MAKERERE UNIVERSITY

COLLEGE OF ENGINEERING DESIGN, ART AND TECHNOLOGY

SCHOOL OF BUILT ENVIRONMENT

DEPARTMENT OF CONSTRUCTION ECONOMICS AND MANAGEMENT

BACHELOR OF SCIENCE IN CONSTRUCTION MANAGEMENT

INVESTIGATING IMPACT OF CONTRACTOR-RELATED REWORKS ON BUILDING CONSTRUCTION PROJECTS IN KAMPALA UGANDA.

DECLARATION

I declare that, apart from the acknowledged assistance, this research is my own work and has not been submitted before for any degree or examination in any other university. It is submitted in fulfilment of the requirement for the Bachelor's Degree in Construction Management at Makerere University.

AYEBAZIBWE CAROS

Signature ..... Date 10/10/2022

APPROVAL

The final year project report has been submitted to the Department of Construction Economics and Management under School of Built Environment, College of Engineering, Design, Art and Technology, Makerere University with the due approval of my supervisor.

Mr. KATONGOLE GEORGE

Signature ..... Date 10/10/2022

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I extend my sincere thanks to the following people that helped me in carrying out this research.

Firstly, I thank the Almighty God who protected me throughout the whole time of research and kept me alive up to date.

I also want to thank the Department of Construction Economics and Management, College of Engineering, Design, Art and Technology and Makerere University at large for availing such a time schedule to carry out this research and other services provided. I also express my appreciation to my supervisor Mr. KATONGOLE GEORGE who spared his time to supervise me and later on inspired and encouraged me.

I also thank my course mates that have really been with throughout all this time and made us a career family.

Lasts I thank my mother and my siblings who have provided me with whatever I needed to make it this far and the love and care that they give me.

ABSTRACT

In construction industry, contractor related reworks are one of the major factors that affect the success of a construction project. It decreases the quality and productivity, and increases the cost and time of construction. Contractor related reworks commonly happens due to insufficient supervision, poor workmanship, wrong or defective materials, etc.

This research intended to determine the impact of contractor related reworks on cost, time, quality and labour productivity. Also, in this research the extent to which the contractor related reworks affect the quality and labour productivity is determined. A questionnaire survey was undertaken among 50projects in Kawempe. The questionnaire survey findings revealed that, the reworks affected the cost by 5% to 15% of construction cost. Also, the findings indicated that, there was time delay due to contractor related reworks. They also indicated that contractor related reworks affect the duration by an average of 5% of construction duration

Keywords: contractor related reworks, impact, duration, cost, quality and labour productivity.

Contents

1.0 INTRODUCTION

1.1 BACK GROUND

The construction industry is a global industry that contributes to the growth of a country's economy (Muwafaq et al., 2020). The construction industry is one of the industries that play an important role in any nation's economic growth. Construction projects are complex because they entail complex activities characterized with uncertainties and changes that are capable of increasing time and the cost of construction projects (Elshaikh, 2019). One of the most significant challenges faced by building construction projects across the globe is rework. Research aimed at investigating the client-related rework (CRR) in Singaporebased building projects confirmed that the client contributed most to rework. 41 of the 51 companies (80.4%). According to (Issn, 2010) up to 30% of construction is rework. These reworks have contributed time-wasting, unnecessary costs, increased errors and misunderstandings, which have invariably resulted in rework occurring in projects (Love & Edwards, 2004). Rework has direct and indirect impacts on project performance (Enshassi et al., 2017). The Construction Industry Institute (CII) defines field rework as activities that have to be done more than once or activities that remove work previously installed as part of a project. Doing something at least one extra time due to nonconformance to requirements (Mastenbroek, 2010). Causes of rework differ from one country to another and from one project type to another therefore, the costs of rework between countries is different (Issn, 2010). Rework occurs in various phases of the construction process or in various divisions of a company (Mastenbroek, 2010). (Muwafaq et al., 2020) concluded that there are 57 reasons accounted for the construction rework, and categorized into 7 groups. Their findings indicated that the main reworks were due to, attempt of fraud by contractor, competitive pressure / low contract value, ineffective management and decision-making, schedule pressures construction process, and the absence of job security capability. There is no gainsaying that the twin problem of cost and time overruns may not yet be over as they still characterize construction projects in most parts of the world especially in developing countries like Nigeria (Issn, 2010).

The construction industry in Uganda contributes approximately 12 percent of the Gross Domestic Product (GDP) and makes a significant contribution to the economy (Alinaitwe

et al., 2013). The construction sector also employs more than 50 percent of the non-farm workers in Uganda
(Alinaitwe et al., 2013). Moreover, the construction sector in Uganda is said to be the second largest source of employment after agriculture. The Ugandan Bureau of Statistics (UBoS) report of 2011.

1.2 PROBLEM STATEMENT

Rework is a pervasive problem within the construction industry both in developing and developed countries though on a large scale when it comes to developing countries like Uganda. Contractor related reworks in developed countries have been reduced to an approximately 4.53% of the overall construction work through using improved methods of work like mechanised technology where most of work is done by machines.

Contractor related reworks in Uganda are still on a large scale that is approximately to 8.42% of the overall construction work. This is due to use of unexperienced contractors that use a large number of unskilled labour more than skilled labour on construction sites, poor supervision and dishonest suppliers who try to go behind contractors' backs to make secret profits

Construction industry in Uganda needs a lot of investments that will improve on the level of technology, train causal workers and cater for constant and timely supervision, and this will help in research and development on all different kinds of reworks, their causes and this will help to develop different ways of reducing reworks in the Construction Industry in Uganda.

1.3 OBJECTIVES

1.3.1 Main objective

To determine the impact of contractor-related reworks on building construction projects in Kampala, Uganda.

1.3.2 Specific objectives

To find out how contractor related reworks affect time allocated to the project.

To determine the impact of contractor related reworks on the cost of the projects.

To determine the impact of contractor related reworks on the quality of the project.

To determine the impact of contractor related reworks on labour productivity.

1.4 Scope

Academic scope

This study was limited to the study of impact of contractor's related reworks on the project in Kampala, Uganda.

Geographic scope

The research was limited to only registered companies operating in Kampala district-Kawempe division particularly.

