MAKERERE UNIVERSITY

CASE STUDY: PROPOSED 70 BED MOTHER KEVIN WING AT ST. FRANCIS HOSPITAL NSAMBYA, KAMPALA UGANDA

BY
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A REPORT SUBMITTED TO THE GRADUATE SCHOOL IN PARTIAL FULFILMENT FOR THE AWARD OF POST GRADUATE DIPLOMA DEGREE OF MAKERERE UNIVERSITY

JANUARY 2022

Declaration

I hereby declare that the work presented is original and has never been submitted for an award to any university or institution of higher learning.

Jonathan Kutosi,

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This report has been submitted for examination with the approval of my supervisor.

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Date.....19/4/22

Dedication

I would like to dedicate this report to my parents and sponsors. There is no doubt in my minds that without their continued support and counsel I could not have completed this process. I also dedicate it to our lecturers at the School of Engineering who have in great works enabled me acquire this mile of education

Acknowledgements

First, I would like to thank the almighty God for keeping me in good health throughout the year 2021. It was a year of trials with the second wave of COVID19 that claimed so many dear ones but I survived.

I also extend my sincere gratitude to my sponsors and family for the great work they have done for me during this period and throughout my academic time, they have supported me financially, advised and strengthened me to reach this academic height. I will always be grateful to them

Special thanks go to my girlfriend Rose Nantongo for the moral support. She has always been a shoulder to lean on in good and bad times.

Also, special thanks go to my project supervisor Eng. Prof. Henry Mwanaki Alinaitwe who tirelessly works for the College of Engineering, Design, Art and Technology. He is diligent, professional practically and ethically as he is a good lecturer. Surely, he is a role model.

Finally, I, in a special way thank all my lecturers throughout my Post graduate programme and the course coordinators for taking a lot of time and effort in ensuring we all received the services we paid for.

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List of Abbreviations

BOQ - Bills of Quantities

COW - Clerk of Works

GMT - G. Meske! Teare (U) PLC

HVAC - Heating, Ventilation and Air Conditioning

IMK- IMK Engineering Company ltd

M&E - Mechanical and Electrical Engineer

MGPS - Medical Gas Piping System

PM- Project Manager/ Team Leader

SEKA - SEKA Associates Consulting Engineers ltd

SFH- St. Francis Hospital Nsambya

XL- Excel Construction ltd

EXECUTIVE SUMMARY

Among the important tasks of site management is the site layout planning.

Extensive time loss and cost overruns could result in large projects, if there is no effective site planning.

A detailed planning of the site layout and location of temporary facilities can make improvement by minimizing travel time, waiting time, and increasing worker morale by showing better and safer work environment.

The Construction Industry Institute reported in its "Constructability Concepts File, 1987" that temporary facilities are important and can either enhance or adversely affect construction productivity.

Site planning has been the most neglected aspect in the construction industry and the attitude of the engineers has been that it will be done as the project progress.

It is important to realize that the site planning will be the conditions that site personnel will live with for the total duration of the construction period. Thus the careful pre-planning is imperative.

Significant saving can be occurred if the labor force moved freely and quickly within the site. Lack of good site layout planning may lead to:

- Material stacks wrongly located. This problem may involve double or triple handling of materials to another location (too far, impede flow, too remote from hoists, etc.)
- Equipment wrongly located (unreachable, insufficient)

Site huts wrongly located in relation to their effective use (noise, dust, safety, insufficient area, inadequate access.

CHAPTER 1: INTRODUCTION

1.1 BACKGROUND INFORMATION

The project encompasses an extension of a 70-bed ward building. It is set on one block with two basement floors, ground floor plus four floors above. The two basement floors are designed with the advantage of having the natural 3 meter level difference from the east to west of the site.

The ground floor is mainly occupied by the main entrance, public lobby, reception/cashier, the lifts, staircases, and the ramp and washes areas. The two major operation theatres and the delivery unit with its dedicated theater are also located in this floor.

The building is designed to contain a mixture of private, semi-private and executive bedrooms (70 beds in total) and two major operation theatres, a delivery unit with an obstetrics theatre, two ICU rooms for the pediatrics and for the adult, a mini-lab, drugstore, sufficient nursing stations with facilities, nurses and doctors' lounges and doctors/nurses on duty resting rooms. All these bedrooms are in four floors above the ground floor.

