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**THE EFFECT OF COVID-19 ON BUILDING CONSTRUCTION PROJECT MANAGEMENT: THE CASE
OF BUILDING CONSTRUCTION PROJECTS IN ADDISS ABABA**

By

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DECLARATION

I, the undersigned, hereby state that the effort enclosed in this project work is my own original work and that I have not formerly in its entirety or in part submitted at any university for a degree or diploma or other organization of advanced education.

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Acronyms

WHO: World Health Organization

EEA: Ethiopian Economic Association

ILO: International Labor Organization

COVID-19: Corona virus Disease 2019

GDP: Gross Domestic Product

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Abstract

Corona virus disease (COVID-19) is a recently discovered disease caused by the novel corona virus SARS-CoV-2. The COVID-19 pandemic has a tremendous negative impact on the health of a society as well as on the economy. The construction industry, which is part of the world economy as well as the core of the nation's economy is believed to face the biggest challenge due to COVID-19 pandemic and cannot isolate its impact.

It is believed that there would be a domino impact on the economy if any construction projects are being delayed or if quality is being compromised. After the occurrence of the global pandemic of COVID-19 it had affected the construction industry, including building projects.

Due to the nature of the unorganized nature of the industry identifying the effect of COVID-19 and the challenges caused by the disease can provide the best solution to reduce the pandemic's impact. Therefore to better understand the possible outcome of the pandemic on building construction projects this study has emphasized on the impact of COVID-19 in the building construction industry by taking the case of Addis Ababa, Ethiopia.

The study used both quantitative and qualitative approach through self-administered questionnaire and interview to address those critical points. Disruption in building material supply, losing jobs, project suspensions, cost and time over run and impact on quality of building construction projects are some of the challenges identified. The scarce and increased cost of construction materials, the shortage in hard currency , shortages of labors, delay of projects and incurring additional cost are also the major impacts of COVID-19 on the building construction industry.

Contractors, subcontractors, and suppliers are experiencing COVID-19 impacts, it is critical to perform a schedule assessment or time-impact analysis, including examining the status of material procurement on your projects, to identify latent delays in the schedule.

However, even though all stakeholders involved in the building construction including contractors, subcontractors, company owners and suppliers are experiencing COVID-19 impacts, it is

critical to perform a schedule assessment or time-impact analysis, including examining the status of material procurement for projects, to identify latent delays in the schedule.

Chapter One: Introduction

Background of the study

Corona virus disease (COVID-19) is a recently discovered disease caused by the novel corona virus SARS-CoV-2. Most people infected with the virus will experience mild to moderate respiratory illness and recover without requiring special treatment. However, some will become seriously ill and require medical attention.[1] In addition to the serious health emergency, the outbreak has resulted in a global economic decline[2].

In Ethiopia the pandemic interrupted economic activity in the country where over 40% of businesses closed due to COVID-19- related restrictions and impacts, and 32% of businesses reported no revenues in the first month of the pandemic (March or April 2020)[3].

The construction industry is a fundamental economic sector that permeates most of the other sectors as it transforms various resources into constructed physical economic and social infrastructure necessary for socioeconomic development[4].

It embraces the process by which the physical infrastructure is planned, designed, procured, constructed, or produced, altered, repaired, maintained, and demolished. The construction industry has important contributions to the Ethiopian economy, as demonstrated by its share in the GDP which contributes about 19.5[5]

The sector is playing a major role in the country's economy and serving as a main by involving a wide range of human resource, financial sectors, consultants, contractors through various material supplies. In addition to that the construction sector, like many other sectors, has been affected in a number of ways[2]. Since the pandemic began, there have been fewer employment opportunities, partially due to the work disruptions that were caused by following[3].

Furthermore the disease outbreak is believed to impact the construction markets worldwide through supply chain disruptions, workforce restrictions, and legislative changes [6]. Nonetheless, developing countries seems to be more defenseless to the challenges related with the global pandemic. In particular, the pandemic has caused many project delays and challenges due to (1) supply chain disruptions, (2) changes in the laws, (3) financing pressures, (4) health and safety

challenges, (5) lack of human resources and workforce restrictions, (6) challenges in accessing job sites, (7) contractual implications and claims, (8) suspension of construction projects, and (9) unavailability of needed materials, tools, and equipment[6]. The goal of this paper is therefore to assess impact of COVID-19 on construction projects and project management in Ethiopia by taking the case of building construction projects in Addis Ababa, Ethiopia. The related objectives include (1) identifying a comprehensive and validated list of construction themes and factors affected by the pandemic in Ethiopia, (2) quantify the impact of COVID-19 on building construction and factor, and (3) investigate the impact in private building construction sectors.

Statement of the problem

The construction industry represents most of every country's finances worldwide and vibrant to the continuous economic development and activities, especially in developing countries. There would be a serious impact on the economy if any construction projects are being affected by any external factor let alone an anticipated factor such as COVID-19.

Before the occurrence of the COVID-19 pandemic, there was a persistent necessity in the construction industry to improve productivity with project performance, address labor shortage by minimizing disintegration, introduce standardization, and increase collaboration. Furthermore the labor-intensive nature of building construction projects and the dynamic construction site characteristics make the construction industry one of the most risky activity worldwide.

As the pandemic of COVID-19 arise globally, it affected the overall economy including building construction projects. Ethiopia, as the second-most populous country in Africa with more than 110m people, is among the developing countries where the pandemic has affected the economy significantly. The country's real GDP growth in 2019 was 9.0% and it was forecasted to be 6.2% in 2020 pre-COVID-19 and this forecast has now been revised downwards to 3.2% in 2020.

The construction industry, mainly the building construction as the core of the nation's back bone economy has been confronting a big challenge from the COVID-19 pandemic and cannot except isolated from its impact. Beyond this, the unorganized and fragmented nature of the industry might have aggravated the effect. Even though it is believed that the COVID-19 global pandemic has an impact on construction projects, its severity and specific effect on building construction projects and project management seems to is less known.

Thus, understanding the impact COVID-19 has caused and the measures taken to address those challenges in building construction projects and overall project management becomes very important since it can provide the best solution in designing preparedness and future mitigation when such catastrophic events occur.

Basic research question

The study will be guided by the following key research questions:

- Does COVID-19 has an impact on building construction projects and project management in Ethiopia
- How the Pandemics (COVID-19) significantly affect project success?
- How the project schedule is planned regarding pandemics (COVID-19)?
- What essential procedures are required to improve project management practices?

Objective of the research

General objective

The general objective of the study is to assess the effect of COVID-19 global pandemic on building construction projects and project management in Addis Ababa, Ethiopia.

