas of Addis Ababa and Dire Dawa. Currently the corporation is undertaking many construction projects of multipurpose

apartment buildings at more than 20 different sites located at prime areas in Addis Ababa. The corporation also able to increase its annual revenue by sixteen-fold within 8 years' time, from ETB 300 million in 2017 to ETB 4.9 Billion in 2025, which enables it to generate finance for its housing development projects. Housing construction specifically and construction projects in general, needs detailed and all individual parts of the project by planning and designing for the effective project management.

1.4 Statement of the Problem

Changes in construction projects are very common and likely to occur from different sources, by various causes, at any stage of a project, and may have considerable negative /positive / impacts on items such as costs, schedule delays and overall performance of the project. A critical change may cause consecutive delays in project schedule, re-estimation of work statement, and extra demands of equipment, materials, labor, and overtime. Changes, if not resolved through a formalized change management process, can become the major source of contract disputes, which is a severe risk contributing to project failure Qi Hao et al, (2008). There are several reasons of project failure but the studies shows that the major factors are lack of risk management, project control and change management AyishaK.,et al, (2024).

Construction projects involve numerous stages, from preconstruction planning to the final delivery and it can be sure about some changes will be made along the way. One of the critical areas of construction management is adapting to these variations and implementing organizational change effectively to ensure work is completed successfully within the expected time frame and budget.

According to the literature reviews, many construction projects at different levels (both public and private sectors) are attributed to the lack of proper project management before they are completed. Construction projects are restricted by their performance, and identification of constraints provides practical steps to take organizational decisions. They can face a problem of time delay and costs overrun that are not of a schedule in a master plan of the construction project which is regarded as in effective identification and treatment of constraints. The projects are the more complex technically or logically, they can be more exposed to complex constraints. If constraints are better understood at the outset, it is believed that better performance can be assumed (Mishra, 2019). Poor project management constraint is one of the major challenges facing in construction projects (Rugenyi, 2016).

Time, scope, resource, quality, and money are just a few of the constraints that construction projects face due to the poor changes (variation) handling and poor preconstruction planning. These constraints must be appropriately controlled and managed for projects to achieve their intended objectives. As a result, this study is decided to conduct the factors of change orders and management

strategies in construction projects and the impact on budget and timeline of the FHC housing projects in Addis Ababa.

Issues to be addressed in this study are:

To analyze the factors causing construction changes and change orders, and their impact on projects budget, time and the overall performance,

To discuss the process or strategies of managing change orders and identifying the parties involved in the process of construction projects.

1.5 Research Questions

This research mainly focuses on examining the factors and the effect of change orders on construction projects' budget, schedule and overall performance; and it was guided by the following research questions:

- ✓ What are the major causes of change orders identified in the construction projects of FHC from the start to completion?
- ✓ What are the major impacts of the change orders in construction projects in FHC housing projects?
- ✓ What strategies /processes/are practiced in managing the changes in construction projects?
- ✓ How a change orders does initiated in the projects of FHC housing construction projects?

1.6 Objective of the Study

1.6.1 General objectives of the study

The overall aim of this study is to discuss and analyze the factors, their impacts and management strategies of the change orders on the performance of the construction projects.

1.6.2 Specific objectives of the study

Specifically the study tries to address the following key research objectives:

- ❖ To identify the major causes of the change orders in FHC housing projects.
- ❖ To analyze the impacts of the changes in construction projects of the corporation.
- ❖ To evaluate the change management strategies taken and their success on the project performance.
- ❖ To discuss the role of parties in change orders management on housing construction projects of FHC

1.7. Significance of the Study

The purpose of this study theoretically is to provide comprehensive analysis of the factors of changes and change orders in construction projects and to suggest the management strategies to reduce adverse impact of the changes in general and practically in addressing the empirical gaps in FHC housing projects.

The understanding of major causes of changes and change orders in construction industry would be helpful for the construction professionals, project managers, organizations and for all stakeholders to take proactive measures during project management and to reduce their adverse impacts of FHC projects. It helps to plan and provide proactive mitigation strategies to improve change management processes in construction projects from preplanning stage to final delivery. The study look at how various changes on construction projects may influence cost, time of completion, quality and client satisfactions and how it will be corrected. In addition, it helps to give starting point for further researches and policy makers in the area.

1.8. Scope and Delimitations of the Study

Geographically the study was limited in Addis Ababa, Federal Housing Corporation housing projects. Thematically the study focused mainly on the reasons for the changes and change orders to be occurred in housing construction projects, their impacts and strategies for the successful completion of the projects. The study focuses on the independent variables such as different causes of the changes and change orders, and the dependent variables, the time & budget of the construction projects. These changes and change orders in projects should be managed in all the steps and by the all stakeholders. Therefore this study methodologically covers the causes of the changes, change orders, their impacts and change management strategies on ten different completed and ongoing construction projects of Federal Housing Corporation in Addis Ababa, Ethiopia starting from 2010 E.C. Professionals of the client, contractors, consultants and other regulatory bodies who were part of the different projects of FHC since 2010 E.C. were participants of this study during data collection through questionnaire and interview.

1.9 Limitations of the Study

The major limitations of this study were first identified as; the limited client or single construction corporation, limited consultant, only government owned projects and single sector (housing sector) to generalize the results obtained. Absence of organized documents from contractor side for cross checking information from client and consultant, and limited information was another limitation to generalize the main findings as a city level or as a country because of the limited participant organizations. No detail and well compiled database of the projects; and also there was financial limitations faced for data collectors. There were some reluctance employees to fill and return the

questionnaire by the time table set at the beginning.

1.10 Definition of the Key Terms

A change is defined as any deviation from an agreed upon well-defined scope and schedule. It is any modification to the contractual guidance provided to the contractor by the owner or owner's representative.

A change order is a formal, document issued after the execution of the initial contract that authorizes an alteration, addition, or omission to the original scope of work, design, contract, or completion time. It is any change to the draft or original contract design, quality, quantity, or scope of works instructed by the Engineer (Consultant) or requested by the Employer.

Causes of change orders are the underlying factors, triggers, or root problems that necessitate a modification to the original construction contract. Common causes in Ethiopian housing include design errors or omissions, owner-requested modifications, unforeseen site/soil conditions, and material price fluctuations or supply chain disruptions.

Project budget is the total estimated financial resource officially allocated and approved for the execution and completion of the project. It encompasses direct costs (materials, labor, and equipment) and indirect costs (supervision, administration, contingencies) agreed upon in the initial Bill of Quantities (BOQ) and contract agreement.

Project time line/ schedule referred as contractually agreed timeframe for the completion of project and handover the entire construction works to the client.

1.11 Organization of the Research

The research is compiled in five chapters. Chapter one contains introduction of the study, background of the study area, statement of the problem, research questions, objective of the study, significance of the study, scope and limitations of the study. Chapter two contains related literature review, theoretical and empirical reviews and conceptual frame work. Chapter three contains research methodologies such as, research design, data type and source, research strategy, sampling technique and procedure, data collection method and tools, data analysis methods. Chapter four focuses on the presentation of results of analysis and the findings of the data collected for the study and discussions. The final, chapter; chapter five gives drawn conclusion and recommendations of the research for further investigations.

CHAPTER TWO

LITERATURE REVIEW

This chapter deals about the review of summaries and analysis of existing research works related to the changes, factors of changes and change management processes in different construction projects. Definitions, Discussions, and reviewing of changes and different change management practices in construction project management are presented. The outputs and findings of previous researches help to better understanding of the research goal.

2.1 Theoretical Concepts

2.1.1 Changes and Change Management Theories

There have been numerous articles written on changes, change orders and change management in construction projects. A change is defined as any deviation from an agreed upon well-defined scope and schedule. It is any modification to the contractual guidance provided to the contractor by the owner or owner's representative. This includes changes to plans, specifications or any other contract document Abdulghafoor H, (2000). Osman, & et al. (2009) defined the change as any deviation from an agreed upon well-defined scope and schedule. A change order is the formal document that is used to modify the original contractual agreement and becomes part of project's documents. Change order in construction industry is an alteration or an amendment to original requirement, information or conditions. It involves additional cost, time extensions and other impacts. Change order is a written instruction of a change signed by the owner/client to the contractor, issued after signing the contract, authorizing a change to the contract agreement Walid M.A.K, Ibrahim M.(2019). Construction projects management can be defined as the planning, co-ordination and control of a project from conception to completion(including commissioning) on behalf of a client, requiring the identification of the client's objectives in terms of utility, function, quality, time and cost; the establishment of relationships between resources; integrating, monitoring and controlling the contributors to the project and their output; and evaluating and selecting alternatives in pursuit of the client's satisfaction with the project outcome (Anthony Walker,2015).

The word change order conjures strong feelings of negativity for all involved in construction projects. Owners do not like them because they generally feel they are paying for other's mistakes. In some cases, contractors believe that change orders disrupt workflow and require additional paperwork and time. In other cases, contractors would find the change orders a mean to improve their outcome of the project Alia Alaryan et al (2014). Some authors swap the terms variation, change and change order for one another or alternately. Keane et al. (2010) gave the clarity as thus; any type of departure from an initial agreement on a defined scope or schedule of work is termed variation or change. Whereas,

change order is document that orders changes; it gives authorization with respect to the agreement contained in the contract document and thus automatically forms part of the project documentation.

Changes in construction projects are very common and likely to occur from different sources, by various causes, at any stage of a project, and may have considerable negative impacts on items such as costs and schedule delays. A critical change may cause consecutive delays in project schedule, re-estimation of work statement, and extra demands of equipment, materials, labor, and overtime. Changes, if not resolved through a formalized change management process, can become the major source of contract disputes, which is a severe risk contributing to project failure Qi Hao, WeimingShen, Joseph Neelamkavil, Russ Thomas (2008).

Changes are described as additions, deletions, or modifications to the projects objectives and scope, whether positively or negatively impact the project's cost, duration or quality Ali F. AlShehab, HussainA. Al-Ayesh, Ibbs et al., (2001).

According to different literatures, deviations or changes in constructions are caused by design processes such as design review, scope change, technological advances or constructability reviews; construction process, fabrication, transportation or operability.

The unique and dynamic nature of the construction industry necessitates change management in all phases of the construction projects since changes are inevitable over their lifecycles Mohammed & Karri, (2020). Accordingly, a systematic change management system during the construction process is essential to minimize the impact of changes on project targets (Bitamba&An, 2020).Upon acknowledging the existence of change in construction projects, the change or variation is formally regularized by the issuance of a change order which is a document describing the scope of the change and its impact on both cost and / or time. If no agreement is reached between the parties of the project on the change, it turns into a claim or dispute that may negatively affect the execution of the project and curtail (limit) its chances of successful completion.

Consideration must be given to these construction phenomena from the early stages of the project until commissioning. A contract change clause is added to define the way that owner, consultant, and contractor will handle changes. A procedure must be set to process a change from its conceptual development until it materializes in the field. Given the fact that an adversarial atmosphere usually exists between the parties in the construction industry, a change must be managed well in order to minimize its cost, schedule and consequential negative effects that can lead to enormous cost and schedule overruns (Senaratne and Sexton, 2011). Researchers have highlighted the importance of developing better change order management systems to mitigate the negative impacts of change orders. As cited in Ahmed Senouciet, al, 2019, Karim and Adeli (1999), have developed an object-oriented change management system to continually monitor, analyze, and approve change orders, and

Park and Pena-Mora (2003) have developed a model-based change management system to analyze change impact on project performance according to change characteristics, discovery status, and time. Love et al.(2002), Chan and Leung (2004), and Chen (2008) have developed other change order management methods and systems. Effective change management can results in significant savings in the total cost of construction projects, increased efficiency, more reliable schedule, and end-user satisfaction can be enhanced (CII, 1994). A change order is a complex information transfer that has to be managed carefully, otherwise disputes between a client and a contractor related to cost and time of work might occur. It involves all the construction teams, together with a voluminous amount of information that either has to be sent, checked, corrected, approved, requested, clarified, transmitted or submitted, among many other things. Having this, the change order management process and its impact on cost and time of Federal Housing Corporation construction projects is analyzed.