Time scope

The study was to take four months that is from May to the end of August

1.5 JUSTIFICATION

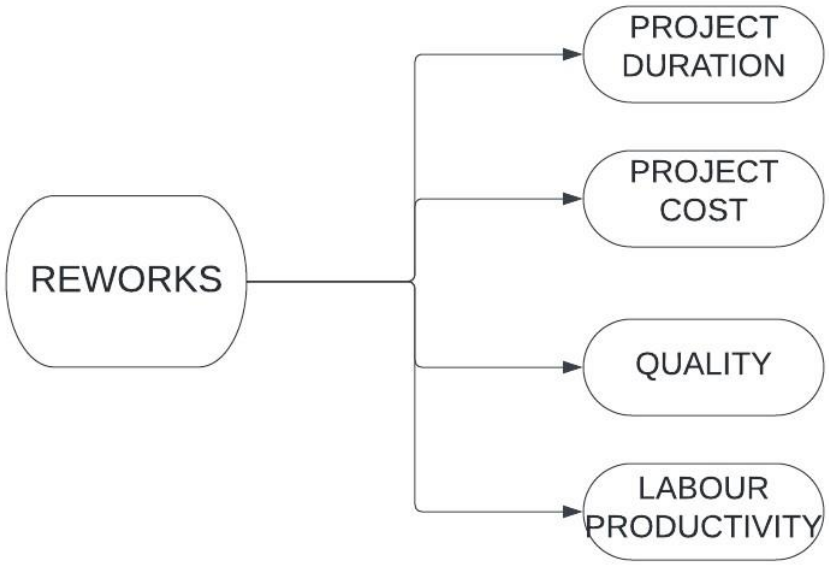
Construction projects involve a large number of direct stakeholders (clients; professional design teams and construction companies), indirect stakeholders (local authority; residents; workers and customers) and suppliers (Mutesi & Kyakula, 2010). In case of any delay whether caused by reworks or any other causes like poor material management, strikes of workers, accidents on sites, disputes between stakeholders, all these stakeholders will be affected some positively others negatively but the most core stakeholders like clients, contractors will be affected negatively which discourages others from getting involved in construction related businesses. The desire to reduce nonvalue-adding activities on construction projects emanated from the recognition of the need to reduce waste and the resultant optimization of the use of resources (Yap et al., 2017)

This study intends to investigate the underlying the impact of contractor related reworks on overall project performance so that effective containment and reduction strategies can be developed. So, I feel if I am allowed to carry out this research, it will solve the problem of delays and cost overruns caused by contractor related reworks and this will enable stabilization

of the construction industry and other dependent sectors like agriculture in Uganda in Kampala particularly

1.6 CONCEPUTAL FRAMEWORK

Conceptual framework is the visual representation of the expected relationship of variables (independent and dependent) of the study.



1.6.1. INDEPENDENT VARIABLE

The independent variable is the core of the experiment and is isolated and manipulated by the researcher to generate quantifiable results (Gould, 2001). Abiodun-Oyebanji(2017) said that the independent variable is the cause, its value is independent of other variables in study.

Reworks

It is the unnecessary effort of redoing a process or activity that was incorrectly implemented the first time (Student, 2016)

1.6.2. DEPENDENT VARIABLES

Dependent variable is the variable that is affected by the independent variable (Gould, 2001). According to Abiodun-Oyebanji(2017) The dependent variable is the effect, its value depends on changes in the independent variable

I. PROJECT COST

Is an estimate of the money required to take a construction project from initiation to closure, including all associated costs and expenses that are accrued during the building process.

II. PROJECT DURATION

Is the deadline set by the owner for the contractor to complete the project under regular working conditions, standard construction practices, and at the lowest possible cost.

III. PROJECT QUALITY

When it comes to building, quality means that projects are completed according to the scope of work. Quality management entails completing the project on schedule, adhering to the agreement's specifications, and staying within the budget.

IV. LABOUR PRODUCTIVITY

This refers to human resource that enable the actual construction of the project. Their productivity is affected by the number of factors which the number of reworks.

2.0 LITERATURE REVIEW

2.1 DEFINITION OF REWORKS.

Rework has various interpretations and definitions. Terms include:

"nonconformance" (Abdul-Rahman, 1995), "quality deviations" (Burati et al., 1992), "defects" (Hammarlund and Josephson, 1999) and "quality failures" (Barber et al., 2000). Rework can be described as unneeded effort of redoing an activity or operation that was enforced in a wrong way from the beginning (Love et al., 2000).

When a service or product does not meet the requirements of customer, rework occurs. Rework includes defects and it may include variations too. By the meaning of conformance, two major definitions of rework can be provided. According to the definition of construction industry development agency, CIDA, (1995) rework is doing something at least one extra time due to non-conformance to requirements. The second definition describes rework as the procedure that making an item to adjust with the requisites by correction or completion (Ashford, 1992).

Rework occasionally happens, according to several observers, due of the intricate nature of the construction procedures. Rework in engineering and rework in building are two distinct things. Rework in engineering is the consequence of changes to specifications and owner scope, mistakes in design or contractual methods, while rework in construction is the result of lax construction management rules or poor construction methods. (O‘conner and Tucker, 1986).

In case of rework sources, Devis et al. (1989) categorized the sources of rework as owner, designer, vender, transporter and, constructor. Likewise, construction industry institute, CII, and Burati et al. (1992) mentioned 5 main fields of rework: design, transportation, manufacturing, construction, and feasibility.

Each of mentioned fields was subdivided by deviation type such as error, change, or negligence. These categorizations have different aspects from those suggested by Love et al. (1999 a, b) and Fayak et al. (2003) which propose that happening of rework is the consequence of ambiguity, poor communications and leadership, and inefficient managing.