Specific Objectives

The Specific Objectives of the research are;

- To determine the effect of covid-19 on building construction projects in terms of time, cost and quality in Addis Ababa, Ethiopia.
- To assess factors associated with the effect of COVID-19 on building construction projects in Addis Ababa, Ethiopia.
- To identify the possible measures taken to overcome the effect of COVID-19 on building construction projects in Addis Ababa, Ethiopia.

Significance of the study

In Ethiopia, the construction industry is a huge investment sector for the last many years averagely 58-60% of the capital budget is spent on this industry. It contributes to employment and income creation for the population. It also contributes to government revenue through the generation of corporate profit tax and employee's income tax which in turn goes to finance public services such as schools and health institutions[3].

The construction industry is a huge investment sector in Ethiopia for many years with 58-60% of the capital budget being spent on this industry[7]. It contributes to employment and income creation for the population in addition to government's revenue through the generation of corporate profit tax and employee's income tax which in turn goes to finance public services such as schools and health institutions among others[4].

Furthermore understanding the impact of COVID-19 and finding approaches to reduce adverse effects is fundamental to avoid negative economic growth in the nation that can eventually result in an economic collapse. Among the mechanisms to minimize COVID-19 effect on building construction projects and project management is to isolate the evolving problems and identify serious challenges that the industry is facing during such difficult circumstances.

Therefore the data obtained from this study will help develop solutions for minimizing the crisis's impact. In addition to that this study will have significance in designing intervention for specific problem since the building construction consists of different project types.

Thus, comprehensive identification of problems caused by COVID-19 in the building construction industry is required to determine the finest mechanisms to combat the challenging pandemic.

This study is therefore conducted to identify the effect of covid-19 from individual and project perspective. The study will also evaluate the measures taken for reducing COVID-19's negative impact on the building construction industry.

It is believed that findings from this project will help improve the construction progress and decision-making and forces company owners and policy makers to emphasize different risk reduction strategies during emergency situations.

Furthermore it will help clients, contractors, consultants, employees and other stakeholders involved in mutually sharing duties and responsibilities to clearly understand factors that could have an effect on cost, time and quality of building construction projects and plan a realistic budget and timeframe. This in return will benefit in avoiding unnecessary conflicts by creating a smooth working environment and relation between parties. The study help in developing a standardized guideline that will help mitigate challenges for future catastrophic emergency situations as COVID-19.

Finally these findings are believed to help policymakers improve the currently available plan of strategy by developing new policy and practice that will be helpful in coping with such circumstances in the future among the building construction sector.

Scope of the study

This study has addressed the effect of COVID-19 of building construction project in Addis Ababa, Ethiopia. Starting from individual to organizational level. It is believed to provide a clear understanding to the frame of knowledge by giving a wide-ranging pool of construction factors affected by the global pandemic. The research tried to address this through semi structured interviews with all level stakeholders engaged in the building construction in Ethiopia.

Thus, understanding the factors establishes basic ground for those aiming to scrutinize the COVID-19 effect or any potential pandemic in the future. Furthermore, the author quantified the impact of the global pandemic from different perspective.

It is true that quantification of risk factors is very important for decision makers and project stakeholders to guarantee reasonable decision making.

Most of the studies conducted in Ethiopia have focused on analyzing the impact of the pandemic on project performance and developing guidelines for safely executing projects. However, there has been little understanding on the effect of the disease from the perception of the professionals engaged in the construction sector. This research can provide significant insights into the insight of all relevant stakeholders in the construction sector and helps to develop a strategy to promote the construction industry in the context of Addis Ababa, Ethiopia.

Ultimately, this study will be able to contribute to the knowledge related with understanding the main and significant impact of COVID-19 on various construction and engineering management disciplines by helping the associated construction practitioners address the impact of the pandemic during the life cycle of construction projects and providing a foothold foundation for researchers and decision makers to enhance investigating the effect of the pandemic with its deep uncertainties.

Chapter two: Literature Review

Introduction

Numerous studies were performed to investigate the impact of the pandemic among the building construction sector. Contractors and employers will, unfortunately, have already experienced COVID-19-related disruptions ever since the pandemic occurred. The review of the existing literature is divided into three subsections. First is COVID-19's impact on the construction industry, next is strategies to address COVID-19 in the construction industry, and lastly, the study's positioning in various literature as to intensify the research gap.

Financial problem is the second issue caused by COVID-19. Three factors that cause financial problems during COVID-19 are late payment, project cost increase, and reduced projects. Late payment. Project payments are usually paid in phases. For government projects, payment will be made after the company claims the completed project's work phase. The payment of claims made was delayed due to disrupted government operations

Theoretical review

Construction sector is playing a major role in Ethiopian economy and serving as a main pillar in the country economy. It involves a wide range of man power with different materials required for the specific project. It also involves many financial sectors, consultants, contractors and suppliers with transporters at different levels.

COVID-19, a health crisis that changed into an economic and a jobs crisis, had potentially become a social and economic crisis both worldwide and in Ethiopia[8]. This has been revealed in study findings numerous researches[8, 9].

A study conducted on impact of COVID-19 in the construction industry have shown that the COVID-19 global pandemic has caused delays in construction projects[10, 11]. However the problem is not limited to delay in project works but rather the disease pandemic has caused so many challenges among which some of the major challenges the construction sector mainly the building construction industry confronted include project suspension due to constraint movements and supply shortage, shortage of workforce due to cessation of projects and the spreading of the virus in gatherings, time overrun which is associated with the movement and measure control period[4, 11],

and cost overrun and financial impact following the economic deterioration and ongoing overhead costs to keep companies running [2, 4].

Other impacts including supply shortage, material price fluctuations, legal issues and interruptions in contractual terms, impact on existing accomplished activities and uncertainty of survival have also been reported[10].

Generally, some of the possible areas of adverse impacts of COVID-19 on construction industry are: Labors shortages due to difficulties in mobilization and it will cause 61% of job loss in the only by construction industry[7]. In this case, temporary/daily laborers (that constitute up to 90% of the jobs in this industry) are expected to lose their jobs relatively quickly, and different levels of skilled works will be affected in the waves[8].

Disruptions on the supply chain of construction resources due to difficulties in mobilizing especially importing materials like cement, steel, aluminum, and their products. This due to the major countries (China, Turkey, Japan, UAE, UK, USA, Italy, South Africa, India,) that Ethiopia imports for the construction industry has been on lockdown due to this Noble Corona Virus pandemic[7]. Additional cost due to new Safety and Health requirements, foreign currency shortages, in general, because of delivery delays[5].