2.1.2 Factors Causes Change in Construction Projects

According to the PMI (2017), Changes may occur at any time throughout the project life cycle and may be requested by any stakeholder involved with the project, (such as owner /client, designer, engineer, Contractor/subcontractors). In PMI, (2021), changes may arise from a consequence of project risks or environmental factors, the need for a deeper understanding of project needs, or client requirements. (Shipton et al. 2014) argued that changes in construction occur due to the needs of clients, while the availability of construction material or unpredictable ground conditions also leads to various changes.

Construction project changes are an alterations or modifications on the pre-existing conditions, assumptions or requirements, or other revisions within the general scope of a contract that can cause an adjustment to the contract price or time. These present a number of problems to parties involved in a construction project(CII, 1994). The elements of project that are subject to change include project scope, project organization, work execution methods, control method and contracts and risk allocation and identifying the causes of changes of these elements is very important in order to avoid potential changes in future projects or to minimize their effects (Walid M. A. Khalifa et al , 2019).

According to love and Li (2000) changes can occur as a results of various reasons, which include addition/ deletion of scope, design errors or omissions, site condition and lack of adequate information. All these can cause adjustment to the contract price and duration. Thus, introduction of changes into a project can lead to problem and hinder the achievement of project success. The main causes for change orders were reported as owner directed changes, unforeseen conditions, design errors/omissions, code requirements, and value engineering (Ahmed Senouci et al., 2019).The Construction Industry Institute (CII 2015) reported that the root causes of construction changes are classified into two categories, namely, project development changes and Scope Changes. A project

development changes represents a change to the original work scope or process basis as defined by the owner. On the other hand, a scope change refers to the changes in the base work scope or process basis as defined by the owner. Moreover, a scope change can be mandatory or discretionary. The mandatory scope changes represent the modifications to comply with regulatory, safety, or legal requirements and meet owner's requirements (CII 2015). On the other hand, a discretionary change is non-mandatory one that alters the premise, process, capacity, location, or schedule. It can also be a contract strategy change to more effectively implement the work plan. Bitamba and An (2020)classified causes of changes in construction under various categories: design-related, contractor-related, owner-related, organizational and management-related, changes related to environment and site conditions, changes related to materials and equipment, changes related to economy and governmental regulations.

Changes to requirements including specification, scope of projects, design brief, etc.; Incomplete/inconsistent drawings; design error/defect; design change; omissions of site conditions and build ability; changes in codes and regulations or, As-built not confirm with as-design; quality defect; unanticipated site conditions; value engineering; materials or equipment not available; inclement weather Changes in design and construction processes.

Changes in construction projects can occur from various sources, it is essential to understand these sources in order to be able to minimize them. Different literatures stated that, project changes can emerge from internal and external sources. The internal sources are changes that are generated from the intra project environment. These are either design generated causes or construction generated causes. Design generated causes are design errors, omissions and changes initiated by client. Whereas construction generated causes are, construction errors, changes due to site conditions, and poor workmanship etc. (Love and Li, 2000; Senaratine and Sexton, 2011). The external sources are related to external environment such as political environment (e.g. changes in government regulations, changes in taxation); economic environment (inflation, changes in interest rates and exchange rates); others are social, legal, and technological environment etc.

2.1.3 The Impact of Change in Construction Projects

In different literatures change in construction projects has impact in different aspects. For example, in research done by (Walid M.A.K and Ibrahim M., 2019), in addition to cost and schedule delay, change orders strain (damage) the relationships of owners, engineers, contractors, subcontractors, and others involved in the construction process. Changes on one project can also affect other unrelated projects by tying up resources that are committed elsewhere. Negative relationships between the parties are another by-product of changes on a project. Not only workflow is disrupted, but also trying to get quick responses quotes, shop drawings, and many other things required to get back

schedule causes a strain on working relationships. Gunhan et al. (2007) as cited in Ahmed Senouci et al., 2019, reported that projects with change orders are usually prone to delays, cost increases, and reduced labor productivity. Change orders have in most cases negative impacts. Moreover, change orders may interrupt the work flow, create delays, cause schedule slips, increase costs, result in costly litigation, reduce labor productivity, and lead to loss of future opportunities (CII, 2015). Gunhan et al. (2007) reported that increased costs cause conflicts between the parties ending up in costly disputes. Change orders affect project duration especially if they are directly related to the activities on the schedule critical path. The project planned date will slip if the extra work extends or postpones the completion of critical activities.

2.1.4 Project Change Management Process

This section delve into the multifaceted aspects that contribute to the dynamics of change within project environments and explores a range of change management processes or strategies that project managers can leverage to drive successful change outcomes within their projects. Since the construction industry is project-based activity and changes are inevitable, the best project management process is to discuss changes in the context of typical stages/phases in a construction project. Understanding the various factors that influence change within projects is crucial for effectively managing and navigating through the complexities of change initiatives. In navigating the complexities of project change, organizations employ various strategies and approaches to effectively manage and implement change initiatives.

Understanding and aligning with organizational culture and leadership, effective stakeholder engagement and communication, assessing an organization's readiness and capacity for change, and external factors and contextual dynamics play a significant role in change management processes. Some of change management strategies that project managers can leverage (influence) to drive successful change outcomes within their projects are explored as follow (H. Majeed Z. et al, 2024).

Proactive vs. Reactive Approaches

Proactive change management strategies involve anticipating and preparing for change before it occurs (Hornstein, 2015). This approach emphasizes the importance of foresight planning, and readiness assessment in identifying potential areas of change and developing proactive mitigation strategies. In contrast, reactive change management strategies respond to change as it arises, focusing on managing the immediate impacts and adapting to emerging challenges (Cameron & Green, 2019). Both approaches have their merits and drawbacks, and project managers must strike a balance between proactive anticipation and reactive responsiveness to effectively manage change within projects.

Change Readiness Assessment

Conducting a thorough change readiness assessment is essential for gauging an organization's preparedness for change (Heckmann, Steger, & Dowling, 2016). This assessment involves evaluating various factors, such as organizational culture, stakeholder engagement, resource availability, and technological capabilities, to identify potential barriers and enablers of change. By understanding the organization's readiness level, project managers can tailor their change management strategies to address specific needs and challenges, thereby increasing the likelihood of successful change implementation.

Change Impact Analysis

Change impact analysis involves assessing the potential consequences of change on various aspects of the project, including scope, schedule, budget, resources, and stakeholders (Crawford, 2021). This analysis helps project managers anticipate and mitigate potential risks and disruptions associated with change, enabling them to develop contingency plans and allocate resources effectively. By understanding the ripple effects (consequences of effect) of change across the project ecosystem, project managers can minimize negative impacts and capitalize on opportunities for improvement.

Change Communication Plans

Effective communication is critical for engaging stakeholders, building consensus, and fostering commitment to change (Butt, Naaranoja, & Savolainen, 2016). Developing a comprehensive change communication plan involves identifying key messages, target audiences, communication channels, and timelines for disseminating information related to change initiatives. Clear, timely, and transparent communication helps manage expectations, address concerns, and maintain stakeholder support throughout the change process, enhancing the likelihood of successful change implementation. Establishing good communication and cooperation among project team members by developing and utilizing a web-based change order management system which supports documentation practice, communication and integration is one of the successful change order workflow (Charoenngam, C., Coquinco, S., & Hadikusumo, B. 2003). Good communication can be facilitated through providing information in a timely mechanism using internet technologies as the communication media, because information can be accessed in a timely and accurate manner and may be accessed from different locations (Charoenngam et al., 2003).

Change management strategies play a pivotal role in guiding organizations through the complexities of project change. By adopting proactive approaches, conducting change readiness assessments, performing change impact analyses, and implementing robust communication plans, project managers can effectively navigate change initiatives and drive successful outcomes within their projects.

Also, QiHao et al, (2008) classified changes in construction project in varieties of ways, for instance,

based on need can be classified as elective (optional) or required (compulsory); based on time can be classified as anticipated or emergent, reactive or proactive and pre-fixity (those occur at the design stage) and post-fixity (those occur after the design stage), based on effect change can be beneficial, neutral or disruptive (CIRIA, 2001; Hao et al., 2008). Change management relates all the internal and external factors that influence project changes. It seeks to forecast possible changes; identify changes that have already occurred; plan preventive measures; and coordinate changes across the entire project. It requires following a formal sequential processes such as identify, evaluate & propose, approve, implement and review (Motawa, I., Anumba, C., & Lee, S., 2007).

Most changes, if not managed properly through a formalized change management process, will have considerable impact as they disrupt work and affect its orderly sequence, adversely impacting productivity and accordingly causing schedule delays and cost overruns. Managing changes effectively is crucial to the success of a construction project (Hossam Mohamed, 2013). Due to unavoidable nature of change in construction projects, there is needed to find ways of minimizing their negative effect. Effective change management is required to address the effect of unwanted changes in projects (S. Senaratne and Sexton, 2011). To effectively implement change management in construction project, the development of a project through the various phases of the project life cycle must be understood.

The AIA best practices (AIA, 2007), reported that two ways to process change orders, namely, Proposed Change Order and Construction Change Directive. Proposed Change Order is a tool for tracking on-site changes that document the process thoroughly. It helps to prevent late or unforeseen claims and maintains open communication (AIA, 2007). When the proposed change affects the cost and duration of any subcontractor, the contractor collects all documentations and prepares and submits for review a change proposal with all backup documents. All the stakeholders may discuss and come up with a solution on how to minimize the cost, delay, and side impacts in good faith.

The Construction Change Directive is used when the change order will delay the project completion time, and the team agrees on the necessity of its modification. Then, the team discusses the importance of the change and come up with a solution, if they agree on the Construction Change Directive and signs it with less unexpected costs (AIA 2007).

To avoid or minimize the effect of detrimental such as interruption of flow of work, delay, and cost overrun which can lead to claim and costly litigation, the researchers identified five principles of effective change management practices (CII, 1994; Ibbs, 2001). These are **promoting a balance change culture, recognize change**, **evaluate change**, **implement change**, and **continuously improve from the lesson learned**. Each phase of a project should have established change management procedures in accordance with the five principles (Mohammed M., Mohammed A.

M.and Mustapha Y. 2017).

Promote a Balanced Change Culture

The first principle of effective change management is to promote a balanced change culture. That is to encourage beneficial change and discourage detrimental change, so that the change will benefit the project end users. Beneficial changes are those changes that increase value; reduce cost, schedule, or degree of difficulty to be encouraged. Whereas, detrimental changes are those that reduce value or have negative impact on a project. Such changes may increase cost and schedule.

Recognize Change

The second principle of effective change management is to recognize change. This means scope of work in terms of schedules, budgets and commitments should be agreed upon by the parties to a contract at the initial stage of a project. The agreement should serve as a baseline so that measurements and tests can be conducted to determine whether change has occurred. This will allow any recognized change to be managed. Thus, it is essential to provide effective means of communication among the team members, to recognize change in earliest possible time. The team should understand the total number and impact of changes on the project.