2.2 Categorization of reworks

Love and Edwards (2004) found that the root causes of rework can be categorized into different groups such as:

- Client related factors*:* including lack of experience and knowledge of design and construction process, lack of client involvement in the project, lack of funding allocated for site investigations, inadequate briefing, inadequacies contract and documentation, and poor communication with design consultants.
- Design-related factors*:* including ineffective use of quality management practices, poor coordination between different design team members, ineffective use of information technologies, lack of manpower to complete the required tasks, poor planning of workload, time boxing/ fixed time for a task, staff turnover/ re-allocation to other projects, insufficient time to prepare contract documentations, incomplete design at the time of tender, and inadequate client brief to prepare detailed contract documentation.
- Contractor related factors*:* such as defects, damages, poor workmanship, use of poorquality materials, inadequate managerial skills, and specific problems associated with multi-layered subcontracting.
- Other factors*:* such as constructability associated concerns, poor site conditions, and environmental parameters. E.g., setting out errors, changes in construction methods to improve constructability, failure to provide protection to construction works, omissions of some activity or task.

2.3 Causes of reworks

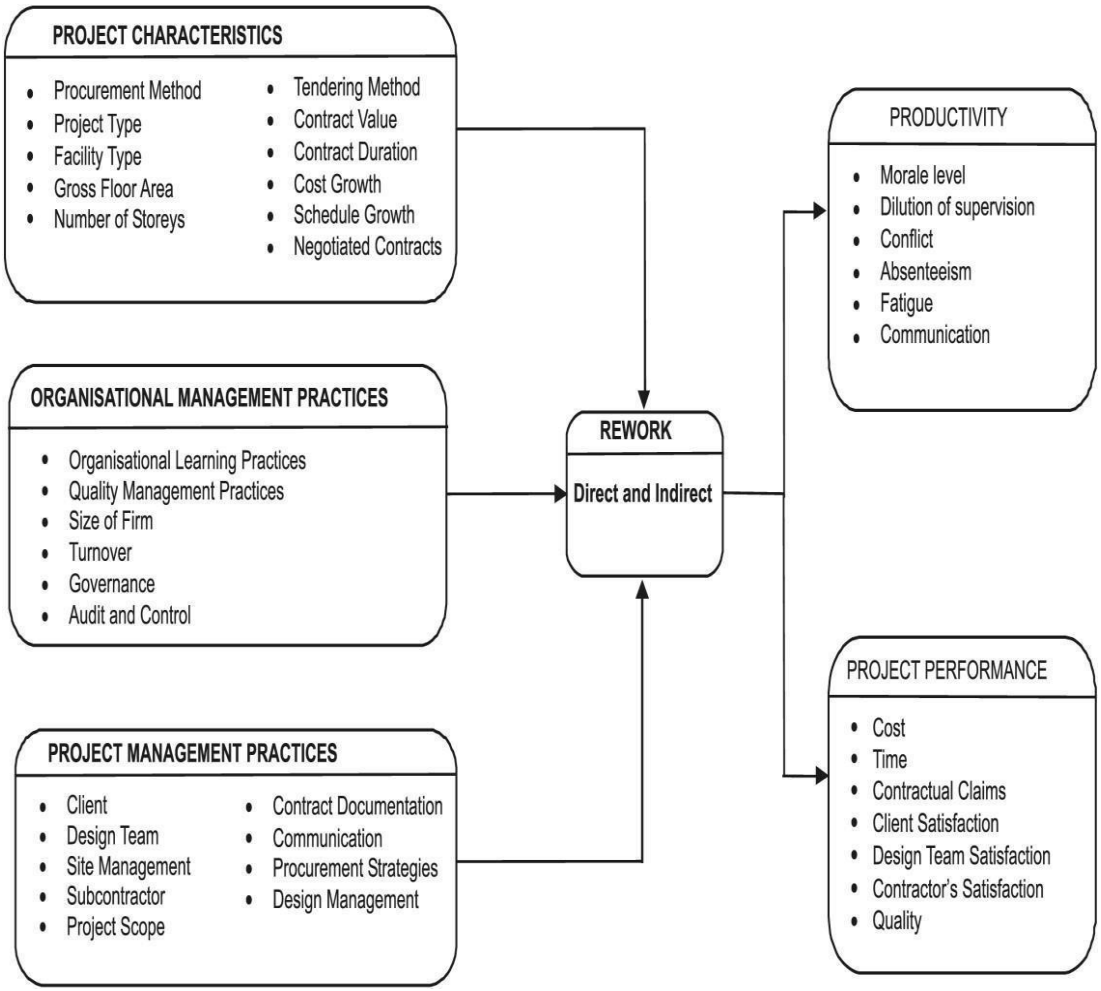
The nature of rework is that it is caused by problems in quality management processes. Several research efforts have attempted to identify and classify the causes of rework, and to quantify its overall extent. Hwang & Low (2012) Rework is frequently caused by the complex nature of construction processes, but it can also be caused by a variety of factors such as alterations and nonconformances (e.g., quality deviations), and defects. Fayek et al. (2004) identifies five major causes of rework, they are: human resource capability, leadership and communications, engineering and reviews, construction planning and scheduling, and materials and equipment supply.

However, Love & Edwards(2004) classified the root causes of rework into design related factors, client-related factors, and contractor related factors. This study investigated the cause of reworks based on these three factors. The causes that are

frequently confirmed, can be grouped into the understanding categories. 50% of the causes are change-related, 37% is error-related and 13% falls into another category. (Mastenbroek, 2010).

Rework models contribute to better understanding of the body structure of rework. Characteristics of rework and rework factors are determined by the models. Various models of rework are represented in this section.

The conceptual model of rework that suggested by Love and Edwards (2004) is shown in the Figure below. According to this model, project characteristics, organizational management practices and project management practices are the factors cause rework directly or indirectly, and they are also subdivided into more specific elements. Rework has effect on productivity and project performance. The two most important components of project performance are cost and time which are focused on in this thesis.