Further delay or additional cost emanated from changes of the law restricting the activities. Reduction in productivity is because of the social distancing of laborers and restrictions by the government [5, 7, 8].

Management becomes intensive because of unfamiliar roles & responsibilities introduced by regulatory bodies and claim administration. Increase expenses due to additional cost for PPEs, and idleness of resources like equipment, machinery, and tools, human resources Materials, plant or equipment are coming from China (or other affected countries) and [6] supply has been delayed Price escalations of a resource[3].

Reduction of new investments in the construction industry Beyond this COVID-19 causing thousands of new cases and fatalities as well as wide scale disruption and fear, both societally and economically[6].

Owners and contractors are carefully analyzing whether they should terminate or suspend projects or portions of projects. Some will opt to press forward while some will opt to terminate or suspend.

Similarly a study done in Ethiopia to evaluate the impact of COVID-19 on construction industry have identified the possible areas of adverse impacts of COVID-19 on construction industry[4]. That include Shortages of labor or human resource because of the troubles in movement from one place to another causing majority of job loss and human resource turnover from the construction industry and becoming one of the biggest obstacle for the sector[12].

Disruptions on the supply chain of construction resources due to difficulties in mobilizing especially importing materials like cement, steel, aluminum, and their products were also affecting the market significantly[4]. In addition to that the dynamic cost inflation due to new Safety and Health requirements, shortage in foreign currency, Delay or additional cost originated from changes of the law restricting the activities, decrement in productivity because of the social distancing of laborers and movement restrictions from one place to another by the government[11], the intensive management due to unfamiliar roles & responsibilities introduced by regulatory bodies and claim administration, an increase expenses and incidentals due to additional cost for personal protective equipment, and the cost for resources like equipment, machinery, and tools, human resources during idle working days were some of the deteriorating challenges the sector have faced due to the pandemic [4, 10, 12]

Furthermore delay in material supply and the escalation of price was also believed to cause newly emerging investments in the industry to significantly decrease causing wide scale disruption and fear both socially and economically[13].

Empirical review

The alarming situation impacting the construction industry badly includes road projects, buildings, and infrastructure projects [13, 14].

Studies by many researchers concurred that the COVID-19 pandemic has impacted the construction industry worldwide[14]. Regarding its effect on the building construction sector, numerous studies emphasize that COVID-19 has disrupted the normal operations of construction projects, placing a high level of attention on the safety and health of construction workers on the field[11].

The building construction markets in developing countries are perceived to be more vulnerable to the challenges associated with the pandemic [6]. As such, the main goal of this study is to clearly understand the impact of COVID-19 on construction projects in Ethiopia by considering the case building construction projects in Addis Ababa, Ethiopia.

Based on the report of the International Labor Organization, approximately 2.7 billion workers, equivalent to 81% of the workforce around the world, was estimated to be affected by COVID-19, and certainly these percentages include workers in the construction sector[15].

Construction has a huge proportion of temporary and unskilled workers that it has been estimated in the market that at least 60% of the projects in construction will cease due to lack of financial liquidity, with all temporary workers in these projects (daily laborers) to be laid-off[8].

A study conducted in Ethiopia to evaluate the impact of COVID-19 on construction industry have identified the possible areas of adverse impacts of COVID-19 on construction industry[4]. Shortages of labor or human resource because of the troubles in movement from one place to another causing 61% of job loss only by the sector of construction is one of the major obstacles[12]. Not only that a necessary share of jobs was estimated to be impacted relatively quickly with a medium-estimate of 741K jobs threatened in 3 months, representing 34% of total employment in construction[8].

In this case, contract or temporary employees such as daily laborers that constitute more than 90% of the work load in construction industry were the ones at first line to lose their job[8]. Furthermore,

preliminary statistics showed that the construction sector in Iraq has experienced 52% of employment reduction and 68% production reduction due to COVID-19[6].

Besides the pandemic has led to Lower number of employees (86%) Extension of the implementation period (65%),Suspension of the implementation(53%), Lack of building materials(18%), Introduction of anti-pandemic measures in the company(94%),Introduction of a home office of technical and economic employees (96%),Provision of protective equipment (82%) and Changes in shift rate (22%)[16].