The site selected was "Proposed 70 Bed Mother Kevin Wing on Plot 2448 Block 15 at St. Francis Hospital Nsambya" It is a $6m project with a duration of 30 months.

Figure 1: Project Billboard

1.2 CONSULTANT

G. MESKEL TEARE Architects, Engineers, Planners Pvt. Ltd. Co is a consulting firm practicing in Eritrea, Ethiopia, Uganda and South Sudan.

The practice is a private Professional Consulting firm in Architecture, Engineering, and Planning that provides consulting and related services such as health and education projects including Project Management services to the private sector, cooperative, government and non-governmental organizations.

ገብረመስቀል ተዓረ
G.MESKEL TEARE
ARCHITECTS • ENGINEERS • PLANNERS
(Eritrea, Ethiopia,Uganda, South Sudan)

Figure 2: Consultants Logo

Other consultants for the project included:

- SEKA Associates for the Structural designs
- IMK Engineering Company Ltd for the Mechanical and Electrical works

1.3 CONTRACTOR

Excel Construction Ltd. is one of the leading players in the Ugandan Construction industry and operates nationally through their head office located at Plot 43-45 Eng. Zikusoka Way, Jinja.

Excel Construction Ltd started off predominantly as building contractors and have gradually started and established themselves in carrying out Civil and Infrastructure works for the oil industry in Uganda.

Excel construction Ltd was formed as a joint venture company between Muljibhai Madhvani and company and Gomba construction Ltd in 1992. It boasts of;

- A team of qualified and experienced managers and technical experts,
- A world-wide network of offices for procurement,
- Project finance & management expertise, and
- Long-established banking relationships.

Aimed at exploiting the widespread Engineering resources and expertise, the company also encompasses the following activities. Joinery, Pre-cast Concrete and Engineering

Workshops. With the availability of fully equipped workshops and experienced foremen.

Figure 3: Contractors Logo

1.4 SITE ORGANISATION

The contractors staff in the field consisted of various team members in a hierarchy as seen in the site organization diagram below;