Evaluate Change

The third principle of effective change management is to evaluate change. The change should be classified as either required or elective change. Required changes are mandatory for project to be viable. This include those changes that are necessary to meet project objectives, regulatory/legal requirements or defined safety or engineering standards. Once a required change is identified its impact should be evaluated and implemented immediately.

On the other hand, elective changes are those changes proposed in order to add value to the project, but not required to meet the original project objectives. Thus, implementation of elective changes are not necessary but are considered to be beneficial. Required and elective changes should be evaluated differently. When an elective change is identified its impact should be evaluated, and then decision should be taken on whether to implement it or not. This requires an assessment and comparison of the impact of the change and its economic benefit.

Implement Change

The fourth principle of effective change management is to implement change. The team members should be ready and able to implement a change at any point during the project implementation. There should be a process agreed upon at the early stage of the project for approving identified change. This gives authorization for the implementation of the change, and ensures all items required prior to the implementation have been met. There should be documentation system that will

adequately explain the impact of the changes and the overall process of managing the changes.

Continuously Improve from Lessons Learned

The fifth principle of effective change management is to continuously improve from lessons learned. That is parties to a project should take advantage of the lesson learned from the project at hand and from previous similar projects to improve the project. This means the parties should discuss problems arising from management of changes and suggest possible ways for improvement. The lessons learned from the current project should be documented to improve future projects.

2.2 The Empirical Studies Review of Changes

2.2.1 Change Orders Experience in Ethiopian Construction Industry

Abdo (2006), (Muzeyin et al., 2022) as cited in Abdilkerim (2023) made a survey on delays in public building construction projects in Ethiopia. The result of the research indicated that 94% of the 52 surveyed public building projects undertaken by local Contractors between the years 1995 to 2005 have encountered delays. Moreover, the time extension ranges from 10% to 367% and the average delay is found to be 89.9%. The most frequent causes of delay which in descending order of criticality were found to be: necessary variations, delayed payments, scarcity of materials, late material supply, less emphasis to planning, sub-surface condition, changes in design, material and labor price escalation, unrealistic time schedule, and failure to update schedules on time. Gebrehiwet and Luo (2017) identified the top greatest main causes of delay in the Ethiopian construction projects. According to their study, corruption is the highest rank of the cause of delay in Ethiopian construction. They also found unavailability of services or utilities at the project site, inflation, less quality material, late design and design documents, less speed of material supply, late in agreement of contract and receiving of completed project work, poor site management and performance, late release budget and unsuccessful project preparation and scheduling. Causes of delay can be, Client related, Contractor related, Consultant related, and External factors.

As Abdilkerim (2023) on his article on the cause and effect of delay in public construction projects in Ethiopia, based on the relative importance index, the primary top ten causes of delay were identified. The top three causes of delay were related to the category of client, namely delay in progress payments by owner, Poor communication and coordination by owner and other parties and slowness in decision making process by owner with RII values of 0.8784, 0.8639 and 0.8433 respectively. From fourth to seventh ranked causes were attributed to contractors that were ineffective planning and scheduling of project by contractor, Poor site management and supervision by contractor, difficulties in financing project by contractor and poor communication and coordination by contractor with other parties with RII values of 0.8288, 0.8269, 0.7938 and 0.7855 respectively. Further more

frequent change order by owner ranked eighth with RII value of 0.7175 and improper construction methods implemented by contractor followed with RII value of 0.7155. The last ranked cause is external which an effect of subsurface conditions like soil, high underground water etc. with RII value of 0.7134. Accordingly as Abdilkerim (2023), based on the top ten causes, contractors share 50% causes of delay; clients share 40% of causes of delay and external causes 10% of delay.

According to M. Abubeker J., 2015, cited by ShambelGebrehiwot et al (2018) in his study of factors affecting time and cost overrun in road construction projects in Addis Ababa, desk study conducted on 10 completed road projects in Addis Ababa, 10 of them had experienced time overrun and cost overrun. Thus, they take more time and cost than what had been estimated. The rates are ranging from a minimum of 25% to the maximum of 264.38% time and a minimum of 4.11% to the maximum of 135.06% of cost.

Financial problems, improper planning, land acquisition and construction delay, design changes, less materials and equipment supply by contractors, incomplete design are the main sources of delay and cost overrun respectively. So, once identified the main causes it is necessarily to give solutions to complete the projects on time and estimated cost.

AndualemEndris (2016) conducted study on 'Causes of Variation Orders on Public Building Projects in Addis Ababa' concluded that based on the desk study, interview and questionnaire, change in design, incomplete contract documents, impediment (obstruction) in prompt decision making process, inadequate working drawing details, and change in specifications were the major causes of variation orders on public building projects in Addis Ababa.

Ashebir S. et al (2017) in their study of 'Causes of Cost Overrun in Federal Road Projects of Ethiopia in Case of Southern District' concluded that the project material price fluctuation as one of the basic outcomes that plays a significant role on project cost status. The client, consultants and contractor's ignorance of these factors potentially affects the overall project cost performance.

Abebe Demissew, et al (2023), in their study of Causes and Impacts of Delays in Ethiopian Public Construction Projects; Case on Debre Markos University Construction Projects, the outcomes of the case study revealed that not a single project was completed within the time frame specified. Rather, they had six projects terminated because they were too late. The delay for finished and ongoing projects ranges from 11.11% (main compass security tower) to 150.5% (main compass staff launch) and 6.11% (Bure compass library buildings) to 268.67% (water wall to main compass), omitting the time required to complete the projects. Furthermore, both the university and the contractor exposed for crises by the delay due to consulting fees and project overhead costs.

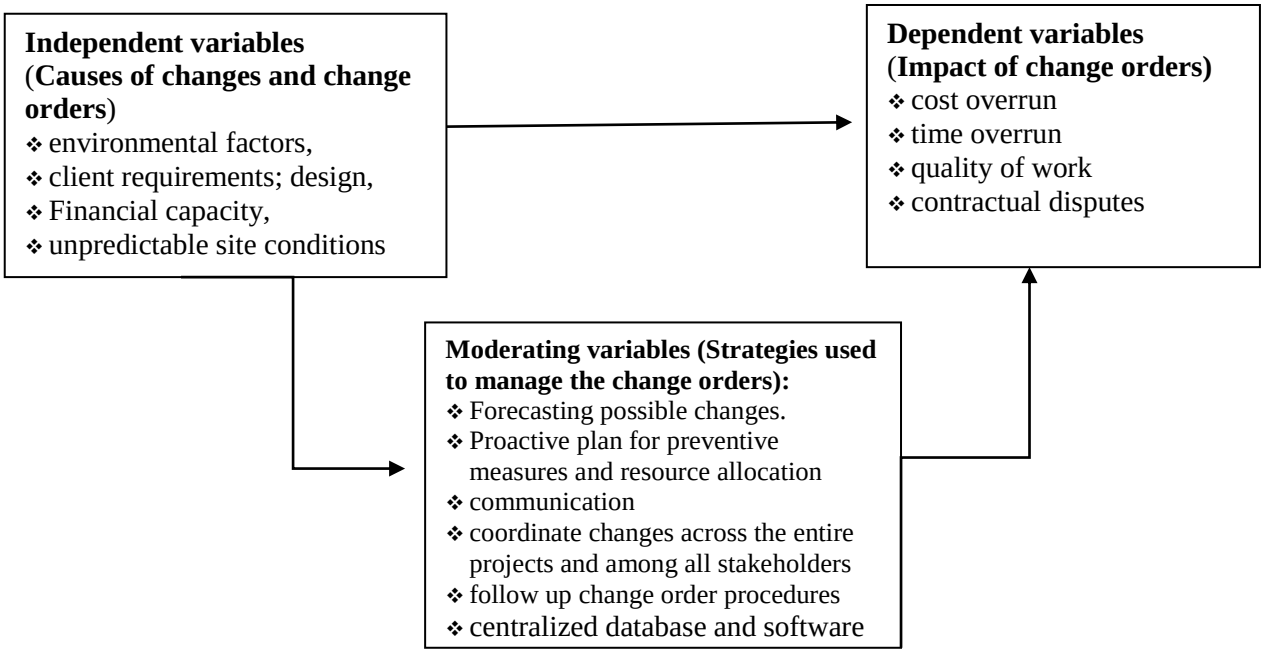
2.3 Summary of Literature Review

Zhao et al. (2009) as cited in Ahmed Senouci et al, (2019) reported that change order management systems are developed to resolve problems when changes occurred in a project or minimize changes that may occur and disrupt the progress of the project. These systems forecast possible changes; identify changes that have already occurred, plan for preventive measures, and coordinate changes across the entire project among all stakeholders. Besides addressing the impact of changes, an effective change management should also look into the cost, time and quality considerations for the project. Motawaet. al. (2007) reported that inconsistent management of the change process can result in many disruptive effects. Moreover, major source of contract disputes arise if changes are not resolved through a formalized change management process, which may lead to project failure. Hwang & Low (2012) reported that a change management process consists of four basic principles: (1) identify changes; (2) evaluate changes; (3) implement changes; and (4) learn from past experiences. These four principles work together to achieve the objective of an effective change management system. Motawa et al. (2007) reported that the development of change management systems needs to include various factors such as project processes and all the internal and external factors that influence project changes. Sun et al. (2006) proposed a change management toolkit for construction projects, which include a change dependency frame work and change prediction and workflow tools. On the other hand, Lee and Peña-Mora (2005) and Motawa et al, (2007) established a system dynamics integrated change management systems that can evaluate negative impacts of errors and changes on construction performance. Moreover, Charoenngam et al, (2003) developed a management system with a change order procedure that involves workflows, documents, records keeping, and a centralized database. Similarly, Isaac and Navon (2008) developed a model that identifies and quantifies possible impact of change orders on building construction projects. Lastly, Zhao et al. (2009) proposed a simulation method using Dependency Structure Matrix (DSM) to predict changes in construction projects, which identifies the sources of changes and verifies the effectiveness of the DSM model.

2.4. Conceptual Framework

Based on the related literature reviewed above, dependency frame work, (the conceptual framework) for this study has developed as follow to show the relationships between the dependent variables such as design change, client ideas variations, financial capacity, site conditions and independent variables like cost overrun, time overrun, quality of work, and disputes.

Figure 2.1 the conceptual relationship between dependent and independent variables



Source: Adapted from managing project change in construction: the dependency framework (S. Senaratne, M. Sexton).

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

The aim of this chapter is to give a framework for conducting the research and explanation on the methods and procedures that is used to answer the research questions of the study. It specified the details of the procedures necessary for obtaining the information needed to structure and includes sections such as research design and approach, data collection procedure, population, sample size and sampling techniques, data sources and collection techniques, method of data analysis, and the ethical consideration of the study.

3.2 The Research Design and Approach

This study is used a descriptive research whose primary objective is to provide clearer picture of the factors of construction project changes, their impacts and management strategies. Descriptive and explanatory research design and analysis methods are used, through qualitative as well as quantitative research approaches. The description of the independent variable (the causes of changes) and dependent variable (project performance, budget and time overrun) are discussed. Because the research focuses on real-world initiatives to identify and describe the presence and frequency of changes, qualitative data through methods such as document reviews, reports, and discussions with technical expertise, and from interview of key professionals were collected. Additionally, quantitative data through questionnaires of the focal persons form consultant, contractors and client, and observation of different projects statuses were conducted.