Conceptual framework of the study

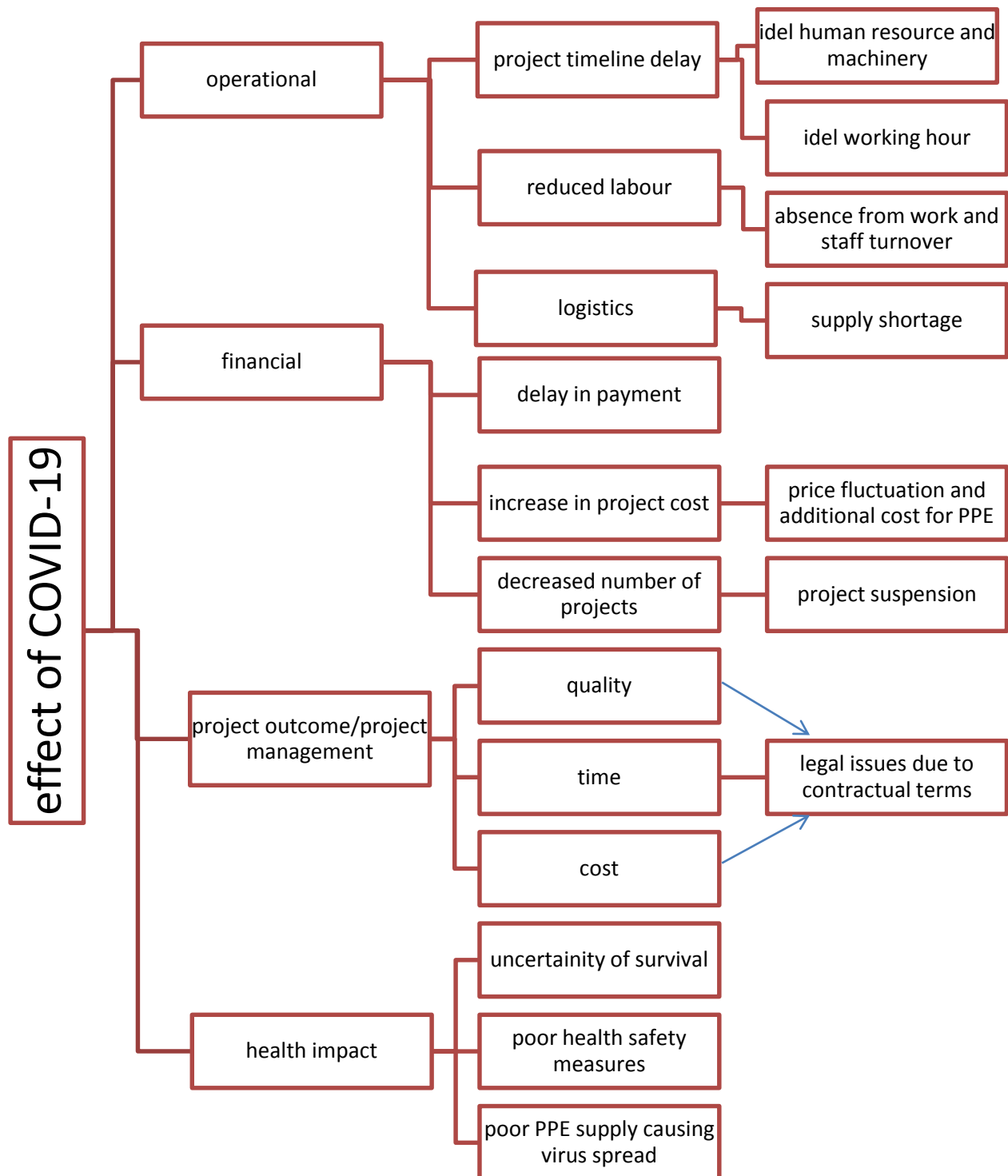


Figure 1. Conceptual framework for the effect of COVID-19 on building construction project management in Addis Ababa, Ethiopia.

Chapter Three: Methodology

Introduction

The research study involves of data collection and analysis through a data sets consisting of quantitative numerical and qualitative interview with the study participants who are involved in companies who are working on building construction projects. Both quantitative and qualitative method has been used to analyze the collected data. The qualitative method (interviews) is used to obtain an overall understanding of the quantitative analysis. The following subsection discusses how the data collection has been collected and been analyzed.

Research design

This is a cross sectional study design using quantitative and qualitative research approach. Carefully selecting the case study's companies is critical to prevent bias in the findings. In this study, the building construction companies were selected based on reviewing several criteria, such as the organization size, engagement in building construction projects and availability of information from past projects mainly during the time of COVID-19.

Participants of the study

The study participants include individuals working in building construction industry, employees, administrative staffs, contractors, sub-contractors, consultants and company owners engaged in building construction projects in Addis Ababa, Ethiopia.

Data collection

Method of data collection

The data collection has been done by developing a semi-structured questionnaire and conducting an interview among employees, contractors, sub-contractors, administrative staffs, consultants and company owners in selected organizations in Addis Ababa, Ethiopia. This approach is used to identify factors that have relationship with effect of covid-19 in the building construction management sector. Some of the basic questions which have been asked include:

- 1) What problems the construction industry has faced due to the global pandemic COVID-19?
- 2) If appropriate notices in a suitable format regarding the changes in time or quality to the client were given or not?
- 3) If any mechanisms to minimize the effect of COVID-19 on building construction projects and the overall project management were considered or not?

The data collection tool or questionnaire is aimed to gather the necessary data or information on how building construction projects and organizations are affected by Covid-19 and factors associated with it. The open-ended interview is used to encourage as much detailed information as desired so that it could probe respondents to give their perceptions on the problem faced by their company due to COVID-19.

However before directly stepping in to data collection pilot testing were done for the tool and the process of piloting the questionnaire on a sample of respondents have allowed the researcher to ensure more response options, add more questions related to sample characteristics, remove redundancies, and make sure the understanding of all respondents who would fill the survey. The data collected during pilot testing were excluded from the final sample to ensure consistent data collection and analysis.

Procedure of data collection

The study was conducted to infer for covid-19 impact on building construction projects where the data collection was to determine the seriousness of the pandemic, mainly for the currently ongoing projects. To achieve the objectives of the study, quantitative data were obtained through a Google questionnaire survey distributed to the target respondents. The questionnaires were sent to those with ability to read and understand English language considering their academic level. Face to face interview has also been done for respondents who might have no access to internet service.

To obtain a representative sample and in order to achieve the goals and objectives of this research work, the study followed a mixed approach that involves both qualitative and quantitative methodologies.

In addition to that a qualitative approach has been used to get a detailed explanation on the subject matter when it is relevant and to clearly analyze the collected data qualitatively. Participants or respondents were selected randomly to avoid selection bias. However the fact that those respondents were involved in various building construction projects were confirmed before proceeding to the interview.

Following that they have been informed about the purpose of the study and their willingness to participate in the interview has been asked and their oral consent was taken. But before proceeding to data collection pre testing of the questionnaire was also made. On the spot checking and review of completed questionnaires to ensure completeness and consistency of the information was done and immediate action were taken. To keep accuracy of data, data entry was done. Non respondents were re- contacted twice and those participants with missing information were asked again to complete.

The data obtained from the survey questionnaires were analyzed using STATA version 14. There were 102 respondents who participated on the questionnaire survey. The results were presented using tables and charts for easier comprehension by the readers.

The figure below shows study methodology flow chart that the research methodology followed.