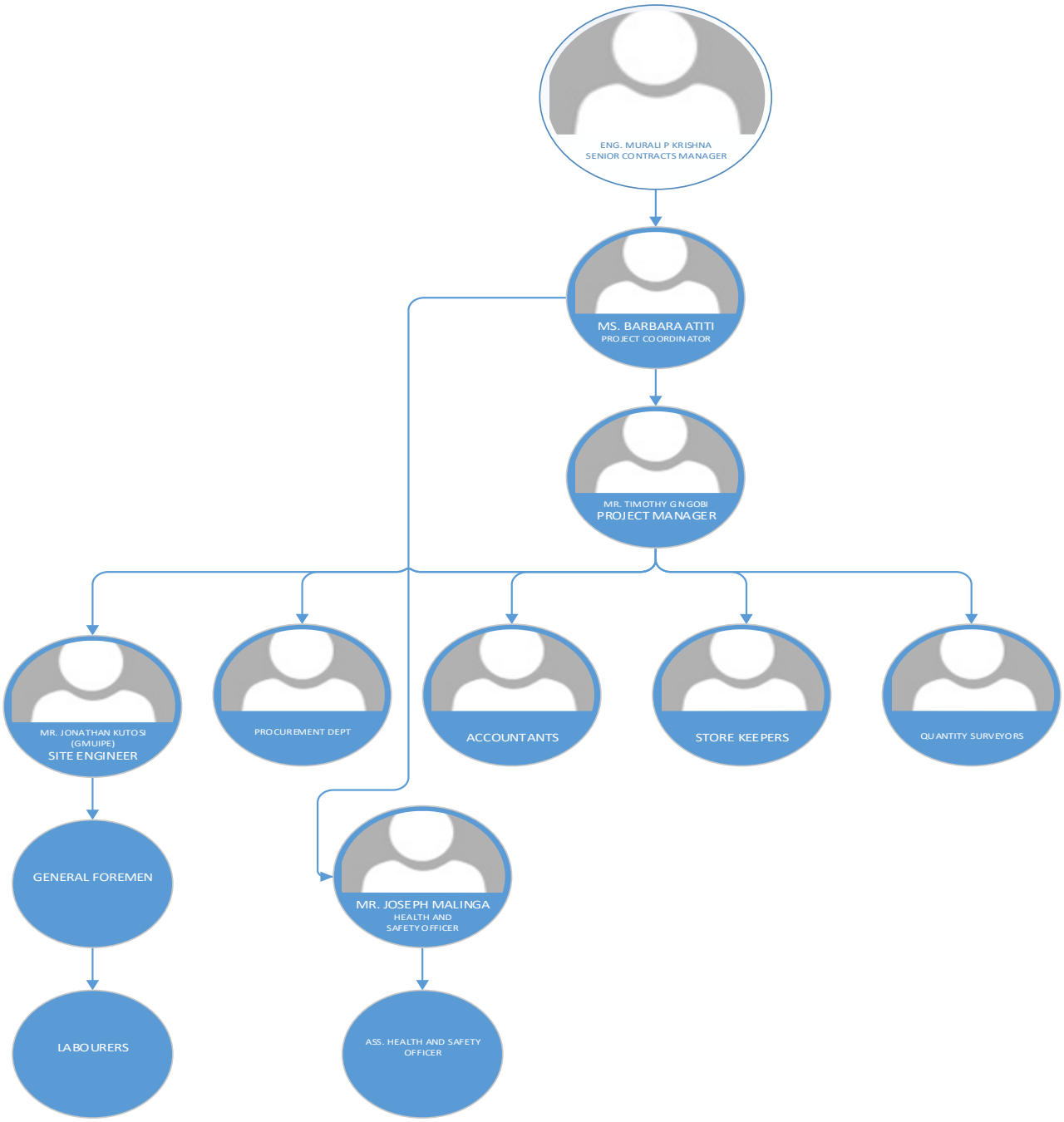

Figure 4: Site Organization Diagram

1.4.1 Responsibilities of project managers:

- To direct and oversee the execution of the contract.
- To determine all the resources required in order to complete the project and meet the construction programme.
- To ensure the Health & Safety policy is implemented on site.
- To implement quality control and quality assurance.
- To review and update the construction programme including site organization chart and resources' scheduling.
- To review and update the construction method statement prepared by Tendering and Planning section.
- To coordinate day to day activities on site.
- To schedule purchase and delivery of materials and equipment on site.
- To coordinate subcontracted works and to exercise control on subcontractors' output and quality.
- To monitor the progress of the project with regular reports.
- To review and manage non-conformance.
- To report variations and manage these in liaison with Head Office.
- To ensure that the project is executed as expected within the budgeted amount.
- To prepare project valuations.

1.4.2 Responsibilities of project engineers:

- Responsible for the quality of work based on project standards
- To Coordinate with construction team in keeping work standard
- Project/site implementation
- Quality Control and Quality Assurance
- Interact with the clients as frequently as required to interpret their needs and requirements

- Cooperate and communicate effectively with project manager and other project participants to provide assistance and technical support

1.4.3 Responsibilities of site engineers:

- Responsible for the quality of work based on project standards.
- To prepare documentation for all tests and inspection done
- Project/site implementation.
- Quality Control and Quality Assurance.
- Setting out the works in accordance with the drawings and specification.
- Checking materials and work in progress for compliance with the specified requirements.
- Resolving technical issues with Client's representatives, local suppliers, subcontractors and statutory authorities.
- Ensure approved relevant survey permit is available prior to start of any work.
- Implementation of safety measures, in coordination with the Site Safety Representative.

1.5 SUBCONTRACTORS

There were a variety of subcontractors given the complexity of the project as regards the scope.

Table 1: Various Subcontractors on the project

ITEM	**SUBCONTRACTOR**
Terrazo Finishes	Super Terrazo (U) Ltd
Medical gas installations	East African Distributors Ltd
HVAC	East African Distributors Ltd
Lifts	East African Distributors Ltd
Aluminium works	Interior Technologies Ltd
Glass works	Prayosha Enterprises Ltd

Steel works and fabrication	Bansal Engineering Works Ltd
Roofing	David Engineering Ltd
Electricity	Seven Hills Impex Ltd
Data	Sahara Computers
Firefighting	East African Distributors Ltd
Granite and Marble	S.S.G Granite

All the Labour on the site was also subcontracted to Harree Construction Ltd. Some minor subcontracts were also awarded to local teams/gangs such as Plaster works, Tile works, screeding, painting and excavations.

1.6 CURRENT PROGRESS OF SITE

Achieved progress of site is about 63% and value of work certified is about 45%. Project period elapsed is 82.4% as of December 2021.