3.3 Target Population, Sample Size and Sampling Technique

Target population for this research was those who participated in ten (10) different housing construction projects of Federal Housing Corporation in Addis Ababa. Contractors, consultants and client professionals who participated (involved) in the projects were the target population. Because the target population is limited in FHC housing projects, to collect data using the questionnaires, interview, and thorough document reviews, the purposive sampling technique was used. Based on the projects and main participants (stakeholders) 67 questionnaires were distributed and 57 was retuned, and data was collected from contractors, consultant and from client representatives. The percentage of the returned data was shown that 87.7% which indicate an acceptable rate of respond from the participants. Professionals from each category who have direct involvement in the construction process of the projects were included. For example from client, site engineers, team leaders, construction supervisors, contract administrators, office engineers, project coordinators and management members of the construction sector, and from contractors and consultants side the

coordinators, project managers, resident engineers, and site engineers were included as respondents.

3.4 Data Type and Collection Method

Both primary and secondary data was used in this research. Data types used for this project work was primarily focused on reviewing selected office documentation, conducting interviews with key stakeholders and preparation and distribution of questionnaire to assess the perceptions and opinions of the professionals participated on the projects. The semi structured interview with the team leaders & project managers and the structured questionnaire were distributed to identify the causes of changes and the measures taken to manage these changes. Structured questionnaire survey has been conducted to gather the required information with five point Likert scale from1=strongly disagree, 2=Disagree, 3=Neutral 4 Agree and 5= strongly agree. It was distributed for 65 respondents of all stakeholders (FHC, contractors and consultant), experts participated in 10 housing projects of the corporation using the purposive sampling technique. From the distributed 65 questionnaire 57 were responded and the analysis was done on this amount using SPSS software. The percentage of the returned data is 87.7 % which indicates an acceptable rate of respond from the participants.

3.5 Data Analysis and Presentation

Qualitative and quantitative data were collected. Quantitative data was analyzed using Statistical Package for Social Science (SPSS) software which is widely used by the researchers for data analysis and data management of descriptive and inferential statistics. Descriptive statistics include the use of percentages, frequencies, central trend (mean) measurements, and dispersal measures (standard deviation). Inferential statistics are used for the analysis of Relative Importance Index and correlation to determine the type of relation between variables.

The Mean Score method was adopted for the analysis of scaled responses by using the mathematical expression of:

$$MS = \Sigma (FX) / N. \qquad (1 \leq MS \leq 5) \ldots\ldots\ldots\ldots \text{(Eqtn.1)}$$

Where “X“ is the score or weight given to each factor being rated or ranked by respondents and ranges from 1 to 5,

“F“ is the frequency of responses to the respective ranking (1 – 5) for each factor, and

“N“ is the total number of responses concerning that factor.

The Mean Score is computed for each factor or cause of change orders, the impact and the management strategy and is then used to compare other factors by ranking. A high mean score represented the most important variable.

Therefore, Mean Score = (5F5 +4F4 + 3F3 +2F2 + F1) /N. …… (Eqtn.2)

3.6 Validity and Reliability Analysis

Validity determines whether the measuring instrument truly measures what it was intended to measure and therefore, data triangulation and method triangulation methods were used to check how truthful the research results. Content validity used in this research to ensure that a measuring instrument provides adequate coverage of the topic under study. Reliability refers to the extent to which the results are consistent over the time and an accurate representation of the total population under the study. The reliability test of the data is a key statistical test defined as the degree of consistency, with which the attribute is being measured. Reliability increases as repeated measurements made by the instrument show reduced variation.

Therefore in this study, the validity and reliability were ensured through carefully conducting the whole research methods, using different sources of data of the same aspect and the questionnaires were designed to cover all relevant topics and have different parts of the same ideas related to the objectives of the research. The Cronbach's alpha coefficient values were used to measure the reliability of the questionnaire data. These are usually used for multiple Likert scales in a survey or questionnaire to validate the reliability of the scale. The Cronbach's alpha value should be between 0 and 1; a value close to 1 means that the internal consistency is greater Chan et al.,(2017) as cited in Khalid K. et al (2022).

Table 3.1 Test of Reliability for Measuring Scale

Reliability Statistics	
Cronbach's Alpha	N of Items
0.965	70

Source: own survey (2026)

As table 3.1 above shows that the Cronbach's alpha values were calculated by SPSS software fall above 0.9 for overall items. Hence, the responses are reliable and consistent enough for further analysis.

3.7 Ethical Consideration

To consider the research ethics, various methods was used. Confidentiality of respondents was treated as a matter of priority. The researcher was explained that the participation of the respondents is voluntarily and based on agreement to participate in the research, the potential respondents were not identified by name, and furthermore, respondents were assured that the information they provide is only be used for an academic study. The researcher may accord the respondents, their due respect while simultaneously guiding them to answer the questions to align with the study objectives.

CHAPTER FOUR

DATA ANALYSIS, DISCUSSION AND INTERPRETATION

4.1 Introduction

This chapter presents the analysis, discussions and interpretations of the results of the study on the analysis of the causes of change orders and their impact on projects budget and timeline. The analysis is based on the quantitative and qualitative survey data which collected from project participants such as contractors, consultants and client professionals. After a series reviewing of the related literature and developing structured questionnaires, data collection was taken and it was analyzed, discussed, interpreted presented in terms of the objectives of the study. Data was interpreted using SPSS software and Microsoft Excel programs to analyze the cause, effect and controlling strategies of change orders in FHC construction projects. Frequency, percentage, means, relative important of index (RII), ranks and tables are used to analyze and organize data of independent and dependent variables which gave meaning to the response rates.

The questionnaire consists several parts of the question. Part one contains demographic information of the respondents; part two the common sources of the causes of the change orders like causes initiated by the owner, contractors, consultant, site conditions and by the regulatory bodies; part three contains the impact of the change orders, part four is about the managing process or the minimizing and controlling strategies of the change orders and part five is general interview questions about the causes, effect and mitigation strategies taken by the corporation. Five point Likert scale to quantify the expression of the respondents by using the scalefrom1=strongly disagree to 5= strongly agree is used. It was distributed for respondents of all stakeholders of FHC, contractors and consultant experts participated in ten (10) housing projects of the corporation.

4.1 Response Rate of Respondents

Table 4.1. Analysis of Response Rate

Questionnaires Distributed	Questionnaires Returned	Percentage
65	57	87.7%

Source: Own field survey, 2026

As shown in table 4.1 above, about response rate, 65 questionnaires were distributed to respondents and 57 were appropriately filled and retuned with the rate of 87.7%. Since according to U.Sekaran & R.Bougie, 2010), response rate of 50% is satisfactory, 60% is good and 70% and above is very good for a study. This implies that, the information gained were sufficient enough to conduct the analysis. Hence, based on this sample size, i.e., 57 (87.7%), the next analysis was carried out.

4.2. Demographic Characteristics

Demographic characteristics such as gender, age, education, year of work experience, etc. of the respondents who participated in the housing construction projects of the FHC were analyzed as in the following tables. As data indicates the male participants are larger in number than female and respondent's educational qualification which has significant impact on the findings show that most of the respondents had bachelor degree and above in sciences and most of them were from engineering background. The experience of the most of the respondent's as shown in the below is above 6years. All the respondents are engaged in FHC projects in different positions and responsibilities.

Table 4.2 Characteristics of the Respondents

Description	Variables	Frequency	Percentage (%)
Gender	Male	31	54.4
	Female	26	45.6
	Total	57	100.0
Year of work experience	less than 2 years	3	5.3
	2-5 years	7	12.3
	6-10 years	14	24.6
	11-15 years	18	31.6
	16-20 years	7	12.3
	20 years and above	8	14.0
	Total	57	100.0
Highest level of education	Grade 10 or 12 complete		
	TVET Diploma	1	1.8
	college diploma	7	12.3
	1st Degree	28	49.1
	Masters and above	21	36.8
	Total	57	100.0
Role or position of the respondent in project	Project Manager	3	5.3
	Team leader	8	14.0
	Resident Engineer	13	22.8
	Office Engineer	11	19.3
	site Engineer	14	24.6
	Other key staff	8	14.0
	Total	57	100.0
Organization	Owner (FHC)	25	43.9
	Contractor	21	36.8
	Consultant	7	12.3
	Regulatory body	2	3.5
	Other	2	3.5
	Total	57	100.0

Source: own survey (2026)

Sex of respondents

As shown in the above table 4.2, out of 57respondents 31 (54.4%) of the respondents are male & 26 (45.6%) of the respondents are female this shows the proportion of female becoming better competent in the challenging behavior of construction environment.

Work experiences of the respondents

Participating of well experienced professionals helps to identify the right perceptions and better understanding from their prolonged exposure on the area. As shown in the above table 4.1 and (figure); 5.3% of the respondents have less than 2 years' experience, 12.3% of the respondents have 2-5 years, 24.6% of the respondents have 6-10 years, 31.6% of the respondents have 11-15 years, 12.3% of the respondents have 16-20 years, &14.0% of the respondents are above 20 years of experience. About 57.9% of respondents have more than 10years of experience. This shows that they can well express the real extent of challenges and strategies of the change orders in construction projects and successfully and adequate enough to produce reliable results.

Level of education

The education background of respondents who participated in this study as indicated in table 4.1 is that 1 (1.8%) of the respondents is has Technical and Vocational School Diploma, 7(12.3%) of the respondents have college Diploma, 28(49.1%) of the respondents have First Degree, and 21(36.8%) of the respondents have Master and above. In terms of educational level of the respondents more than 85% are First-Degree holders and above. There is no respondent of grade 12 and blow in the construction projects who participated in questionnaire. This shows that the respondents are capable of providing the relevant information on the objectives of the study.

Responsibility (the current role) on the project

Results from Table 4.2 and figure, majority of the respondents 3 (5.3%) are project managers, 8 (14.0%) are team leaders of the projects, 13 (22.8%) are resident engineers 11 (19.3%) are office engineers, 14 (24.6%) are site engineers and 8(14%) are other key staff of the projects. The questionnaire addressed the selected targeted population that participated in the projects on site and in office at different levels from site engineer to project managers. This the diversity of responsibility helps to get better information from their specific experience, different perceptions and subsequently to justify based on broad view.

Organizational distribution of the respondents

In terms of their organizations, the distribution is as follow: 25 (43.9%) are from client or FHC, 21 (36.8%) are from contractors, 7 (12.3%) respondents are form consultant, 2 (3.5%) are from regulatory body and others.

4.3. Causes of the Change orders

In this section, the determinants causes of the change orders are discussed. The study required to examine factors that causes for change and change orders in housing construction projects of FHC. For decades, various researchers have studied the causes of change orders and delay in construction projects around the world and at home in various ways. Since the reasons for change orders and project delay were different according to project type, area, and the number of stakeholders involved.

In this study about 32 different causing factors of change orders which reviewed from different literatures were grouped in the questionnaire and the responses were discussed. Descriptive statistics, including percentage, mean, and standard deviation, were employed to analyze the responses. To interpret the mean scores from the five-point Likert scale, a mean score interpretation scale, adapted from commonly accepted practices for Likert-type data, was developed.

As described above, the respondents of this study are professionals in construction industry, and participated in either one of the organizations (clients, contractors and consultants) of FHC housing construction projects. These individuals are expected to be able to identify the causes of change orders, the impact and handling processes of construction projects based on their experience.