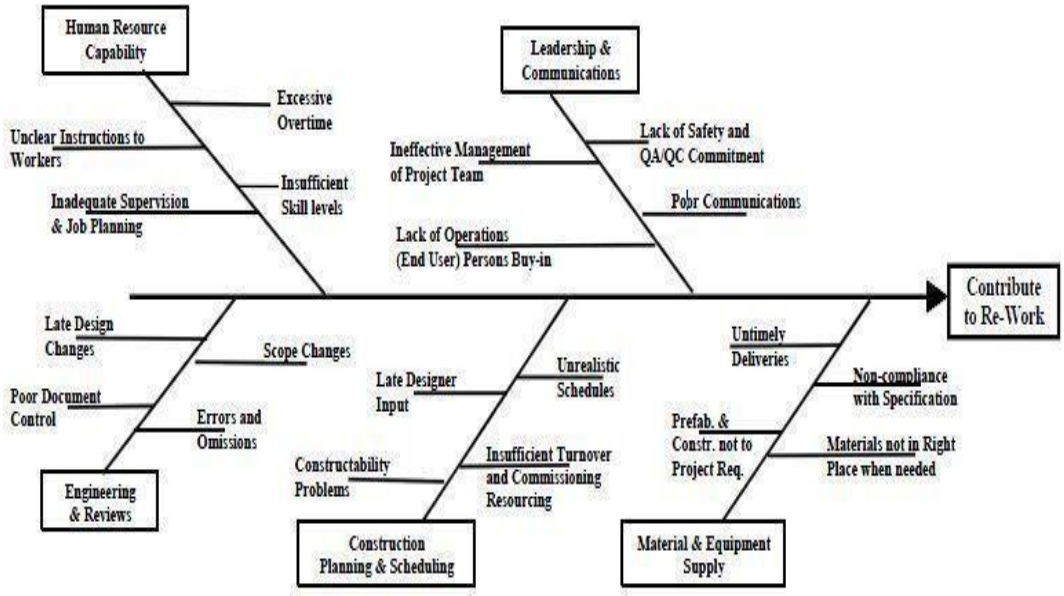


COAA's (Construction Owners Association of Alberta) rework cause classification which is also called fishbone diagram because of its shape is presented in the figure below, It is technically known as Cause and Effect (CE) diagram and it was last updated on October 2002. This model classifies rework contributor to the following items:

- Human resource capability (excessive overtime, unclear instructions to workers, insufficient skill levels and inadequate supervision & job planning).
- Leadership and communications (lack of safety and quality assurance & control commitment, poor communications and lack of operations (end user) persons buy-in).

- Engineering & Reviews (errors and omissions, poor document control, scope changes and late design changes).

- Construction planning and scheduling (constructability problems, insufficient turnover and commissioning resourcing, late design input and unrealistic schedules) and,
- Material and equipment supply (materials not in right place when needed, prefabricate and construct not to project requirements, non-compliance with specification and untimely deliveries).



Palaneeswaran, (2006) Recommended strategies for zero rework should embrace the following eight overlapping channels;

1) Avoiding non-conformances, defects, errors, omissions, and other quality deviations (e.g. through quality management systems and appropriate supervisions.

2) Reducing changes and adversarial conflicts (e.g. through early involvements and enhanced stakeholder interactions, improved scope definitions including freezing from further changes, etc).

3) Enhancing systematization such as improved documentation, information and communication arrangements.

4) Selecting high value business partners: knowledgeable and understanding clients (including continuous monitoring of their satisfaction levels), best possible supply chain sources such as subcontractors and suppliers (including continuous monitoring of their performances as well as motivation levels).

5) Adopting suitable contractual safeguards and developing appropriate incentive/ disincentive mechanism.

6) Reinforcing relationships and enabling better supply chain integrations.

7) Utilizing relevant advanced construction technologies (e.g. standardization, prefabricated components, robotics and other automation).

8) Learning and training arrangements (e.g. through lessons learned frameworks, success and failure stories.

2.4 IMPACT OF REWORKS

Results of seven case studies in Sweden by Josephson et al. (2002) indicated that the estimated correction costs amounted to SEK 7.25 million as of the 4.4% of the construction values for the period of observation. Furthermore, the results demonstrated 7.1% of the total work hours were spent on rework during the observation period.

Palaneeswaran (2006) confirmed that the direct impacts of rework on project management transactions include:

a) Additional time to do rework,

b) Additional costs to cover rework occurrences,

c) Additional materials for rework and handling the subsequent wastage, and

d) Additional labor force for rework and related extensions of supervision manpower.

Rhodes and Smallwood (2003):

- In a South Africa based study, 13% of the value of completed construction was found to be as the cost of rework.
- In the same article it was mentioned that the results of research on nine industrial projects which was conducted by Associated General Contractors of America indicated that the average cost of rework was 12.4% of the project cost.

Love and Edwards (2004):

- Construction Industry Development Authority in Australia found that in the projects without having a formal quality management system, the average rework cost is 6.5% of the contract value. However, this number for the projects with a quality management system was found to be 0.72%.
- 161 projects were studied in another Australian based study (Love, 2002) and the average of direct and indirect costs of rework were found to be 6.4% and 5.6% of the original contract value respectively. This study also showed that the project contractual type may not have substantial influence on the rework costs.

In the most of researches, direct and monetary impacts of rework have been focused. However, rework has additional indirect consequences and some of them are listed below (Love, 2002).

- End-user dissatisfaction
- Inter-organizational conflicts
- Fatigue
- Stress
- De-motivation

- Work inactivity
- Absenteeism
- Loss of future work
- Poor moral
- Reduced profit
- Damage to professional image

The mentioned factors can greatly influence a company’s present or future wellbeing but they can hardly be assigned a monetary value.

2.5 OVER VIEW

Most of the mentioned researches in this chapter investigated the impacts of rework in construction generally, although some of them specified type of the project. This research focuses on the impacts of contractor related reworks on any construction projects.

The findings of this study are consistent with the majority of earlier studies of a similar nature. For example, Love et al(1998) .'s study found that the direct cost of rework for residential apartment blocks was 3.15% of the construction cost, and Alwi et al(1999) .'s study found that the cost of rework for 10 high-rise buildings ranged from 2.01% to 3.21% of the construction cost. They were created throughout the building's construction; however this study primarily focuses on the impact of contractor-related reworks. Wasfy (2010) and Oyewobi et al. (2011) conducted related study and discovered the cost of rework in various construction elements. Wasfy (2010) estimated the cost and time impact of rework in various construction activities. But this study examines the effects of contractor-related reworks during the building phase on costs, timelines, quality, and labour productivity.