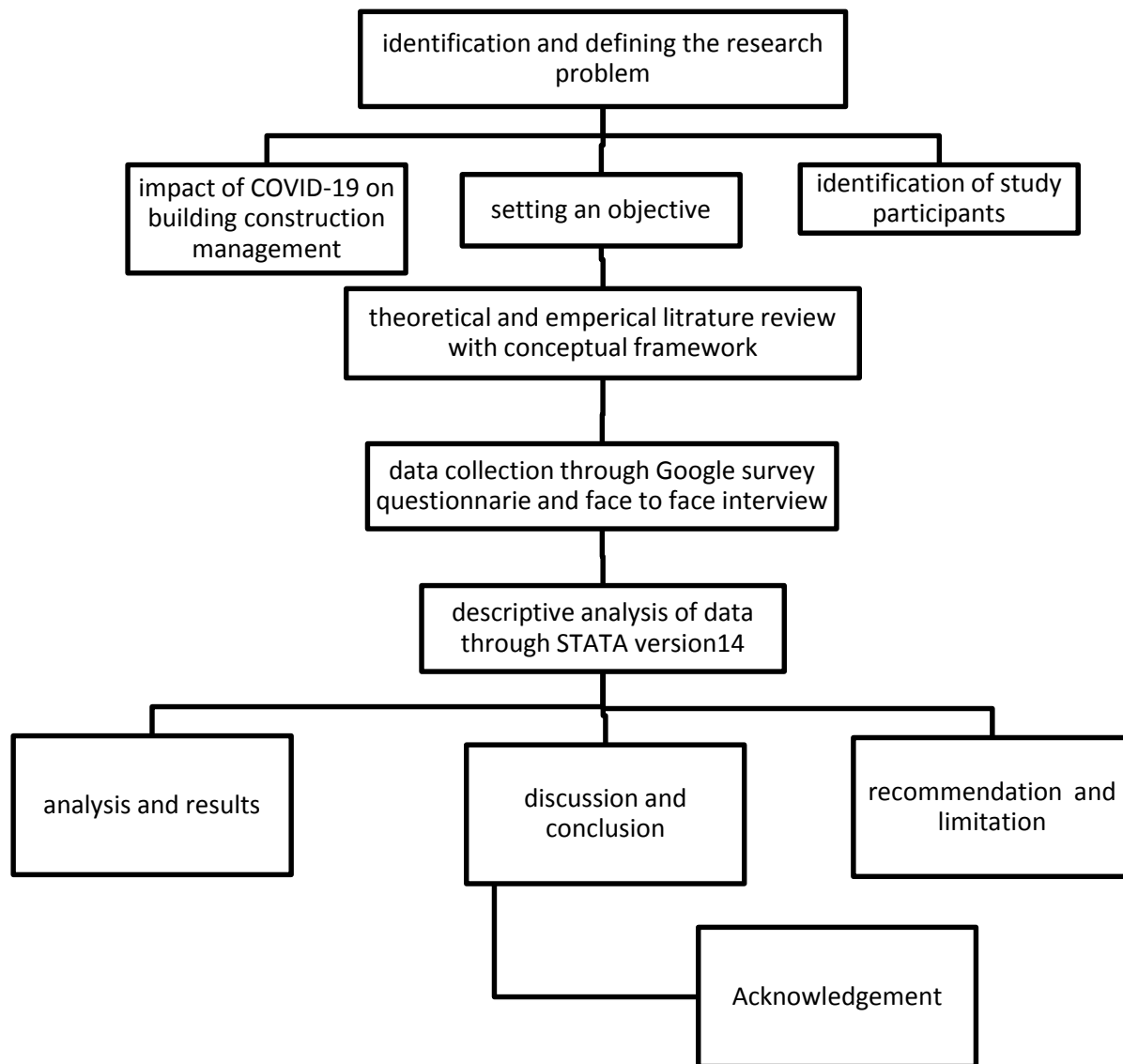


Fig 2. Study methodology flow chart for the effect of COVID-19 on building construction project management.

Data analysis

Data were coded, entered and cleaned using Epi data version 3. 1. All statistical tests were performed using STATA version 14. Data were cleaned for outliers and corrected by transforming in to categorical variable if they were numeric or by omitting extreme values (highest and lowest value). Missing data was omitted before analysis is done.

The findings from a total of 102 respondents to the questionnaire were presented. Participants comprised both genders with different backgrounds, age groups, levels of education, working positions, and experience in the construction industry. The data and information from the findings were gathered to determine the effects of the COVID19 pandemic on the building construction industry as well as project sites. The demography of respondents is presented using descriptive analysis.

To see the effect of each independent variable on the outcome variable, cross tabulation is used and the strength of the associations was assessed by computing chi square test.

Chapter Four: Results and discussion

Respondent's Demographic Description

A total of 102 respondents participated in the research study. Among the total respondents 64.71% of them were males and 35.29% of them were females. Majority of the study participants ranges within the age of 30-40 having percentage of 34%. On the other hand 45(51,14%) of them holds a bachelor degree and 30(34.09%) of them holds master degree. When we see the marital status 60.78% of them are married and 38.24% of the respondents are single.

Further year of work experience of participants were assessed and showed that 26.47% part of them has <5years and 22.55% of them has 5-10years and 21.57% of them has 10-15 years of experience. Regarding their current employment or involvement in project status there were 101 participants who gave answer for this question among which 18(17.82%) of them are building construction company owners and majority of the respondents 34(33.66%) are permanent employees.

The tables below also illustrates the detailed descriptive data for respondents general demographic status including age, sex, educational level, marital status, year of working experience and current employment or involvement status.

Age	Freq.	Percent	Cum.
18-25	13	12.75	12.75
25-30	23	22.55	35.29
30-40	34	33.33	68.63
40-50	24	23.53	92.16
50 and	8	7.84	100.00
Total	102	100.00	

Table 1. Age of study participants

Sex	Freq.	Percent	Cum.
F	36	35.29	35.29
M	66	64.71	100.00
Total	102	100.00	

Table 2. sex of study participants

Education level	Freq.	Percent	Cum.
Bachelor	45	51.14	51.14
Certificate	4	4.55	55.68
Diploma	7	7.95	63.64
Masters	30	34.09	97.73
PHD	2	2.27	100.00
Total	88	100.00	

Table 3. Educational status of study participants

Marital Status	Freq.	Percent	Cum.
Divorced	1	0.98	0.98
Married	62	60.78	61.76
Single	39	38.24	100.00
Total	102	100.00	

Table 4. Marital status of study participants

Besides involvement of the respondents in the organization they represent has also been assessed. Among those who filled the survey majority of the respondents were in senior positions, such as site engineer, consultants or project manager roles representing 20%, 18.89% and 14.44% consecutively. In this assessment 14(15.56%) of them were contractors and 14.44 of them were other stakeholders involved in the building construction management within the organization.

The following bar chart showed role of survey respondents in the organization they represent based on sex.