Figure 5:Site Progress in elevation

1.6.1 MANPOWER

The Site has had an average weekly manpower of 186 workers providing about 1488 man-hours a day. Of these 186 workers, 164 are male and 22 are female.

The workforce is divided into several trades including masons (25), steel benders (2), Carpenters (5), Plumbers (7), Electricians (6), Askaris (4), Helpers (60), Painters (10), Operators (3), and Foremen (7) e.tc

1.6.2 MAJOR ACTIVITIES

- Plumbing works
- Terrazzo finishing
- Tiling works
- Plaster works
- Painting works
- Medical gas piping
- Mechanical works in lifts
- Aluminum window fixing
- External wall Render
- Block work
- Balustrade fixing
- Door frame fixing
- Granite Cills
- External drainage and Sewer line connection to NWSC Point

1.6.3 MAJOR MATERIALS ON SITE

- Quarry Tiles
- Floor and Wall Tiles
- Blocks
- Sand
- Electrical material
- Aggregate
- Steel
- Cement
- Plumbing material

1.6.4 TOOLS AND EQUIPMENT PRESENT

Table 2: Equipment on site and their condition.

	EQUIPMENT	QUANTITY	REMARKS
1	Tipper 7 Ton	1	Good Condition
2	Pick up trucks	2	Good Condition
3	Concrete mixers	2	Good Condition
4	Vibrator	4	Good Condition
5	Pokers	6	Good Condition
6	Pedestrian roller	1	Good Condition
7	Plate compactor	2	Good Condition
8	Generator 15kVA	1	Good Condition
9	Water pump	3	Good Condition
10	Dumpy level	1	Good Condition
11	Total Station	1	Good Condition
12	Welding Machine	2	Good Condition
13	Metal work and woodwork tool	1	Good Condition
14	Jack Hammer	1	Good Condition
15	Terrazo grinding machines	6	Good Condition
16	Hoist machine	1	Good Condition
17	Lifting Tower crane	1	Good Condition (On-site when required)

CHAPTER 2: GENERAL METHODOLOGY /MATERIALS AND METHODS

2.1 INTRODUCTION

This chapter introduces majorly the general site layout of the project and addresses the concerns of the existing plan.

2.2 SITE LAYOUT AND RECOMMENDATIONS

Construction site layout involved:

- Identifying,
- Sizing, and
- Placing temporary facilities (TFs) within the boundaries of construction site. These temporary facilities range from simple lay-down areas to warehouses, fabrication shops, maintenance shops, batch plant, and residence facilities

2.2.1 OBJECTIVE

Site layout planning objectives were:

- Site must be designed to maximize efficiency of operations in order to promote worker productivity, to shorten project time and to reduce cost
- It must create a project with a good work environment in order to attract and retain the best personnel and thus contribute to better work quality and productivity

A well planned site including all facilities and utilities led to:

- increased productivity and safety
- reduced area(s) needed for temporary construction
- maximal utilization

2.2.2 TEMPORARY FACILITIES CHARACTERISTICS

- Satisfying environmental and safety regulations (batch plant, etc.)
- Availability of diverse solutions for the same problem (build on site, rent a building etc.)

- Relatively short life span of a specific location
- Reutilization with a minimum loss for the same or modified function at another location
- Easy of assembly, dismantling, and exploitation; Prefabricated modules are ideal for constructing temporary facilities and they are usually easy to assemble and dismantle
- Standardization of design; This approach makes the maintenance, transportation and storage of temporary facilities easy. The benefits of the learning curve can be gained from repetitive field operations

2.3 SITE LAYOUT ELEMENTS FROM CASE STUDY AND RECOMMENDATIONS

2.3.1 Safety:

- Fire prevention, fire extinguishers were basic requirements on a construction project. The site had a variety of firefighting equipment including 8 fire extinguishers, 2 fire blankets, etc.
- Medical services: a first aid kit was necessary. In remote projects, a well-equipped medical room with a doctor and nurse is important. The site had two well-trained safety officers with first aid treatment training.
- Construction safety clothing. The site had a variety of Personal Protective equipment for all its workers and staff. A strict Health and Safety Policy back this.

Figure 6: Site Safety guidelines and statistics

2.3.2 Site Accessibility:

Easy accessibility would keep the morale of the equipment and vehicle drivers high, minimize the chance of accidents, and save time in maneuvering to arrive at and leave the project (roads, parking lots).