3.0 METHODOLOGY

3.1 INTRODUCTION

The methodology chapter discusses and explains the research design which was used to acquire the data to be analysed. Also, the sampling size and techniques, as well as the data collection procedure which included the form that was used to collect data on particular items reworked on and the questionnaire designing and administering the questionnaire, have been described. In addition, the data analysis techniques

The research methodology covers the scope of the study, the collection and analysis of the data and the development of the conclusions and recommendations. Bell (2005) stated that the research design methodology chosen is an important part of any research project, as it gives the overall framework for collecting and formulating the data needed for the research. The argument presented by Leedy and Ormrod (2010) concerning the choice of research method is used as a basis, where consideration should be given to the nature of the data that will be collected in the resolution of the problem. Moreover, Leedy and Ormrod (2010) suggested that a pragmatic presentation regarding the data may be perhaps most expeditiously handled if the following four principal questions with respect to research data are answered:

“What data are needed?” Data concerning the impact of contractor related reworks.

“Where is the data located?” Data was collected in the Kawempe division on active projects only.

“How will the data be obtained?” Data was obtained through measuring reworks on the sites and self-administered questionnaire, containing both open and closed-ended questions, which was formulated and distributed to get the data

“How will the data be interpreted?” data was analysed with combination of two approaches, namely quantitative and qualitative methods were adopted to achieve the aim and objectives of the study

3.2 Quantitative Research

A quantitative research approach refers to research which counts things, analyses data statistically and quotes the results in numerical forms (Gomm, 2008).

I used quantitative approach to analyse quantitative data and quantify the amount of impact reworks have on projects. I used Stata and Excel software to analyse quantitative data that helped in presenting work graphically.

3.3 Qualitative Research

According to Leedy and Ormrod (2010), qualitative research involves looking at characteristics, or qualities, that cannot easily be reduced to numerical values.

The qualitative method was used to analyse qualitative data from the field that could not be quantified using qualitative methods. Data collected on the impact of the contractor related reworks was qualitative and Likert was used to analyse it.

3.4 Population and Sample size

A selected number of cases in a population are referred to as the sample (Walliman, 2005). Fellows and Liu (2008) stated that, where the research study is concerned, it is necessary to obtain data from only a portion of the total population. Fellows and Liu (2008) further asserted that an important aspect of sampling is the determination of the size of the sample to be studied. Kawempe was selected and 50quesitions were supplied where 39questionnaires were answered and picked by the time of data analysis. 39questionnaires present the 78% of the total questionnaires supplied.

3.5 DATA COLLECTION METHODS

3.5.1 Secondary

Secondary data consists of the review of the literature pertaining to the study area of the research. According to Naoum (1998), literature review involves reading and evaluating what other people have written about one's subject area, both descriptive and analytical. The review of literature is descriptive, in that it describes the work of previous writers, yet analytical in the sense that it critically analyses the contribution of others with the purpose of identifying similarities and contradictions made by previous writers. The literature was reviewed to give the general perceptive of reworks in construction.

3.5.2 Primary

Primary data involves sources which collect data by direct, detached observation or measurement of phenomena in the real word, undisturbed by any intermediate interpreter

(Walliman, 2005). However, Leedy and Ormrod (2010:89) ‘maintained that primary data are often the most valid, illuminating and most truth-manifesting’.
Primary data was collected using questionnaires and the form that was used to collect data at the site

3.6 Questionnaires

A questionnaire is an instrument which enables one to gather data beyond his physical reach, without seeing the source from which the data has originated. Because of the impersonality associated with questionnaires, a questionnaire needs to be governed by certain practical guidelines (Leedy and Ormrod, 2010).Firstly, the language used must be unmistakably clear, because what may be stated clearly in the questionnaire may be meaningless to the respondent. Secondly, questionnaires should be designed to fulfill a specific research objective, as questions are often inexpertly written, and this result in a low response rate (Leedy and Ormrod, 2010). Moreover, according to Fellows and Liu (2008), questionnaires should be unambiguous and uncomplicated for the respondent to answer. More specifically, questionnaires should not require extensive data gathering by the respondent to facilitate answering the questions.

3.7 Questionnaire design

The questions were formulated according to the research objectives and the perceptive during the literature study. The questionnaire is comprised of five sections, namely: profile of respondents, awareness of reworks by the construction professionals, impact on costs, impact on duration, impact on quality, impact on labour productivity.

The first section (section A) of the questionnaire requested information about the profile of respondents. The information gathered includes the role of the organisation and the current position of the respondents. Section B obtained information concerning the project and facility type, the contract value and duration, procurement method and the size of the project.

3.7.1 Different types of questions were used

Open-ended questionnaire

According to Fellows and Liu (2008), an open-ended questionnaire is designed to enable the respondent to answer the questions fully by answering in any manner and to the extent the respondent chooses. Furthermore, the motives, expectations and true feelings of the respondent surface when open-type questions are asked.

Respondents were allowed to give their opinions on how contractor related reworks affect quality and labour productivity on construction projects.

Closed-ended questionnaire

A closed-ended questionnaire allows one to limit the number of responses by offering specific alternatives from which the respondent must choose one or more. It simplifies the recording, tabulation and editing process considerably (Struwig and Stead 2001). Furthermore, closed-type questions are exact and to the point, and therefore the responses are clear, enabling the responses of a similar nature to be grouped and quantified easily.

Respondents were tasked to choose from the availed options that were developed from literature review.

Main questions

What is the impact imposed on cost of a project by reworks caused by a contractor?

What are the effects of reworks due to contractor on project duration?

How is the quality of the project affected by rework by due to contractor?

To what extent do contractor related reworks affect the quality of the project?

To what extent do contractor related reworks affect the labour productivity on construction sites?

3.8 LIKERT SCALE

A series of four or more Likert-type elements that reflect related questions are merged into a single composite score to form a Likert scale. As interval data, likert scale data can be studied, and the mean is the best indicator of central tendency

Doesn’t affect all =1

Slightly =2

Moderately 3

Strongly 4

Extremely 5

The Likert scale was as follows

Formula = (a-b)/c

Where;
a is highest value in the scale
b is the lowest value
c is the number of options
I got (5-1)/5 = 0.8, I kept on adding 0.8 to the last value to get the next range.