4.3.1. Ranking and RII Computation

The ranking and importance index use an interval scale by assigning a weight to each interval from (strongly disagree) which equals to 1to (strongly agree) equals to 5to conduct the required parametric statistics.

Mean Item Score

The Mean Score method was adopted for the analysis of scaled responses by using the mathematical expression of: $MS = \Sigma (FX) / N. (1 \leq MS \leq 5)$ ……(Eqtn.1)

Where "X" is the score or weight given to each factor being rated or ranked by respondents and ranges from 1 to 5,
"F" is the frequency of responses to the respective ranking (1 – 5) for each factor, and
"N" is the total number of responses concerning that factor.

The Mean Score is computed for each factor or cause of change orders, the impact and the management strategy and is then used to compare other factors by ranking. A high mean score represented the most important variable.

Therefore, Mean Score = $(5F5 + 4F4 + 3F3 + 2F2 + F1)/N$.

Table 4.3 Top ten factors for the causes of changes of FHC projects

Causing factor of change order	Responsible stakeholder	RII	Mean score	Rank
Fluctuations of market demand for materials	external	0.85	4.23	1st
Change of design modifications (owners request change)	Owner	0.83	4.16	2nd
Addition, omission or alteration of works by the client	Owner	0.82	4.09	3rd
Change in specification/ materials change by the client	Owner	0.78	3.88	4th
Financial difficulties faced by contractor	Contractor	0.77	3.84	5th
Unavailability of project materials or equipment in local market	External	0.76	3.82	6th
Delay in response to the fast decision-making process by the contractor	Contractor	0.76	3.82	7th
Financial problems faced by the client	Owner	0.76	3.79	8th
Utility companies	External	0.76	3.79	9th
Change in technology	External	0.76	3.79	10th

Source: own survey and SPSS result (2026).

As shown in the table 4.3 above, the top 10 ranking of the change orders factors was determined by taking the relative importance index of the reported data for all respondents. From the 32 causing factors of the change orders in FHC housing construction projects, the fluctuation of market demand of materials from external factors stands 1st with RII of 0.85& 4.28 mean score and change by design modifications or owners request change, addition, omission or alteration of works by the client from owner related causes are stand 2nd and 3rd with RII of 0.83 & mean score of 4.16, and with RII of 0.82 & mean score of 4.09 respectively. According to the respondents, consultant related causing factors are not stand in top ten ranking order and client related causes take big proportion followed by external factors for the change orders in the corporation. Lack of experience and judgment of the supervising authority is the least important causing factor for change orders with RII of 0.66 & mean score of 3.30 from consultant related factors. The average of all the 32 respondents RII value is 0.74.

Table 4.4 average mean score and RII of stakeholders' factors of change orders

Group	Average Mean score	Average RII value
Owner related Causes	3.8	0.76
Regulatory and external	3.78	0.76
Contractor related	3.64	0.73
Site conditions	3.63	0.73
Consultant related	3.55	0.71

Source: own survey and SPSS result (2026).

Table 4.4 above shows the collective (origin of factors), owner related causes of change orders are considered as the most important cause with RII of 0.76 and mean score of 3.8 followed by Regulatory factors/ external factors with RII of 0.76 and mean score of 3.78. Contractor related change causing factors with RII of 0.73 and mean score of 3.64is the third group of factors. According to the survey report, consultant related factors are less important for the changes in the construction projects of the corporation.

4.5 Impact of the change orders

According to many literatures in projects specifically in the construction industry, the word delay is applied to describe the time overrun of a project beyond the officially agreed completion time due to causes related to the main stakeholders involved in the contract. Delay can be caused by client, contractor, and consultant, external factors such as regulatory bodies, market, bad weather conditions, and suppliers.

In this respect, the respondents were asked to rank the delay or the impact of the change orders on the projects of the FHC using five point likert scales. The following table clearly shows the Relative importance index (RII) of effects on the projects by the above mention factors and changes.

Table 4.5: Mean and RII of the effects in FHC projects by change order

	Impact	RII	Mean score	rank
1	Impact on delay of time	0.88	4.40	1
2	Impact on cost overrun	0.88	4.39	2
3	Impact on quality of work	0.78	3.88	5
4	Impact on parties /dispute	0.76	3.82	6
5	Impact on other projects (work hold)	0.76	3.81	7
6	Workflow disruption	0.75	3.77	8
7	Labor productivity	0.76	3.82	6
8	Demolition and rework	0.83	4.14	3
9	Delay in due payment	0.80	4.02	4
	Average	**0.80**	**4.01**	

Source: own survey and SPSS result (2026)

From the result of the analysis presented in Table 4.5, nine (9) effects or outcomes of changes are perceived to occur often in FHC projects because their mean scores are above 4.0 which means “often,4.0” on the measurement scale used. The effects that often occur in construction projects due to change orders as the respondents filling are: time overrun with RII of 0.88 & mean score (4.40) strands as the first variable, cost overrun with RII of 0.88 & mean score (4.39) stands the second variable, and demolition and rework with RII of 0.83 & mean score (4.14). Others are; dispute between parties (3.82), Labor productivity during construction (3.82), and Impact on other projects (work hold) (3.81) are least impacted outcomes or variable of change orders in FHC housing projects.

As the expression of respondents, all the variables can be affected strongly by the change orders on average of RII 0.80 and mean score of (4.01).

4.5.1 The Relationship between Variables

4.5.1.1 Correlation

A correlation coefficient is a statistical number between -1 and 1 that measure the strength and direction of a relationship between two or more variables. It is used to determine whether there is a significant relationship between the variables. It also reflects how similar the measurements of two or more variables are across a datasets in the study. In this study, Pearson's correlation coefficient (r) analysis method is used to show the connection between dependent and independent variables.

Table 4.6 Mean and standard deviation of Dependent and Independent Variables

Dependent and independent Variables			
Variables	N	Mean	Std. Deviation
Client related	57	2.66140	.541412
Consultant Related	57	2.83860	.734301
Site related	57	1.08772	.239098
External Factors	57	2.26667	.392489
Contractor related	57	2.91053	.813872
Impact of change order	57	3.60526	.648741

Source: own survey and SPSS result (2026).

From the table 4.6 above the analysis of the independent and dependent variables, ranked from the highest mean score to the lowest; the impact of the change orders (dependent variable) with highest mean value of 3.6 and slandered deviation of 0.65 shows that the respondents perceived that there is substantial impacts on time and budget of construction projects with some varied opinions. The moderate value of independent variables impact of change orders on time and cost ranged from contractor related factors with mean value of 2.9 to the low impact of site related factors with the mean value of 1.08 and slandered deviation of 0.24.

Table 4.7 Correlation analysis

Variables		Client related	Consultant Related	Site related	External Factor	Contractor related	Impact of change order
Client related	Pearson Correlation	1					
Consultant Related	Pearson Correlation	.731**	1				
Site related	Pearson Correlation	.594**	.584**	1			
External Factor	Pearson Correlation	.658**	.440**	.633**	1		
Contractor related	Pearson Correlation	.670**	.681**	.512**	.449**	1	
Impact of change order	Pearson Correlation	**.688****	**.626****	**.599****	**.465****	**.787****	1
**. Correlation is significant at the 0.01 level (2-tailed).							

Source: own survey and SPSS result (2026).

The above table 4.7 shows the Pearson correlation analysis examining the relationship between the impacts of the change order such as client related, consultant related, site related, external factors, and contractor related causes on the time delay and cost overrun of the housing construction projects. As a grouped analysis of independent and dependent variables; there is positive, statistically significant relationships with dependent and independent variables with relationships occurred by (p value less than 0.00).

Contractor-related factors have the strongest relationship (r = 0.787). This indicates that as contractor-related causes such as (incompetent technical staff, financial difficulties, lack of experience, poor workmanship, poor planning and scheduling, insufficient coordination of parties, delay in response, safety considerations) in collectively increase the impact of change orders increases substantially.

Client-related causes (r = 0.688) and **Consultant-related causes** (r = 0.626) also have strong positive correlations with the impacts of change orders. **Site-related causes** (r = 0.599) show a moderate to strong relationship and **External factors** (r =0.465) have the least relationship with the impact of change orders compared to the other variables.

Accordingly as indicated above, the Pearson Correlation matrix presented show that all independent variables except site related and external factors have strong positive and statistically significant relationships impact of change orders at ($p < 0.01$) significance level.

4.5.1.2 Regression Analysis

Whereas correlation analysis provides us with a summary coefficient of the extent of relationship between two variables, regression analysis provides us with an equation describing *the nature of the relationship* between two variables. In addition, regression analysis supplies variance measures which allow us to assess the accuracy with which the regression equation can predict values on the criterion variable, making it more than just a curve-fitting technique (Kachigan, S. K. (1991).

Multiple regression analysis helps to identify the individual contribution of each predictor variable while controlling the effects of other variables in the model. The regression model is expressed as:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon$$

Where:

- Y = Dependent Variable,
- β_0 = Constant,
- β_1–β_4 = Regression coefficients,
- X_1 = client related causes,
- X_2 = consultant related,
- X_3 = site related factors,
- X_4 = external factors,
- X_5 =contractor related factors
- ε = Error term.

The regression model's overall significance was assessed through assumption tests; p-values and ANOVA tests, with variables yielding a significance value below 0.05 identified as statistically significant predictors of change orders impacts.

Normality Test

The normality test is done to examine whether the residuals of the regression model are normally distributed in which it is one of the key assumptions of multiple linear regression analysis. Ensuring its normality is necessary because it affects the validity of statistical analysis, including hypothesis testing and confidence intervals. Thus in this study, normality test was assessed using histogram of standardized residuals and a Normal P-P plot.

Histogram of Regression Standardized Residuals

A histogram of regression standardized residuals with a superimposed normal curve for the dependent variable of impact of change orders is used to conduct a normality test.

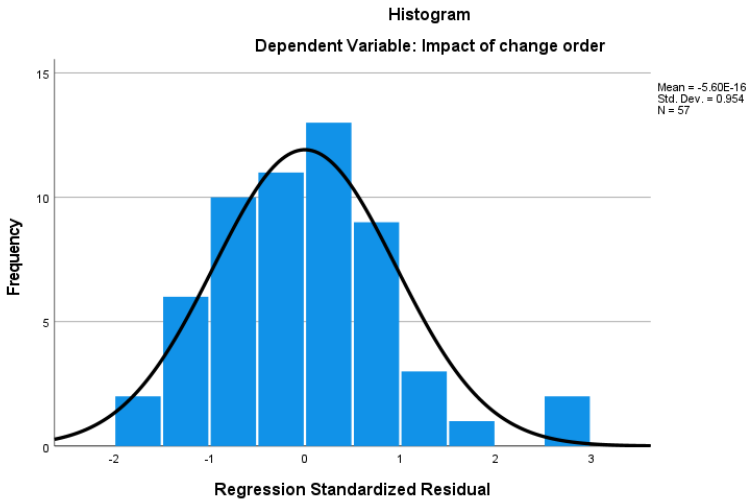


Figure 4.1 Histogram of Regression Standardized Residual
Source: SPSS result (2026).

A histogram of the standardized residuals implies that the residuals are approximately normally distributed in which the distribution of bars generally follows a bell-shaped curve. Most observations are concentrated around the center, implying that the residuals are centered to zero.