As seen in Figure 7 below, the access for vehicles and trucks ferrying materials is adequate. This is plausible. This access can also be seen on the site layout drawing.

Figure 7: Site Access route for pedestrians and trucks

2.3.3 Information Sign

Site map showing gates, escape ways, Traffic regulatory signs, Display of safety rules, Emergency routes and underground services etc.

These signs were inadequate on site and it is therefore recommended to place them in sensitive areas.

2.3.4 Security:

- Entrance (proper guard entrance to the site)
- Lighting (standby generator to maintain site lighting)
- Fencing (boundaries should be fenced off from a security point of view)

Site had a proper entrance, proper lighting and a fence. However, the fencing was incomplete at the backside, which made the site vulnerable to insecure acts.

Figure 8: Stand-by Generator for Lighting and heavy duty machinery works in emergency need.

2.3.5 Accommodation

It is necessary to provide camp accommodation for all type of staff involved in the project.

It is recommended that such a site with large manpower and high number of workers residing far to have site accommodation to save time.

2.3.6 Offices

Offices should be close together, close to the site, and in a safe area. Provide proper

office equipment.

The site has convenient site offices and proper office equipment as seen on the site layout drawing. This is commendable.

Figure 9: Site Offices

2.3.7 Water Supply and Sanitation

It is necessary to have water and toilet facilities in convenient locations to accommodate the work force.

The site had several toilet and shower facilities. It also had water supply points for both drinking water and tap water. These can be seen on the Site Layout drawing.

Figure 10: Toilet Facilities

2.3.8 Material Handling

One third or more of all construction operations can be classified as material handling. Use of proper equipment for handling and planning for minimizing multiple handling results in cost and time saving.

The site had a hoist machine and material stock placed close by to reduce the chances of multiple handling.

Figure 11: Material and Hoist Machine

2.3.9 Storage and site cleaning

Laydown areas; storage of large materials and equipment Warehouses: sheltered storage facilities.

Material staging areas: materials were stored near the work on a short-term basis. Site cleaning: It was necessary to keep work place clean from debris.

2.3.10 Craft Change-Houses

It provided sheltered space for craft personnel to change and store clothes, wash, and rest during waiting periods.

The site had male and female changing rooms that also acted as rest rooms. These can be seen on the Site layout drawing.

2.3.11 Batch plant and Fabrication Shops

Batch plants are provided on projects where it is more economical to produce concrete on site Aggregate storage piles, cement silos and admixture tanks will accompany an on-site batch plant.

Figure 12: Concrete batch plant at site. In view is a small mixer machine

Shops are used where materials and equipment are fabricated on site: electrical, mechanical, carpentry, etc.

Testing shops used to house the testing equipment

2.4 QUALITY CONTROL

There were several quality control measures in place for the works which included testing of materials for example steel, concrete and blocks. This was generally done following ASTM.

Quality Assurance was also given to the client in terms of documentation from respectable institutions of testing materials.

Figure 13: Slump test for concrete

Examples of Quality Assurances included;

Our Site Safety Officer Mr. Malinga Joseph records Accident/Incident reports daily and organizes a monthly report for the monthly progress meeting.

The type of accidents recorded include;

- Fatality
- Broken bones or fractures
- Amputations of fingers, toes or limbs
- Burns from fire, explosions or electrocution
- Cuts, Lacerations or abrasions from tools, machinery and materials
- Eye Injuries and loss of vision from flying objects or use of hazardous substances
- Sprain and strains (Shoulder, knee or ankle injuries)
- Headaches. Etc.

The monthly records are as follows;

Table 3: Data from reports of HSE

Nov-19	Report 1	0
Dec-19	Report 2	8
Jan-20	Report 3	8
Feb-20	Report 3	6
Mar-20	Report 4	8
Apr-20	Report 5	10
May-20	Report 6	18
Jun-20	Report 7	34
Jul-20	Report 8	25
Aug-20	Report 9	42
Sep-20	Report 10	25
Oct-20	Report 11	11
Nov-20	Report 12	19
Dec-20	Report 13	14
Jan-21	Report 14	9
Feb-21	Report 15	6

The site Engineer (Me) takes laboratory tests for the compressive strength of concrete cubes C25 at 7days and 28 days for different elements of the structure. Below are the average compressive strength results at 28 days taken between August 2020 and February 2021.