Then I used it to make the scale range for how reworks affect some project parameters

Doesn’t affect all 1-1.8

Slightly 1.9-2.6

Moderately 2.7-3.4

Strongly 3.5-4.2

Extremely 4.3-5.0

3.9 Research methodology justification

The objective of qualitative research was to gain and develop understanding, discover meaning and explain phenomena. Therefore, qualitative research methods were chosen to enable the researcher to develop a coherent and comprehensive view of insights into the causes and effect of contractor related rework during construction projects from the perspective of the respondents. More specifically, the questionnaire survey method provided a tool to gather data over and beyond the physical reach of the researcher.

4.0 DATA ANALYSIS AND DISCUSSIONS

4.1 ANALYSIS

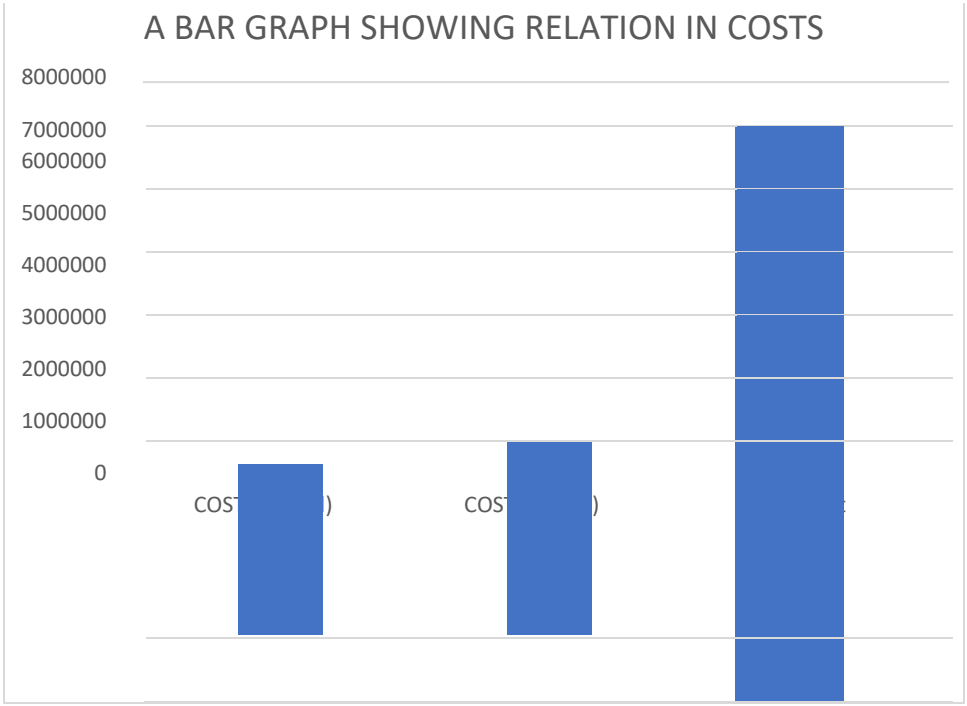
DATA ANALYSIS

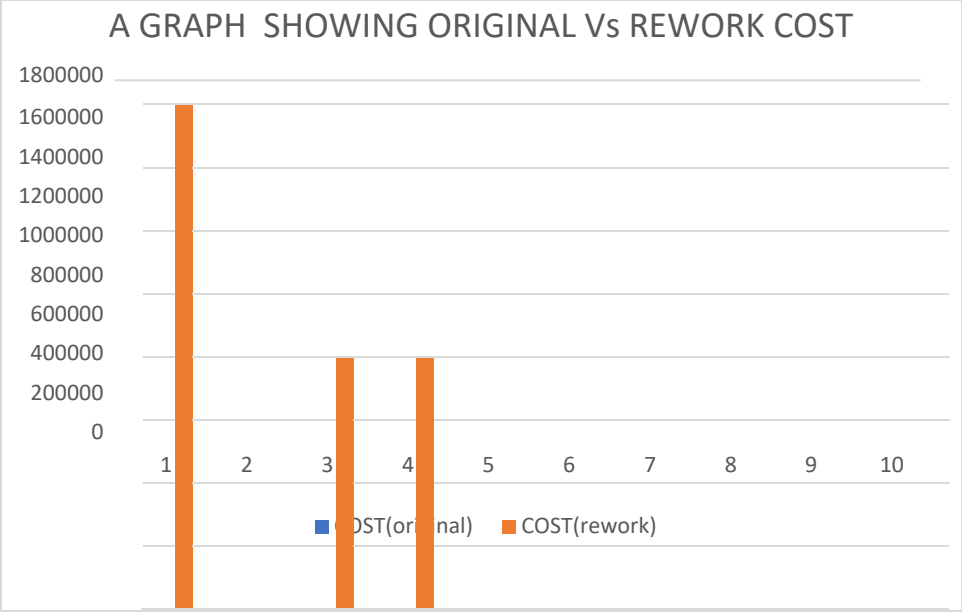
Results of the study and their analysis are provided in this chapter with their explanations and discussions. This chapter is divided into four parts, the first represents the impact of reworks on the total duration of the project which answers the first objective, the second section covers the impact of contractor related reworks on the cost of the project and this answers the second objective, the third section presents the impacts of reworks on the quality of the project and the forth part covers the effects of reworks on labour productivity.

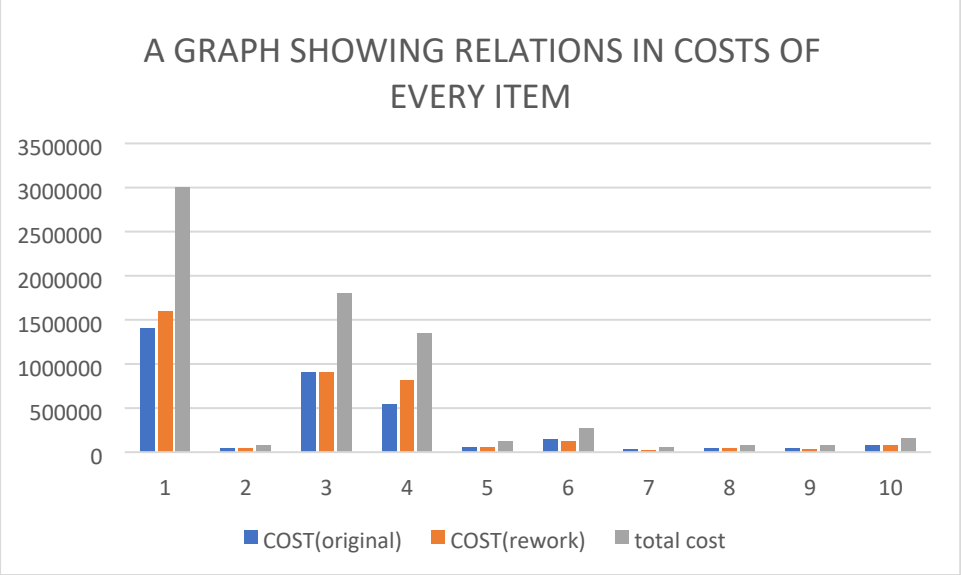
Quantitative analysis involves mathematical operations which quantifies the results in numerical values. Quantitative data extracted from closed ended questionnaires was encoded using STATA and EXCEL, And, results were carefully analysed statistically using both the descriptive and inferential statistics.