In addition to this, the mean of standardized residuals is approximately *-5.60E-16* in which it is effectively zero, verifying that the residuals are centered on zero as expected in a correctly specified regression model. And also, the standard deviation of standardized residuals is 0.950 in which it is very close to the expected value of 1, supporting that the residual distribution is consistent with the normality assumptions. Given the relatively large sample size (n = 57), minor deviations are not strong evidence of serious skewness or kurtosis that would indicate a violation of the normality assumption. Therefore, a histogram shows that the normality assumption of the multiple regressions is reasonably satisfied for the study regarding the impacts of change orders in construction projects.

Normal P–P Plot of Regression Standardized Residuals

A Normal Probability-Probability (P-P) Plot was used to further assess whether the residuals of the regression model are normally distributed, which is a key assumption for multiple linear regression analysis.

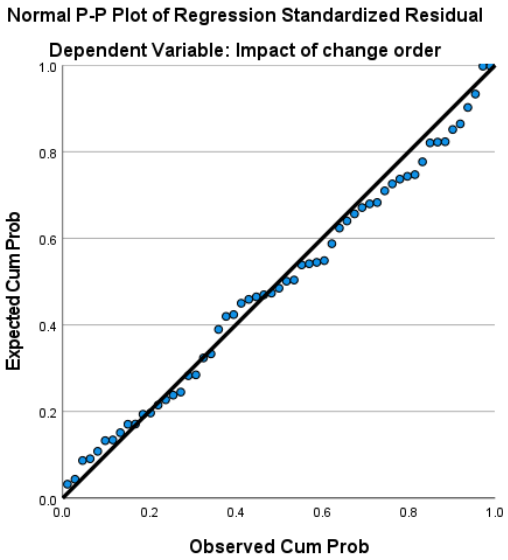


Figure 4.2 Normal P-P Plot of Regression Standardized Residual
Source: SPSS result (2026).

A Normal P-P Plot of Regression Standardized Residuals compares the observed cumulative probabilities of the standardized residuals with the expected cumulative probabilities under a normal distribution. As shown in Figure 4.2, the plotted points present in this study, are distributed reasonably close to the diagonal reference line implying that the residuals are normally distributed. The residuals show that the model is stable, balanced (zero mean error), lacks problematic outliers, and predicts the impact of change orders with an average accuracy margin of about 3.58 points.

The overall pattern of the distributions remains reasonably aligned with the diagonal line, indicating that the observed residual distribution does not substantially differ from the expected normal distribution. Thus in the study, the Normal P-P Plot shows that the normality of the assumption tests needed for regression analysis is reasonably satisfied.

Table 4.8 Multiple Regression Model Summary

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.834[a]	.696	.666	.375079
a. Predictors: (Constant), Contractor related, External Factor, Site related, Consultant Related, Client related				
b. Dependent Variable: Impact of change order				

Source: SPSS result (2026).

From the table 4.8 above, about 69.6% of the variance in the Impact of change order (dependent variable) is explained by the independent variables such as contractor related, External Factor, Site related, Consultant Related, and Client related factors. This indicates a strong model fit, as nearly 70% of the changes or fluctuations in the impact of change orders can be accounted for by these predictors.

Table 4.9 ANOVA test assumption

ANOVA						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	16.39354	5	3.27871	8.3305	.000[b]
	Residual	7.17489	51	.4068		
	Total	23.56842	56			
a. Dependent Variable: Impact of change order						
b. Predictors: (Constant), Contractor related, External Factor, Site related, Consultant Related, Client related						

Source: SPSS result (2026).

As shown in the table 4.9 above, the F-statistic tests of an ANOVA indicates whether the independent variables (Contractor, External Factors, Site, Consultant, and Client related) as a group significantly predict the dependent variable (Impact of change order). Because the significance value of p value less than 0.05, the overall regression model is highly statistically significant. The predictors explain a significant amount of the variance in the impacts of change orders.

4.6 The Current Statuses of FHC Projects

Federal Housing Corporation has restarted construction of new building projects after the reforming of the organization in 2018 that is after the long period of time of its construction experience. Formerly in 1980's it has a good experience of construction and renovation works and in between it was not engaged in construction works. After the reform, mixed use housing construction projects were started in 2019 by hiring Designing Consultants and then designing by two phases, with phase one (Tezena, Mekanisa, Bole, British, and Aware sites) and phase two (Kebena, Kokeba-tsiba, Mesirak-Atekalay, Gerji and Somale-tera) sites. All the projects are mixed use housing projects (for commercial or office and residential).For the construction of the projects, the corporation has also hired Construction Project Management (CPM) Consultant in order to supervise the construction processes. All the projects except Gerji, which is Design-Build (DB) project, followed a conventional Design-Bid-Build (DBB) bidding systems. From phase one lot 1, (Tezena site) which is located in KolfeKeranio Sub City around Tor Hayloch near Tezena Hospital with the structural design of two towers 2B+G+10 stories project started on May 20, 2019 with an initial contract duration of 603 days. The total initial cost of the project was recorded as 353,723,090.66 Birr. Lot 2,Mekanisa site project, which is found in Nifassilk Lafto Sub City around Mekanisa area in front of Mekaneyesus Seminary College with the design of two towers B+G+10 stories project, started on Apr 05, 2019 with an initial contract duration set at 720 days. The total initial contract cost of the project was recorded as 351,082,658.58Birr. Lot 3, Bole site project is found in Bole Sub City at the back of Bole Friendship with the project size of 2B+G+9 stories project, started on Apr05, 2019 with an initial contract

duration set at 720 days. The total project initial contract cost was 217,733,344.46 Birr. Lot 4, Aware site project which is found in Yeka Sub City near Aware Roundabout with the project size of 3B+G+10 stories project, started on Apr 05, 2019 with an initial contract duration set at 540 days. The total project initial contract cost was 169,914,387.78Birr.

Lot 5, Kebenasite project which is found in Arada Sub City near Kebena Roundabout with the project size of 2B+G+10 stories project, started on Apr20, 2020with initial contract duration set at 540 days. The total project initial contract cost was 251,214,192Birr. This project was incorporated in to the first phase projects by substituting British Embassy site which was late to handover the project for contractor because of the Tigray region conflict.

Currently except British Embassy site(lot 6), which is 2B+G+10 stories two tower project, all the first phase projects are completed and the final acceptances were took place. British site has been terminated twice, first during the Tigray region conflict because it was held by Tekelebrihan Ambaye Construction and at the time the construction company was in trouble to do construction works. The second case was because of the material cost inflation, and now its project status is at 63% only and currently it is shifted in to second phase projects category. Initially it was started on Jul.12, 2021by the contract amount of 251,214,192 Birr and duration of600 days.

Second phase projects such as Kokeba-tsiba, Mesirak-Atekalay, Gerji and Somale-teraare at different level of statuses.

Lot 7, Kokeba-tsibasite project, which is found in Yeka Sub City at the back of Kokeba-tsiba School with the project size of 2B+G+9 stories with two towers project was started on Apr 20, 2020with an initial contract duration of 540 days. The total project initial contract amount was 229,733,266.23 Birr.

Lot 8,Mesirak-Atekalaysite project, which is found in Yeka Sub City at the side of Misirak-Atekalay School with the project size of two towers 2B + G+ 10 stories project, was started on Apr.20, 2020with an initial contract duration of 720 days. The total project initial contract amount was 359,464,744.33 Birr.

Lot 9 Gerjisite project, which is found in Bole Sub City GerjiGoergis area at a near distance of Bole International Airport with a village of six B+G+10 sky light blocks and ten B+G+10 stories apartments housing started on Oct. 10, 2020with initial contract duration of 540 days. The total initial project contract amount was 3,066,405,712.50 Birr. It is a Design and Build (DB) type of contract with new ‘Aluminum Formwork’ technology.

Lot 10, Somale-Terasite project, is found in Arada Sub City Somale-Tera area in front of Benin Mosque. It is the largest high-rise project with the size of 3B+G+23 two towers stories which was started on Feb.3, 2021with initial contract duration of 864 days. The total initial project contract

amount was 2,142,613,137.26 Birr. It is a largest and highest Design-Bid-Build (DBB) project which is constructed by foreign contractor, China Communication Construction Company (CCCC).

Currently Federal Housing Corporation (FHC) is undertaking several other commercial and residential construction projects in addition to the above mentioned, each exhibiting varying levels of completion and complexity.

As shown in the table 4.10 below, the summery of the selected projects was presented in terms of changes by time and cost. All the projects are encountered changes in time and cost due to one or more reasons of the change causing factors. As the interviewees of the corporation project contract administration engineers and other professionals explained, there are numbers of reasons for the occurrences of change orders and then for delay of time and cost overrun. Among these reasons the majors are: unavailability of materials in market or escalations of material cost, design modifications, unforeseen geological situations, material specification changes (especially finishing materials), adverse weather, impact of COVID 19 and conflicts in the different parts of the country (which reduced labor and material supply), high inflation rate of currency, addition and omission of works by changing ideas or request by owner like commercial or residential parts or lots and so on. These factors can be initiated by owner (FHC), some are by consultant and contractors. Infrastructure providing organizations also have their own contribution for the changes and then for the delay of the projects by changing and setting their own standards and specifications of the utility lines such as water, electric, sewer.

Table 4.10 Selected FHC housing projects and their statuses

No.	Project	Contract		Current status	Time delay	%	Cost overrun	%
		Amount/ cost	time (days)					
1	Tezena site	353,723,090.66	600	Completed	617	102.8	270,575,426.08	40.9%
2	Mekanisa site	351,082,658.58	720	Completed	545	75.7	143,726,092.95	76.5%
3	Bole friendship site	217,733,344.46	600	Completed	545	90.8	70,358,154.71	32.3%
4	British Embassy site	483261569.55	600	63%	911	151.8	386,609,255.64	80%
5	Aware site	169,914,387.78	540	Completed	724	133.3	73,053,844.87	22.8%
6	Kebena site	251,214,192.22	720	Completed	766	106.4	112,978,491.73	25.5%
7	MeserakAtekalay site	359,464,434.33	720	Completed	1074	149.2	203,175,777.03	56.5%
8	Kokebtsiba site	229,733,266.23	540	Completed	1266	234.4	183,786,612.98	80%
9	Gerji site	3,066,405,712.50	524	Completed	438	83.6	1,633,078,181.33	53.3%
10	Somaletera site	2,142,613,137.2	864	95%	1018	117.8	1,714,090,509.81	80%

		6						
	Total	**7,625,146,102.9**	**6428**		**7904**	**123%**	**4,791,432,347.1**	**62.8%**

Source: Project follow up and contract administration directorate and desk report document 2026

Table 4.10 above shows the analysis of secondary data collected on the original and final contract period of individual projects to assess completion time, time overrun cost and cost overrun and their percentages experienced as a result of change orders.

Time overrun of the case projects

As analyzed above from questionnaire of respondents, delay of time is the most affected variable by the change order factors in construction projects with relative importance index (RII) of 0.88 & mean score (4.40). Also according to the document analysis shown in above table, from the case study projects started by FHC from May, 2019 to date, there is no project completed within the pre estimated time schedule. They all exceeded their originally estimated completion time with a minimum deviation from the schedule of 545 days (75.5%) by Mekanisa site to the maximum of 1266 days (234.4%) by Kokeba-stiba site. On the average, the projects exceeded their completion time with a total deviation of 7904 days (123%). This is a big deviation of time schedule in construction projects and much more from acceptable range in contract documents. This finding is consistent with some of the previous studies like (Shambel Gebrehiwot et al 2018), (Abebe Demissew, et al 2023), and (Andualem Endris 2016).