Table 4: Data from laboratory testing

Month	**Aug-20**	**Sep-20**	**Oct-20**	**Nov-20**	**Dec-20**	**Jan-21**	**Feb-21**
Average Strengths (N/mm^2)	36	39.5	38	26	26.5	33	25
	39	34	31.5	39.6	28		42
	39	29.5	33	41	34		34
	43.5	36	29.66	29.5	27		
	38.5	27	23.5	46	41		
	42	42	41.5	33.1	35		
	41.5	46	33	36.2	27.5		
	38	42	40	30.8	33		
	26	35	34	33	28		
	36.5	45	35.5	33			
	28	36	49	42			
		44	36	32			
		32	39	33.5			
		31	44	27.5			

		36.5	34.5	33.3			
		30	41	37			
		33	23.5	36.5			
			29.5				

CHAPTER 3: KEY CHALLENGES FACED AND THEIR IMPLICATION

3.1 Introduction

The project lived through an exciting phase of its life, growing nonstop and facing many challenges at the same time. Some of these challenges were relatively new; others were as old as the construction industry itself.

There were several different approaches to the construction issues, as well. For example, sometimes slow technology adoption rates were treated as a single big challenge, and sometimes it was treated as a multitude of different problems – including communication problems, scheduling problems, problems with documentation, and so on.

Some of the most significant issues on the construction project included;

a) Keeping up with COVID19 compliance regulations

COVID19 was a global pandemic that brought business to a halt. It was without doubt the most challenging situation of the last two (2) years even for the construction industry. The government regulated movement of people (labour) and hence materials which affected the entire project. The government gave guidelines and Standard Operating Procedures (SOPs) to mitigate the spread of the virus. However, it was difficult to keep up with the guidelines while ensuring healthy project progress.

It's a good practice to try and reroute regulation-related messages to a specific place where you can find them easier. Additionally, some people tend to dedicate a part of their day to catch up with regulation updates and rule changes.

b) Working on a schedule

This is one of many problems that modern technology and its advantages are either partially or entirely solvable.

c) Communication problems

A surprisingly high percentage of problems within the construction project was directly related to the lack of faster communication between different teams and departments.

Workers' smartphones can be used to make the communication process that much faster (since there are billions of people that have access to a personal smartphone in the world) –

be it via emails, regular messages, or even using various construction-related apps.

d) Managing your documentation

The construction project generally had a lot of documentation to deal with – including contracts, receipts, insurance certificates, material orders, etc. Dealing with all that regularly made the entire process of document management slower and more prone to human error.

At this point, getting your entire business to work primarily paperless is something that should've been done for a while now. There are many different systems and solutions that can help with document management in many ways – be it categorization, due dates, project deadlines, and more.

e) The lack of a skilled workforce

This was one of the biggest problems of the construction project. Semi-skilled laborers and unskilled laborers were more common to acquire than skilled workers for complex works.

Two of the biggest potential approaches to this are mentoring and construction staffing agencies. Mentorship can work for both inexperienced students/college graduates and for existing skilled labor, allowing for more potential employees to be brought in. On the other hand, staffing agencies are tasked with covering most of the recruiting and pre-screening, offering workforce exactly when you need them.

f) Vandalism/theft on site

Theft and vandalism were issues that were typically associated with the construction project Valuable assets of the contractor were stolen for example computers, grinders, gas cylinders, drill machines, saws etc.

This was especially bad for the contractor since each missing or unusable material would decrease the overall margin of a project.

Fixing this problem requires some investments in your regular surveillance equipment, such as fences, cameras, alarms, more lighting on-site, more closed containers to store materials in, and so on.

g) Irregular equipment maintenance/replacement

Some equipment were poorly maintained which led to cost overruns and delay in works whenever there was a breakdown. This for example the hoist machine.

Some of the means of trying to fix this problem include keeping a close eye on equipment that begins to show signs of malfunctioning all of a sudden and being quick on your feet if your equipment breaks down mid-construction (to replace it as soon as possible, be it via an equipment loan or using your funds).

h) "Forgetful" clients

One of the most common cases here was for a client/contract administrator to request some change mid-project and then pretend to "forget" it when paying for the interim certificates.