1st section First objective

Contractor related reworks affected the costs highly as shown in the graph below, cost spent on reworks was way more higher than the cost spent on the work done first reasons being, the contractor incurred costs to demolish the item put in place that doesn't meet the standards and costs for repairing it.

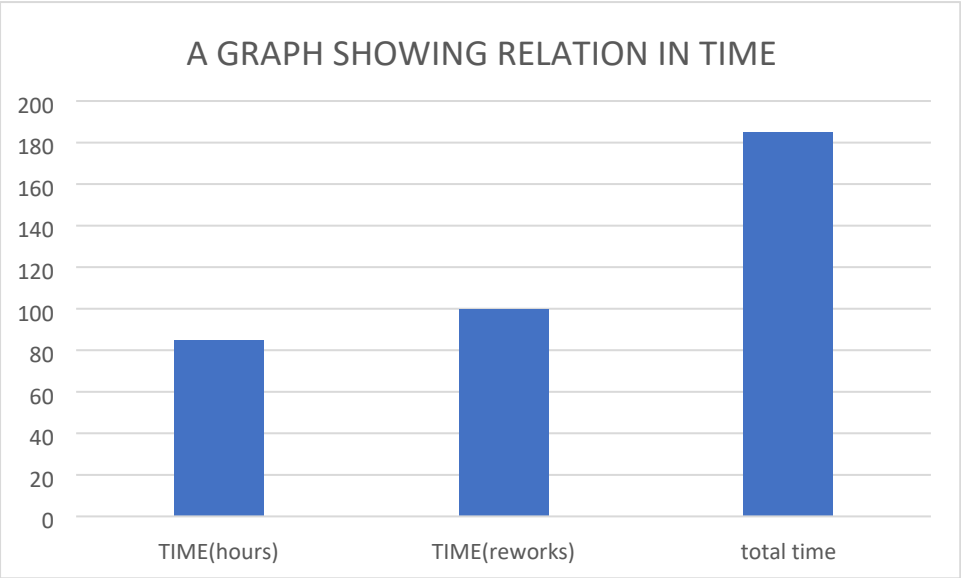


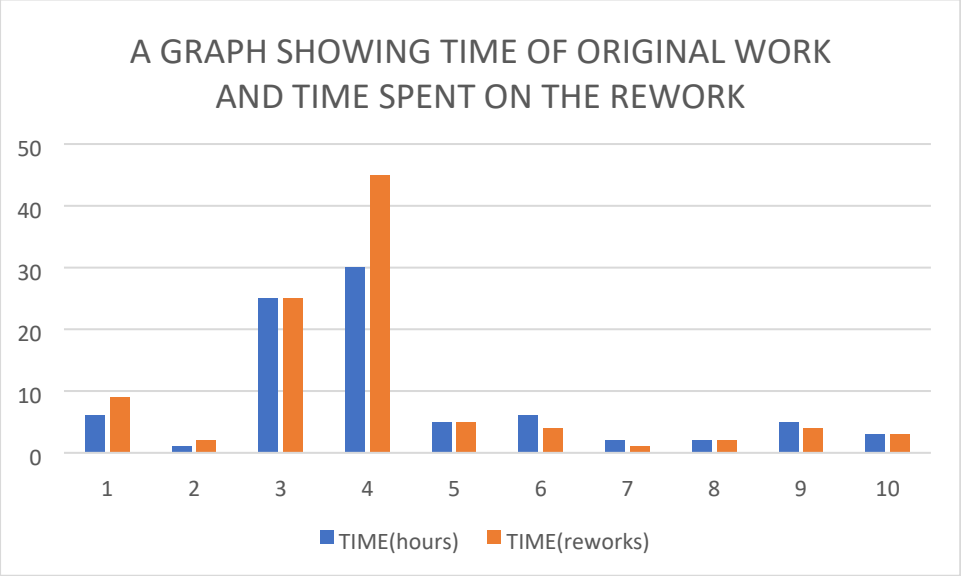


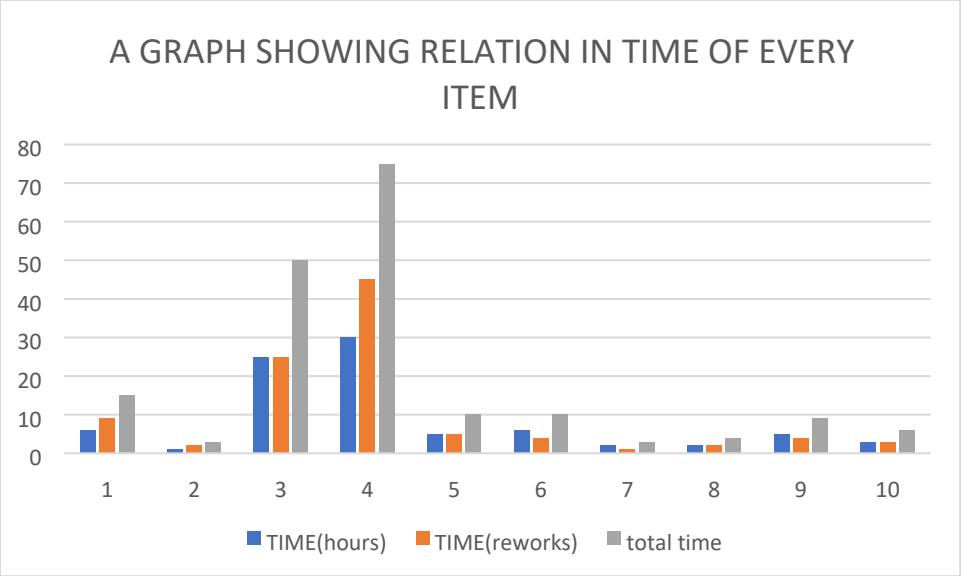


SECOND OBJECTIVE

Contractor related reworks affected the time allocated to every item as shown in the graphs below, time spent on reworks was way more higher than the time consumed by the work done at first reasons being, the contractor took time to demolish the item put in place that doesn't meet the standards and time for repairing it.