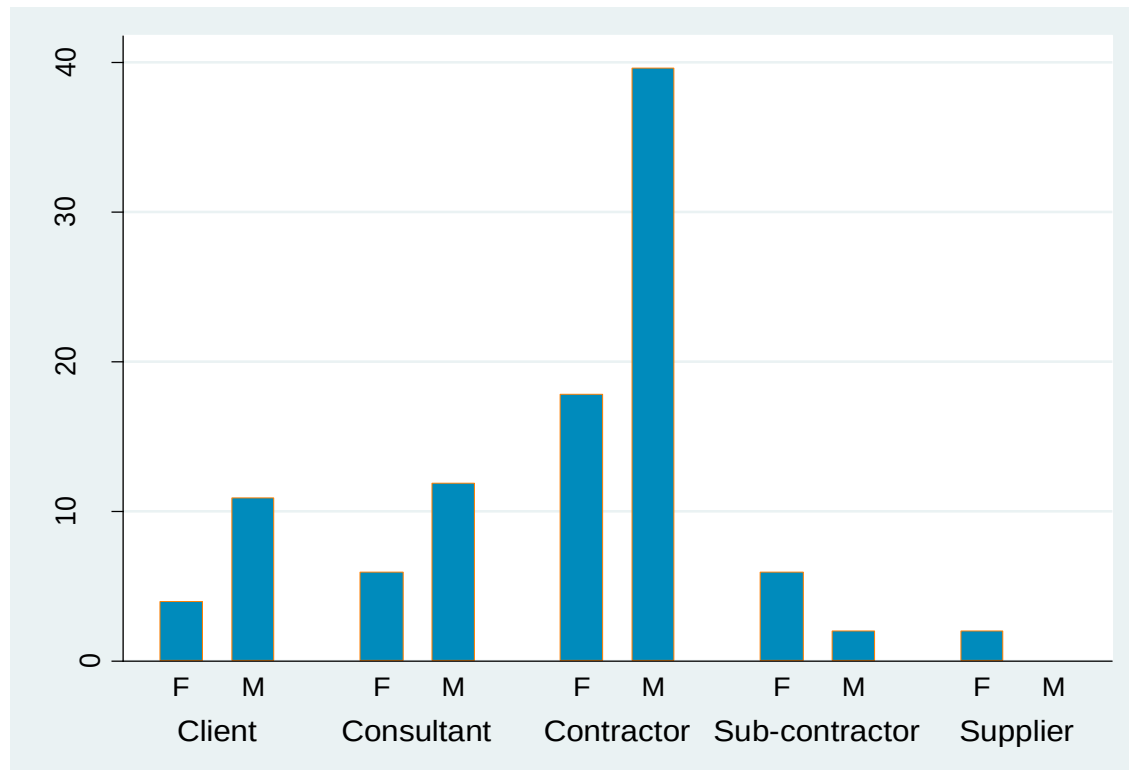


Figure 3. role of respondents in their organization based on their sex

In terms of work experience, 26.47% or 27 out of 102 respondents have <5years experience ; while

22(21.57%) of them have 10-15 years of experience. The other 23(22.55%) of the respondents have 5-10 years of experience working in building construction industry.

Work Experience	Freq.	Percent	Cum.
10-15 yrs	22	21.57	21.57
15-20 yrs	16	15.69	37.25
20-25 yrs	8	7.84	45.10
5-10 yrs	23	22.55	67.65
< 5 yrs	27	26.47	94.12
>25 yrs	6	5.88	100.00
Total	102	100.00	

Table 5. Year of working

experience of study participants

current involvement	Freq.	Percent	Cum.
Company owner	18	17.82	17.82
Consultant	13	12.87	30.69
Contract employer	15	14.85	45.54
Daily laborer	16	15.84	61.39
Permanent employer	34	33.66	95.05
Other	5	4.95	100.00
Total	101	100.00	

Table 6. Current employment or involvement in the company status of study participants

COVID-19 infection and protection mechanisms among building construction workers

Regarding the COVID-19 infection status, a total of 96 study participants have responded among which 39(40.63%) of them have confirmed that they have been infected with the disease.

On the other hand 19(19.79%) of them believe that they might have been infected with COVID-19 and the rest 38(39.58) responded that they haven't been diagnosed with COVID-19.

Below is a pie chart showing a detailed description about the information if they have ever been infected with COVID.

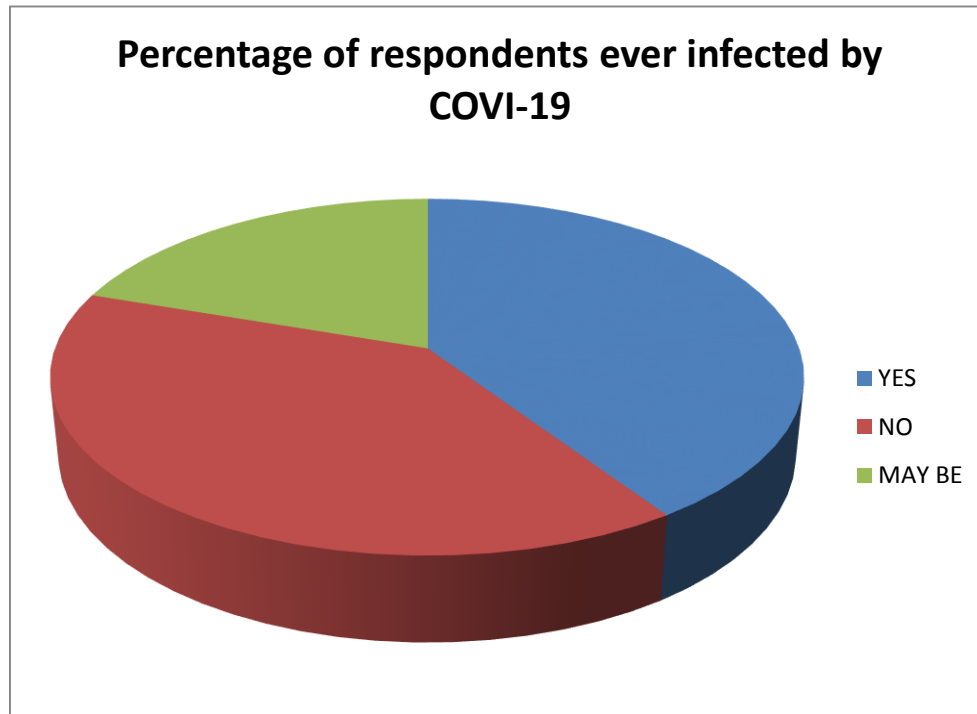


Figure 4. Respondent's status of ever being infected by COVID-19

Further below is a pie chart showing the vaccination status of respondents. From a total of 100 respondents 67(72.04%) of them are not vaccinated and only 26(27.96%) are vaccinated. On the bottom of the pie chart we see COVID-19 being infected based on sex of the respondent.