As we can see from table 4.10 above, estimated time for each projects depend up on the volume of work. The three projects such as Tezena, Mekanisa and Kokebatsiba sites have almost the same work volume (2blocks, 2B+G+10 buildings) except their location differences. But the estimated time duration for the completion of the three projects was not similar like 600, 720 and 540 days respectively. This shows that there was unrealistic contract duration estimated by project team which can be one of the causing factors for time overrun in construction projects.

Cost overrun

Cost overrun is the most predominant adverse effect of change orders on project performance. It experienced in all the projects of the corporation. There is no project completed within the pre estimated budget. All projects exceeded their originally estimated completion budget with a minimum deviation of 73,053,844.87 birr (22.8%) of Aware site and the maximum percentage of deviation of the projects by 80% of Kokeba-stiba, British and Somale-tera sites by the amounts of birr 183,786,612.98, 386,609,255.64 and 1,714,090,509.81 respectively. On the average, the projects exceeded their completion budgets with a total deviation of 4,791,432,347.12 birr (62.8%). This is a big deviation of budget in construction projects and much more from acceptable range of 25% to 30% in contract documents. British and Somale-tera sites are still ongoing projects thus; cost overrun may increase from this amount.

4.7 Change management strategies

Table 4.11 Ranking of change control strategies

	Change management strategies	RII	Mean score	Rank
1	Understanding Scope and schedule of change work	0.88	4.42	1
2	Proper use of Work Breakdown Structure	0.88	4.42	2
3	Effective Leadership skill	0.87	4.33	3
4	Identifying potential areas of changes, risks, (+ve& -ve changes)	0.86	4.32	4
5	Available technical skill (qualified and competent PM team)	0.86	4.30	5
6	Well defined project planning of scope, objectives	0.85	4.26	6
7	Knowing, Checking and reviewing of Contract document	0.85	4.26	9
8	Develop contingency plans (budget & resources understanding)	0.85	4.26	8
9	Setting priorities for changes	0.85	4.26	7
10	Evaluating resource availability	0.85	4.25	10

Source: own survey and SPSS result (2026)

The strategies presented in Table 4.11 indicates that the top ten most effective change orders management strategies of different 29 variables, which are selected by the respondents perceptions according to their RII and mean scores. 'Understanding Scope and Schedule of change work' and 'Proper use of Work Breakdown Structure' from change impact analysis phase with equal RII of 0.88 and mean score of 4.42 falls in strongly agree perception rate. 'Effective Leadership skill' with RII of 0.87& mean score of 4.33, 'Identifying potential areas of changes risks' with RII of 0.86 and mean score of 4.32, 'Available technical skill' (qualified and competent project management team) with RII of 0.86 and mean score of 4.30, and Well defined project planning of scope, objectives with RII of 0.85 and mean score of 4.26 from proactive phase strategy takes from 3rd to 6th positions. Thus, as the data indicates that understanding the scope of change work, preparedness for change by organizations and proactive strategies are the most effective strategies to control or minimize the adverse effects of changes on construction projects performance.

Change Management Strategy cases

As discussed above in literature part, since the construction industry is project-based activity and changes are inevitable, the best project management processes are to be discussed in the context of typical stages/phases/ in a construction projects.

According to the interviewee participants of this study and documents, any change can be identified and proposed by responsible body of the project like residence engineer (RE) of the contractor or project engineer (consultant), and by the owner for design &material specifications changes and financial cases. The process of change management has to pass through stakeholders review; work breakdown and cost benefit analysis. Then after the idea was accepted and cost-benefit analysis

checked by the engineers of stakeholders, for the final approval and decision the case should bring to the higher officials or chief executive officers, then if it is accepted and approved, it will be implemented and documents will be organized as revised bill of quantities, as built drawings, and amended contract and schedules. The interviewees said that, in FHC projects all the processes and procedures of change orders management strategies has been conducted with close project site supervision, and control of higher officials by regular weekly and monthly meetings with stakeholders, and this close supervision of the projects made it to be successful.

The change orders management system in FHC projects is structured as usual like identification, (request by contractor or other stakeholders), verification and approval by consultant and client by evaluating projects merits and demerits. Changes are not made and implemented without appropriate decision &approval and written document.

After confirming and accepting the ideas or concepts for changes, the corporation tried to provide different solutions for implementing of different changes accordingly. For example, for changes occurred due to the unavailability of materials in market, or inaccessible due to the regional conflicts, the corporation made discussion and consensuses with contractors and consultant to change the scarce materials with locally available ones with in closed supervision of both consultant and corporation. Marble and some of the sanitary and electric materials were changed to locally available materials due to the inaccessibility on local market. Another important practice of the corporation to protect delay of projects and support contractors is supplying the construction materials by credit. Federal Housing Corporation is one of the construction materials supplier company and therefore it can supply materials for contractors by the using the advantage of long time experience of supplying construction materials from manufacturers to contractors. Cement, reinforcement bar, hollow concrete blocks and ceramics were supplied for all contractors by credit to be deducted from payment to support cash shortage of contractors. The corporation also work closely with contractors by making decision even by taking risk to test and use of new items, technologies and methodology in construction sectors which provided by the contractors or consultant like Aluminum formwork, and 3D technologies, which can help to increase workability and decreases time of completion of construction work and increase quality. These technologies are currently used by all over the city and became the so called new technologies introduced by the corporation.

In terms of changes occurred in quantity of work and for unforeseen conditions, after the detail procedures of change approval processes, corporation can made payment for the amount of work done and for materials by checking cost breakdown analysis approved and provided by the consultant. Always the corporation works in closed mutual relationship with contractors and consultant with supports and solutions rather than claiming and litigations for delay of projects.

Working closely with contractors and consultant is important to the completion of projects within cost and time schedule and for better performance. This closed cooperative relation between client, contractors and consultant helps for the project completion in pre estimated schedule and budget.

Although the change management strategies in the corporation is formal and stepped, preconstruction planning and design phase or proactive change management strategies are not comprehensive and not examined in details. It has to be considered and should be improved. Most of the changes were created by design & use change of housing, addition of work and alteration of materials which can be managed in planning and design phases by active participation of all stakeholders. Lack of detail working drawings, material specifications which cannot be applied and incompatible with local standards, rough bills of quantities and not detailed contract or bid documents, and not assessed potential risk areas are some of the sources of change orders should be considered in planning phase critically. On the other hand, the organization culture of the corporation is good for change readiness and communication between project team and stakeholders after changes occurred.

4.8 Major Findings of the Analysis

About 32 different causing factors of change orders from different literatures were grouped in the questionnaire by origin of causes as client related, contractor related, consultant related, site related and external or regulatory body related causing factors for change orders; about 9 impacts or outcomes of the change orders and 29 points of strategies to control the changes in construction projects were analyzed.

For the causes of change orders by using RII and mean score ranking methods and inferential statistics to analyze the questionnaires; 'fluctuations of market demand for materials' from external origin of factors became the most affecting factor or cause for change orders in the construction projects followed by the 'change of design modifications', 'addition, omission or alteration of work by client' and 'material change' by client from owner related causes from the individual causes and contractor related causes contribute more from origin grouped factors. Thus from the analysis, owner related causes of change orders as an origin of causes in construction projects of FHC are considered as the second most important causes for change orders and consultant related causes became the least factors for changes. When we compare the outcomes of this investigation with some previous research outcomes, we found that the outcomes agree with the results of research conducted in Jordan by Jamal M. A. et al (2015) and in Oman by Alnuaimi et al. (2010) where it is clearly concluded that the first two reasons for changes are owner related.

From the data analysis of the impact of construction projects due to the changes, the most affected variables as of the respondents were time and cost. Delay of time and cost overrun by the same RII values of 0.88 and mean score values of 4.40 & 4.39 respectively. As the expression of respondents,

all the variables can affected strongly by the change orders on average of RII of 0.80 and mean score of (4.01).

On the same way in the case study projects from the document review, the minimum time extension was 545 days (75.5%) for Mekanisa project and maximum of 1266 days (234.4%) for Kokeba-tsiba project. An average delay of time is 123%. Comparing the outcomes of this investigation with some previous research outcomes we found that, variation of time in FHC projects is almost the same as of an average percentage of **126.5%** variations of time in previously studied project by Tewodros Zewdu (2022) in road construction projects in Addis Ababa. But it has big difference from the average time delay of 57**%** which studied previously by Abebe Demissew of Deber Markos University projects and **29.20%** average time delay of African countries context stated by Simon-Eigbe, B.O. (2022) in Edo State in Nigeria.

In terms of cost overrun, Aware site project with minimum of addition of 73,053,844.87 birr (22.8%) and maximum of 80% by the sites like Kokeba-stiba, British and Somale-tera projects. A total of 7,625,146,102.9 birr was estimated initially for the ten projects and 4,791,432,347.1 birr was added which accounts an average of 62.8% cost overrun. This outcome of cost overrun in FHC projects is much more than the previously studied average percentage of **25.56%** variations in road construction projects in Addis Ababa studied by Tewodros Zewdu (2022). Again 80% maximum cost overrun of this study is greater than the maximum of **19.60%** which studied by Andualem Endris (2016) in Addis Ababa public projects; and less than the maximum of **135.06%** of cost studied by Shambel Gebrehiwot (2018) in Addis Ababa road projects review paper. In the FHC projects, time schedule in planning period was seems estimated very tight and there was some unrealistic estimations. For example, the time estimation in the selected cases, for some projects which have approximately the same volume (scope) of works, there is different time schedule. This indicates that improper time schedule and cost estimation was made in planning and designing phases which is one of the causes for time and cost overrun. Scheduling and estimation has to be done by taking time and using the proper work break down structure.

The strategies to control the adverse effects of change orders on construction projects that strongly agreed and rated by respondents are; understanding of scope and schedule of change work, proper use of work breakdown structure (WBS), effective leadership skill, and identifying potential areas of changes risks.

As of the interviewee, although there is success of completion of more than ten projects in past five years by upper management commitments such as strong supervision, timely decisions of issues, breakthrough of an unnecessary bureaucracies and forming close relation with project stakeholders; projects of the FHC are not free from challenges and problems. They faced delay of time, cost

overrun, end user claim about sanitary work quality and poor workmanships, and also projects have problems of formal project closing process such as timely formal acceptance of the project, archiving of the files and documenting lessons learned, complete contract closures of projects after the provisional and final acceptances of the projects faced.

CHAPTER FIVE

CONCLUSION & RECOMMENDATIONS

5.1. Conclusions

This study investigated the change orders by conducting desk study, questionnaires and interview to identify the projects change management performances. The primary goal of this study is to identify and explore the major causes of change orders, their impact of the change orders and the managing strategies of change orders in Federal Housing Corporation housing construction projects. In conclusion, change orders, which are basically caused by the fluctuation of market demand of materials, design modifications, an addition, omission or alteration of works by the client, change in specification or materials change by the client, financial difficulties faced by contractor are the most significant causes of changes in FHC housing projects. Thus as the collective origin of causes for changes, even though all factors have strong effects; contractor and owner related factors have the more effect as a source of change causing factors followed by external factors. The consultant related factors are relatively less important for the causes as the respondents of this research. Most of the factors related to owner are factors which can be addressed and prepared in detailed during designing, scheduling and planning phases. These factors have a significant impact on cost, time, safety, productivity and work quality and in general on the performance of projects.

Time and cost overruns are the dominant frequent outcomes of changes in construction projects. Delay of time is the most affected variable by the change order factors in FHC construction projects. No one project accomplished within the estimated schedule. The average time delay percentage of the projects is 123 %. This big deviation of time seems not only by the change orders rather there is improper time schedule for the projects. Cost overrun is also one of the project factors which can be affected by the change orders especially in construction projects. In the FHC case, the entire project's cost is more than the estimated budget by an average of 62.8%. Quality of work, rework, wastage of materials, disputes, low productivity of labors, and delay of payments are another impacts of the changes.