The only way to avoid these situations is to get a signed change order for each change in your project if anything was requested after the initial plan was finalized.

i) The lack of reliable subcontractors

Some minor subcontractors were unreliable. They face no penalties or damages yet any delay on their works could affect the entire project duration. These include painters, carpenters and steel fixers.

A good way to avoid picking an unreliable sub-contractor would be to ask your vendors or material suppliers for recommendations. Asking subcontractors you've worked for also works wonders on finding reliable communications.

It's also recommended to check subcontractors' licenses, general liability insurance and list yourself as additionally insured within their insurance before finalizing the hiring process.

3.2 Conclusion

The construction industry is quite old and has been through a lot. Some of the problems are extremely old; others have become more prominent in recent years and were not a problem before. In this report, the most significant construction issues on the market were reviewed, as well as some of the means of avoiding or eliminating them.

APPENDIX

Table 5: Results of analysis of data from Table 3.

Statistics

Accidents/injuries

Mean	15.19
Median	10.50
Mode	8
Range	42
Minimum	0
Maximum	42

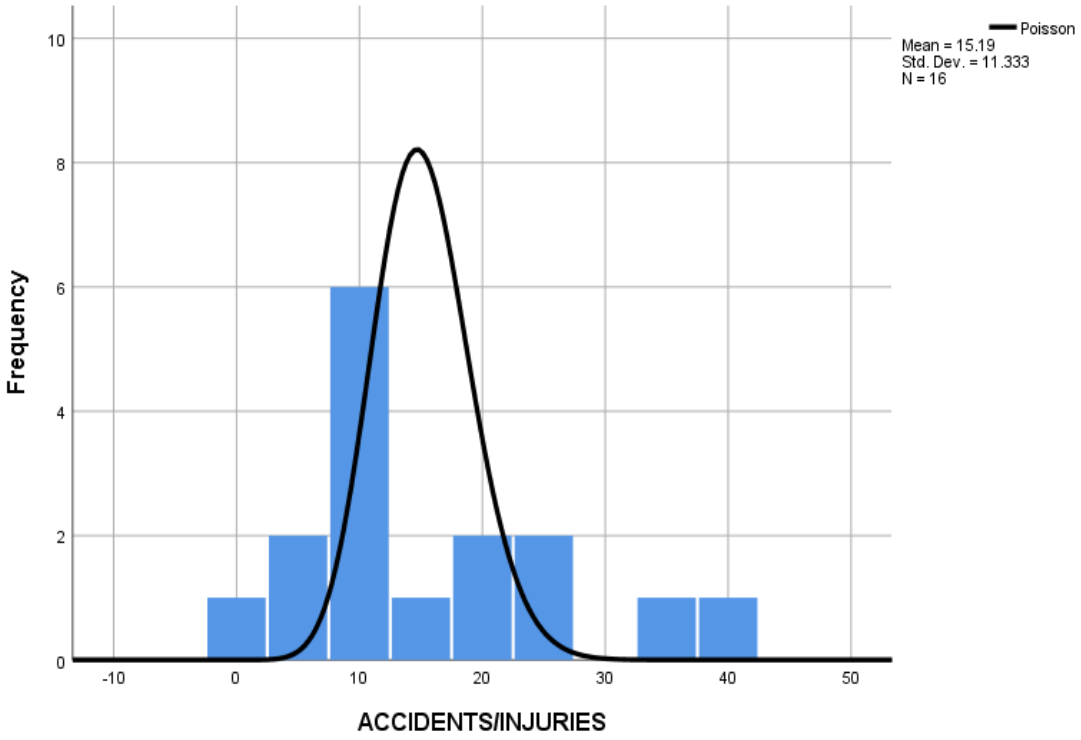

Figure 14: Poisson distribution graph of results from analysis above

Table 6: Table of results for data in Table 4:

Statistics

		Statistic	Std. Error
C25 CUBE RESULTS	Mean	35.0876	0.67612
	Median	34.7500	
	Variance	34.742	
	Std. Deviation	5.89426	
	Minimum	23.50	
	Maximum	49.00	
	Range	25.50	
	Interquartile Range	8.73	
	Skewness	0.083	0.276
	Kurtosis	-0.637	0.545