A GRAPH SHOWING RELATION IN TIME
200
180
160
140
120
100
80
60
40
20
0
TIME(hours)
TIME(reworks)
total time


A GRAPH SHOWING TIME OF ORIGINAL WORK AND TIME SPENT ON THE REWORK
50
40
30
20
10
0
1
2
3
4
5
6
7
8
9
10
TIME(hours)
TIME(reworks)


A GRAPH SHOWING RELATION IN TIME OF EVERY ITEM
80
70
60
50
40
30
20
10
0
1
2
3
4
5
6
7
8
9
10
TIME(hours)
TIME(reworks)
total time

3rd section. Quality

This section covers the effects of contractor related reworks on quality of works done by a contractor.

The average for the data was calculated and found to be 2.666 which approximately to 2.7.

Using Likert scale, showed that contractor related moderately affect the labour productivity.

4th section. Labour productivity

The average was 2.69 approximately to 2.7. Using Likert scale, showed that contractor related moderately affect the labour productivity.

5. CONCLUSION AND RECOMMENDATIONS

5.1 CONCLUSIONS

Reworks is one of the key factors affecting construction productivity. This research aimed at investigating the impact of contractor related reworks on project parameters which are cost, time, quality and labour productivity. It was found that it affects the duration and cost mostly.

5.2 RECOMMENDATIONS

Clients should avoid involving in construction works such as holding tender

directly since this leads to hiring unexperienced contractor that lead to high rate of reworks. It is recommended to assign them to the consultant or representative who is familiar with technical issues.

Owners should hire the construction manager to do cost and time management, organize the contracts, select the suitable construction methods or materials and observe the construction process.

Having a fulltime supervisor in the project site to prevent the rework or make the wrong implemented works correct on time is recommended.

Preventing contractor related reworks from happening by considering the technical competency of the contractors. Most of the times, the best contractor to select is not the one who offered the lowest price as there are hidden costs such as rework cost with them.

Contractor should not use substandard materials in construction. In order to make profits.

Hiring trained workmanship.

Using concrete from trusted source. This will enable the contractor to always meet the set specifications.

I recommend that further studies on rework in the following areas should be carried out:

Cost and time impact of rework in construction industry.

Investigate the impact of reworks on the general construction industry

Investigating impact of subcontractor related reworks

The study recommends that contracting companies create organizational measuring systems for tracking the occurrence of contractor related reworks and the expenses associated with it. Effective methods for containing and reducing them can be determined by identifying their impact on the whole project.

REFERENCES

Abiodun-Oyebanji, O. (2017). *RESEARCH VARIABLES: TYPES, USES AND DEFINITION OF TERMS* (pp. 43–54).

Elshaikh, E. (2019). *The Potential Effects of Variation Orders on Building Projects in Khartoum State-Sudan*. *March*. https://doi.org/10.5923/j.ijcem.20190802.04

Enshassi, A., Sundermeier, M., & Zeiter, M. A. (2017). Factors Contributing to Rework and their Impact on Construction Projects Performance. *International Journal of Sustainable Construction Engineering & Technology*, *8*(1), 2180–3242. http://penerbit.uthm.edu.my/ojs/index.php/IJSCET

Gould, J. (2001). Variables in Research Designs. *Concise Handbook of Experimental Methods for the Behavioral and Biological Sciences*, *3*(4), 75–110. https://doi.org/10.1201/9781420040869.ch4

Hwang, B. G., & Low, L. K. (2012). Construction project change management in Singapore: Status, importance and impact. *International Journal of Project Management*, *30*(7), 817–826. https://doi.org/10.1016/j.ijproman.2011.11.001

Issn, B. P. (2010). Factors Influencing Reworks Occurrence in Construction: a Study of Selected Building Projects in Nigeria. *Journal of Building Performance*, *1*(1), 1–20.

Love, P. E. D., & Edwards, D. J. (2004). Determinants of rework in building construction projects. *Engineering, Construction and Architectural Management*, *11*(4), 259–274. https://doi.org/10.1108/09699980410547612

Mastenbroek, Y. C. (2010). *Reducing rework costs in construction projects*.

Mutesi, E. T., & Kyakula, M. (2010). Application of ICT in the construction industry in Kampala. *Second International Conference on Advances in Engineering and Technology*, *January 2011*, 263–269. https://www.mak.ac.ug/documents/Makfiles/aet2011/Mutesi.pdf

Muwafaq, A., Abdel-Monem, M., & El-Dash, K. (2020). Review study for rework causes in construction industry. *Civil Engineering Research Magazine (CERM)*, *42*(1), 20 – 35.

Palaneeswaran, E. (2006). Reducing Rework to Enhance Project. *Proceedings of the One Day Seminar on Recent Developments in Project Management in Hong Kong, Hong Kong (10 Pp.).*, *c*, 1–10.

Samuel K. Ansah. (2011). Causes and Effects Of Rework on Construction Projects In Nigeria.

Journal of Construction Project Management and Innovation, *1*(1), 236. https://journals.co.za/doi/10.10520/EJC51128

Student, M. E. (2016). *Development of Field Rework Index To Minimize the Impact of Rework for Effective Construction Work*. *1*(5), 370–375.

Yap, J. B. H., Low, P. L., & Wang, C. (2017). Rework in Malaysian building construction: impacts, causes and potential solutions. In *Journal of Engineering, Design and Technology* (Vol. 15, Issue 5, pp. 591–618). https://doi.org/10.1108/JEDT-01-2017-0002