In terms of change management strategies and control, there are significant implications of change management strategies from the results obtained. The top most effective change orders management strategies ranked by the respondent indicate that understanding of the scope of change work, preparedness for change by organizations and proactive strategies are the most effective strategies to controls or minimize the adverse effects of changes on construction projects.

The change orders management system in FHC projects is structured as usual like identification, or request by contractor or other stakeholders, then verification and approval by consultant and client by

evaluating projects merits and demerits. Changes are not made and implemented without appropriate approval and written document. Then after confirming and acceptance of changes, the corporation made discussion and consensuses with contractors and consultant for change without compromising standards and within closed supervision of both consultant and corporation. An important practice of the corporation to manage the projects changes is supplying the construction materials for contractors by credit to solve financial problems using the supplier advantage of the corporation. Strong communication, discussion and working in collaboration with contractors and consultants rather than claiming one another is the other change minimizing strategies of the corporation. There is no claim and legislation case in any project with contractors and consultant which can be considered as strength of the corporation.

5.2 Recommendation

Projects should be managed effectively for the successes of project completion. Managing change orders can facilitate the delivery of a successful project and prevent adverse effect such as delay, disputes, and dissatisfactions among the project parties.

Causes of change orders discussed in this study are mainly due to contractor, owner related and external factors; the impact of delays and strategies of control methods are discussed. Thus, the study draws the following recommendations to minimize the occurrence of changes and change orders occurrences and for effective change orders management processes in construction projects.

The client's proactive change order strategies preparation for the projects has critical importance on the success of project change management performance. Thus, in planning and preparation phase; clear project ideas & brief scope of the work, WBS, complete contract document preparations, assessment of market conditions, regulations and standards, should be identified and prepared by owner ahead by carrying feasibility and feedback of end users.

Consultants and other stakeholders have to prepare detail design, clear specification and bill of quantities, clear bid document preparations, and reasonable estimation of project schedule & establish change control systems in the document ahead. They also have to study in detail about site conditions, standards, rules and regulations,

Client, contractors and consultants relationship should be cooperative & collaborative rather than complaint one another on the progress of construction for the good performance of projects. In FHC case it has good exemplar practice of cooperation with contractors and suppliers that should be exercised in all projects. No case in law with stakeholders on this long process, delays and cost overrun. There is close relation with contractors and consultant to solve the encountered problems by negotiation without legislation the disputes.

Establishment of a proper risk management system and contingencies allowance provision for unexpected changes of materials in market fluctuations in projects, budget should be considered especially for projects extended for two and above years.

The change orders should be negotiated by knowledgeable persons or project management team and appropriate approval in writing must be taken, regular discussion and communication should be holed by the all parties.

In the case study projects, there are series time and cost overrun so it needs a detail time and cost estimations, in time projects acceptance and closing process, archiving and documentations of the projects history. As with previous research, companies that leveraged technologies such as Building Information Modeling (BIM) and real-time data analytics experienced smoother workflows due to better foresight regarding process changes. So that employees should have to take trainings of the new technologies and project management software to estimate appropriate time and scope of work, and organize & develop web based database for further lessons and documentations.

5.3 Suggestions for further study and limitations

For further study, researchers should explore changes, their impact and change management systems by comparing local contractors verses foreign, and or conventional method projects such as design-bid-build (DBB) verses design-build (DB) projects for the comparisons of effectiveness of managing change in construction projects.

This study is conducted on one institution’s construction projects and limited contractors, there may have limitation to generalize the owner side factors for the causes of changes, change orders and change management strategies taken by the client. Another limitation encountered while undertaking this study was unwillingness of respondent to back the questionnaire, delay and shortage of shelf documents of projects.

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Annex

ADDIS ABABA UNIVERSITY COLLEGE OF BUSINESS & ECONOMICS

SCHOOL OF COMMERCE
Department of Project Management
Questionnaire

Dear respondents,

I am a master's student of Addis Ababa University in project management program and I'm conducting a research paper on the title "**Managing Changes in Construction Projects**; **Analyzing the process of Managing change orders and their impact on project budget and timeline"** at Federal Housing corporation construction projects for partial fulfillment of master's degree in project management.

In this study I kindly request your participation for the response of the following questionnaire and it will greatly contribute to the success of my research. To ensure data accuracy, please answer all questions as honestly and thoroughly as possible. The data will be used **for academic purposes only** and your response remains **strictly confidential**.

For any questions, suggestions or further information about this study, feel free to contact me by:

- Phone: Seyoumchafamo +251 912 14 27 73
- Email: seyoumchafamo@gmail.com

Thank you for your valuable time and contributions!

These are the structured questionnaires for the potential respondents of the all categories.

Part I .Background information of the respondents

Please thick your selection in the space, box or table provided using thick mark (√).

1. Your gender? Male ☐ Female ☐
2. How many years of working experience do you have? Less than 2, ☐ 2-5 ☐, 6-10 ,☐ 11-15 ☐ 20, ☐ 0 and above ☐
3. Level of your education background. Grade 10 or 12 complete, ☐ hnical and vocational school Diploma, college di☐ a, 1st Degre☐ Masters ☐ bove. ☐
4. Your responsibility on the project (current role). Project Manager _____, Team leader_____, Project Engineer_____ , Resident Engineer_____ , Office Engineer_____, site Engineer_____, Other key staff _____.
5. In which organization do you currently working? Owner (FHC)_____, contractor _____, consultant_____, regulatory body_____. Other (specify)_____.

Part II

Questions related to the extent of **the causes of change order, impact and the managing process or strategies of change orders i**n the construction projects of Federal Housing Corporation.

i. Questions related to the source of the causes or factors of the change orders (variations) in construction projects.

Instruction: in this section you are requested to rate the intensity of **the existence of the causes of** Change orders in **your construction projects:**

Alternatives: **Strongly disagree (1), Disagree (2), Neutral(3), Agree (4), Strongly agree (5)**

S.No	Source of the causes of change orders	1	2	3	4	5
	Owner(client) related causes/ sources:					
1.1	Change of design modifications (owners request change)					
1.2	Inadequate/incomplete project objectives by the client.					
1.3	Undefined scope of the project (work, schedule)					
1.4	Change in specification/ materials change by the client					
1.5	Financial problems faced by the client					
1.6	Addition, omission or alteration of works by the client					
1.7	Insufficient coordination of parties by the owner					
	Consultant related causes/sources					
1.8	Lack of planning, designing, or estimating quantities of work well accurately,					
1.9	lack of communication among design consultants,					
1.10	Inconsistency in drawing information and specifications,					
1.11	Poor supervision and rework					
1.12	Conflict between the contract document					
1.13	Lack of experience and judgment of the supervising authority					
1.14	Insufficient coordination of parties by the consultant					
1.15	Delay of response by the consultant to the fast decision-making process.					
	Site related causes					
1.16	Unforeseen site (ground) condition,					
1.17	Inclement/severe weather condition and climate					
1.18	Unavailability of project materials or equipment in local market					
	Regulatory factors/ external factors					
1.19	Changes in policies, codes and regulations by government					
1.20	Variations of standards, and quality effects,					
1.21	Difficulties and Delay in response to the fast decision-making process by regulatory body					
1.22	Utility companies					
1.23	Change of market demand					
1.24	Change in technology					
	Contractor related causes					
1.25	Construction errors, or incompetent technical staff assigned					
1.26	Financial difficulties faced by contractor					
1.27	Lack of experience of the projects					
1.28	Poor workmanship					
1.29	Poor planning and scheduling					
1.30	Insufficient coordination of parties by the contractor					
1.31	Delay in response to the fast decision-making process					

1.32	Safety considerations by contractor,					

ii. Questions related to the impact of the change orders (variations) on time and budget in construction projects.

Instruction: in this section you are requested to rate the intensity of the **effect or the impact of Change orders** that affected the construction projects performance (time & cost) in your project by the above mentioned causes:
Alternatives: **Very low effect (1), low effect (2), Moderate effect (3), High effect(4), Very high effect (5)**

S.No	The impact of change orders	1	2	3	4	5
2.1	Impact on delay of time					
2.2	Impact on cost overrun					
2.3	Impact on quality of work					
2.4	Impact on parties /dispute					
2.5	Impact on other projects (work hold)					
2.6	Workflow disruption					
2.7	Labor productivity					
2.8	Demolition and rework					
2.9	Delay in due payment					

iii. Questions related to **the managing process of the change orders (minimizing and controlling) strategies** in construction projects.

Instruction: in this section you are requested to rate the intensity of **the change management strategies taken or practiced** in your construction projects:
Alternatives: **Strongly disagree (1), Disagree (2), Neutral (3), Agree (4) , Strongly agree (5)**

	The managing (controlling and minimizing) processes	**1**	**2**	**3**	**4**	**5**
	Proactive vsreactive approaches					
3.1	Well defined project planning of scope, objectives,					
3.2	Identifying potential areas of changes, risks, (+ve& -ve changes)					
3.3	Developing proactive mitigation strategies					
3.4	Focusing on managing the immediate impacts					
3.5	Negotiation by knowledgeable persons					
3.6	Knowing, Checking and reviewing of Contract document					
3.7	Establishment of a claims and disputes resolution system as set out in the Contract,					
3.8	Knowing appropriate & clear procedures and scope of changes,					
3.9	Material specification should be clear					
3.10	Strict follow up of Project guidelines					
	Change Readiness Assessment					
3.11	Evaluating organizational culture					
3.12	Effective Leadership skill					
3.13	Available technical skill (qualified and competent PM team).					

3.14	Systematic auditing of contractor's health and safety plan					
3.15	Stakeholder engagement/ involvement					
3.16	Evaluating resource availability					
3.17	Evaluating technological capabilities					
	Change Impact Analysis					
3.18	Develop contingency plans (budget & resources understanding)					
3.19	Understanding Scope and schedule of change work					
3.20	Setting priorities for changes					
3.21	Proper use of Work Breakdown Structure					
3.22	Documented lesson learned system					
3.23	Checking and review of design changes for Feasibility					
	Communication plan					
3.24	Developing communication plan and means,					
3.25	Regular and constant communication (meeting) b/n parties,					
3.26	Developing centralized data base,					
3.27	Identifying participants and initiatives,					
3.28	Follow the sequential process of changes before accepting ,					
3.29	Developing and utilizing a web-based change order management system ,					

Part III

Interview and open ended questions to collect data for the analysis of the process of Managing change orders and their impact on project budget and timeline in FHC projects.

1. Is there any change orders occurred in your projects?
2. What are the major or common changes and the cases/ factors for the changes occurred in your construction projects?
3. Who initiated the changes in your projects and how the change orders are approved and proceed?
4. Is your organization established claims and disputes resolution systems in the contract document?
5. What are the major impacts caused due to the change orders?
6. Do you have any established organized change control system which learned from past similar projects in your organization? (Can you explain or describe or show the system?)
7. Do you conduct regular meetings between contracting parties to discuss about changes?
8. What methods or technologies or programs do you use for change order management and control in your projects?
9. How do you administer /practice the change evaluation and approval process? How effective is the process?
10. What are the roles and responsibilities of different stakeholders in managing change orders in your project?
11. What recommendation would you give to project managers on how to effectively manage change orders in construction projects?