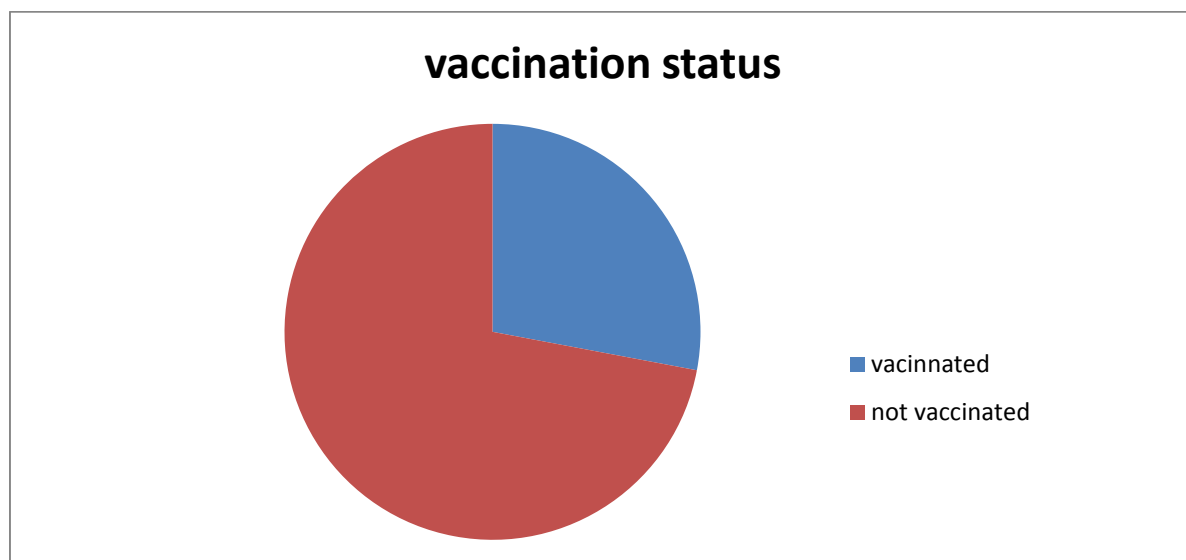


Figure 5. COVID-19 vaccination status of study participants

Sex * ever infected by COVID Cross tabulation					
Count		Ever infected by COVID-19			Total
		Maybe	No	Yes	
Sex	F	7	9	20	36
	M	11	32	22	65
Total		18	41	42	101

Table 7. COVID-19 infection status among study participants

In addition to the above pie chart the following two tables below reveals the number of days participants with COVID-19 disease have been absent from work .it shows that more than half percentage(52.50%) of respondents who have been infected by COVID-19 have been absent from work place for 16-30 working days.

If yes how many days	Freq.	Percent	Cum.
1(0-5 days)	8	20.00	20.00
2(6-15 days)	11	27.50	47.50
3(16-30 days)	21	52.50	100.00
Total	40	100.00	

Table 8. Number of work absent days due to COVID-19 infection among study participants

Ever infected by COVID	If yes how many days			
	1(0-5days)	2(6-15days)	3(16-30 days)	Total
Maybe	2	0	0	2
Yes	6	11	21	38
Total	8	11	21	40

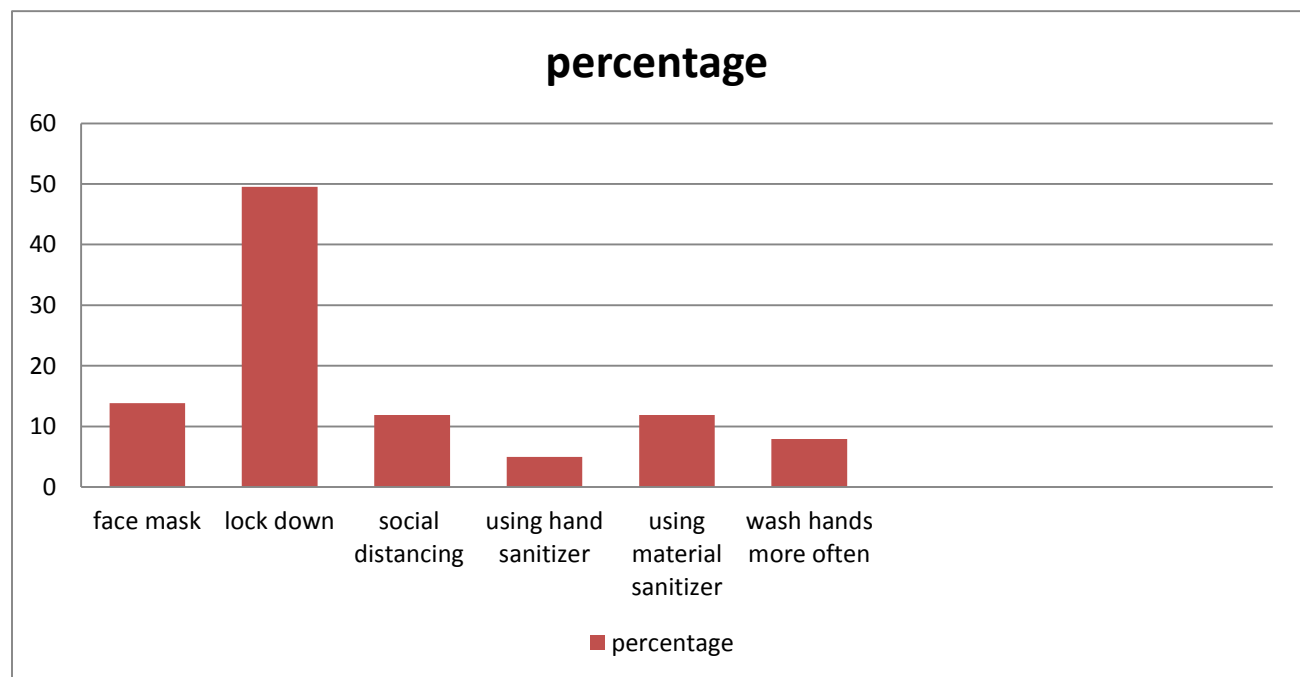
Table 9. Average number of absent days due to COVID-19 infection

In addition among those participants who have been infected with COVID only 26 of them have their position replaced but the rest 16; their position at work placed was not replaced.

Ever infected by COVID	The Position replaced		Total
	No	Yes	
Maybe	7	3	10
No	7	2	9
Yes	16	26	42
Total	30	31	61

Table 10. workers position placement during absence from work due to COVID-19 infection

The following bar graph also shows the frequency and percentage of respondents on the COVID-19 protection methods which are not preferable for them and methods that they have not applied it at all. Nearly 50% of the study participants have mentioned that lock down is among the COVID-19 protection method which was not preferable for them that they have never implemented it.