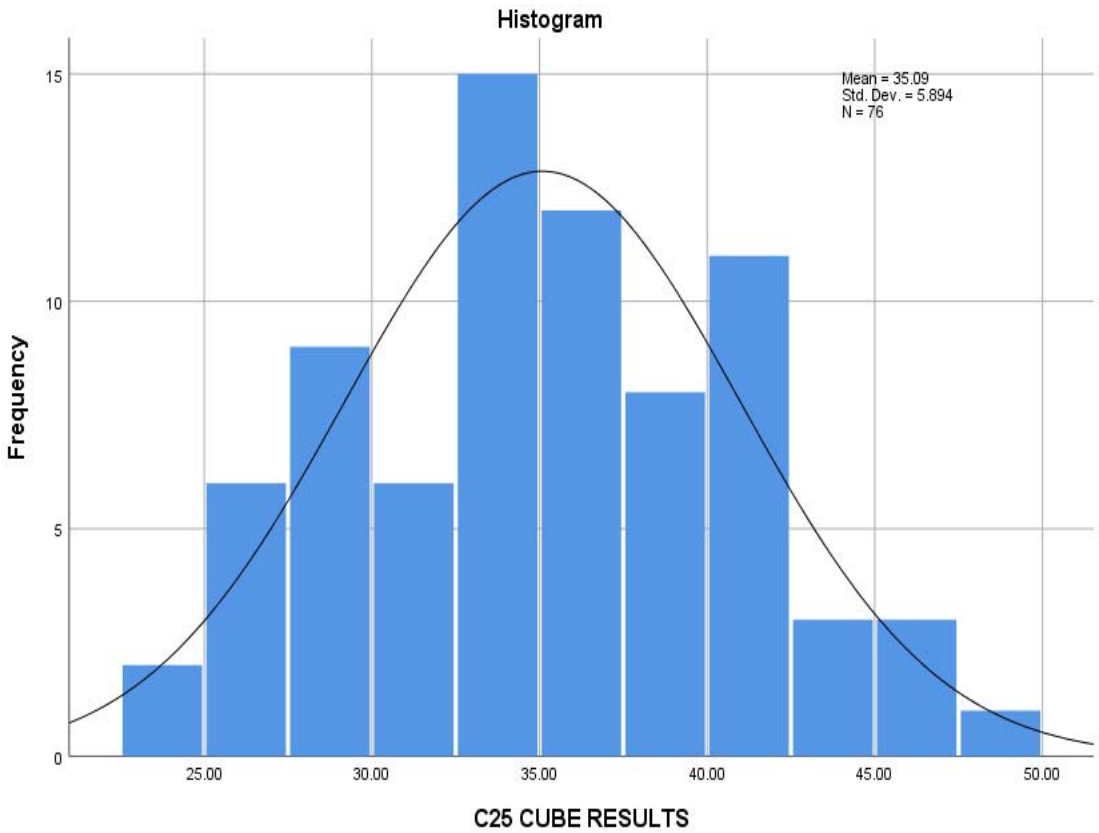

Figure 15: Figure showing binomial distribution for results above.

N

NSAMBYA ROAD

Access Gate

Site Main Access Gate

Security House

Boundary wall

Drainage channel

Nsambya Hospital Main Entrance Gate

ENTRY

EXIT

Existing Hospital Gate to Morgue

E X I S T I N G A C C E S S R O A D

EXISTING ACCESS ROAD

Boundary wall

Drainage Channel

Plot Boundary line

M O R T U A R Y

Staff Toilets

Paved Walkway

Plumbing Store

Plumbing Store

Hoarding

Waste Collection Point 1

Existing Retaining Wall

Site Offices Top and Cement Stores below

Electricals Stores

Stock Pile

Mixer Machine

Block Pile

Kitchen

Generator

Waste Collection Point 2

Stock Pile

Hoist Machine

Covered walkway

Green Garden

Green Garden

E x i s t i n g B u i l d i n g

EXISTING PRIVATE WING

(OLF)

PARKING LOT

BUILDING SITE

EXISTING PRIVATE WING

(OLF)

EXISTING ADMINISTRATION BLOCK

HOLY MARY GROTTO

Existing Wall

Waste Collection Point 3

Toilets and Shower rooms

Female Changing Room

Male Changing Room

EXISTING OXYGEN PRODUCTIONROOM

EXISTING STORE

14.602

7.006

6.753

5.905

12.068

6.350

4.404

15.800

7.000

3.750

45.318

8.500

2.668

5.819

11.602

9.784

9.698

8.026

11.159

9.474

6.200

9.500

5.300

2.500

5000