**Figure 6. bar chart on percentage of un preferable/not suitable/ COVID-19 protection methods**

Challenges faced by contractor and company owners

The table below shows some of the most commonly challenges faced by contractors and company owners. Delay in monthly salary, adjusting to the new work schedule and losing job were among the commonest challenges faced by contractors.

contractor challenges	Freq.	Percent	Cum.
Adjusting to new work schedule	14	19.44	19.44
Lack of safe working environment	9	12.50	31.94
Uncertainty of survival	7	9.72	41.67
losing jobs	13	18.06	59.72
managing a heavier work load	10	13.89	73.61
monthly salary delay	15	20.83	94.44
other	4	5.56	100.00
Total	72	100.00	

Table 11; challenges faced by contractor during the COVID-19 pandemic

On the other hand cost overrun and financial impact, material price fluctuation and shortage of material supply with increasing expense for the idleness of resources like equipment of machinery are some of the challenges mentioned by company owners.

challenges faced by company owners	Freq.	Percent	Cum.
cost overrun and financial impact	7	25.93	25.93
Impact on existing accomplished activities	1	3.70	29.63
Increase expense for idleness of resources like equipment & machinery	3	11.11	40.74
Legal issues and interruptions in contractual terms	1	3.70	44.44
material price fluctuations	6	22.22	66.67
Other	2	7.41	74.07
project suspension	2	7.41	81.48
shortage of material supply	3	11.11	92.59
time overrun	2	7.41	100.00
Total	27	100.00	

Table 12.Challenges faced by company owners during the COVID-19 pandemic

Effects of the COVID-19 Pandemic on building construction projects

A total of 101 participants have given their response regarding their representation during project works. Among the total majority of them which is 57.43% represents the contractor and only 1.98% of them represent construction material supplier. The chart below shows the overall data of participants representativeness in the study.

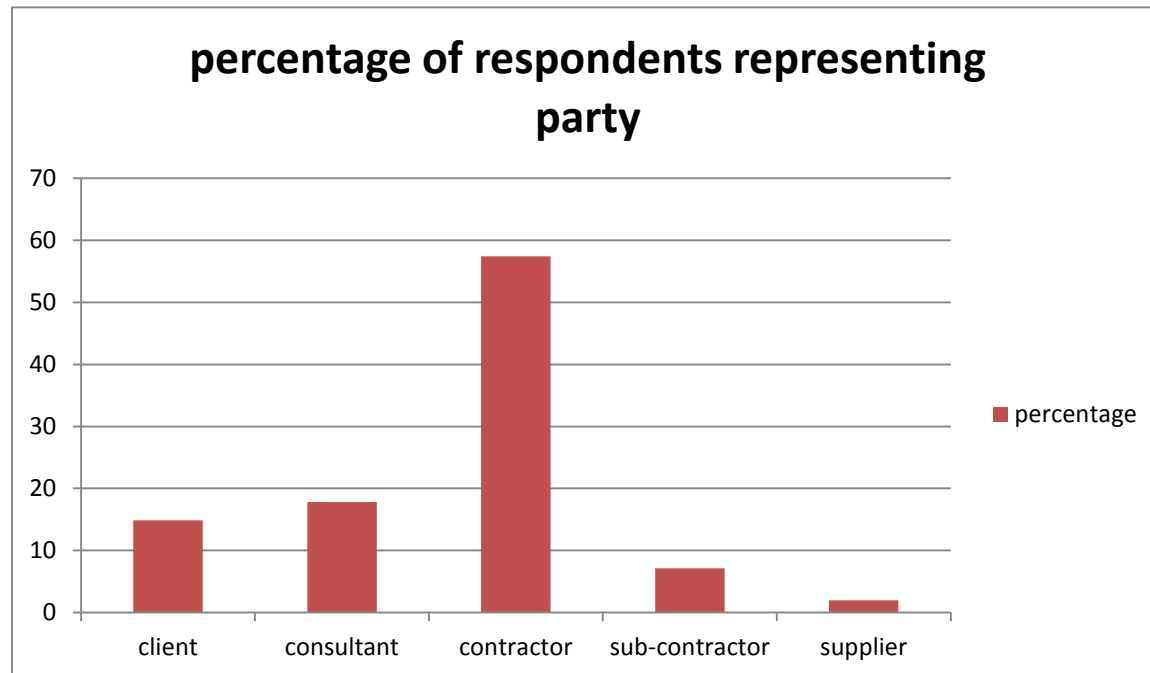


Figure 7. bar chart showing percentage of respondents representing party

In terms of effect of COVID-19 in construction projects 96.51% of the survey respondents have clearly mentioned that the global pandemic COVID-19 has significantly affected their building construction project and only 3.49% said that their building construction project hasn't been affected by the disease.

Did COVI-19 affect your construction project?	Freq.	Percent(%)	Cum.
No	3	3.49%	3.49
Yes	83	96.51%	100.00
Total	86	100.00	

Table 13. effect of COVID-19 on building construction project

Besides effect of COVID-19 on building construction project timeliness, overall project cost and project quality has been evaluated. The finding from stata analysis has showed that the disease has significantly affected the project time and cost than project quality in the building construction industry.

Below is a combined set of data on the table regarding the effect of the disease on project time, cost and quality.

Project status	Affected by COVID-19	frequency	Percentage
Project go up on time	Yes	73	85.88%
	No	12	14.12%
Project go up on cost	I don't know	1	1.16%
	Yes	67	77.91%
	No	18	20.93%
Project go up on quality	Yes	47	58.02%
	No	34	41.98%

Table 14. effect of COVID-19 on building construction in terms of cost, time and quality

effect of COVID-19 on building construction project	Freq.	Percent	Cum.
Cost	22	28.21	28.21
Quality	8	10.26	38.46
Time	31	39.74	78.21
Time, Cost	10	12.82	91.03
Time, Cost, Quality	7	8.97	100.00
Total	78	100.00	

Table 15 effect of COVID-19 on specific types of building construction project

In addition to assessing the effect of COVID-19 on building construction projects, respondents have addressed its level of effect on time, cost and quality of those mentioned projects. As mentioned on the table below 33(50%) of the study participants have confirmed that the pandemic has delayed their project in 6-12 months. The rest 20(30.30%) have also addressed that because of the pandemic their project work has been delayed by 12-18 months, which is very much significant for project work activity and achievement.

effect of COVID-19 on building construction project	Level of effect/ (specific effect of COVID-19)	Freq (No.)	Percentage (%)
Time	12-18 months	20	30.30
	18-24 months	4	6.06
	6-12 months	33	50.00
	<6 months	9	13.64
Total		66	100%
Cost	20 - 40 % project cost	21	30.43
	40 - 60 % project cost	18	26.09
	60 - 80 % project cost	11	15.94
	80 - 100 % project cost	10	14.49
	< 20 % project cost	8	11.59
	> 100 % project cost	1	1.45
Total		69	100%
Quality	Change the labor quality with a lesser one	18	28.13
	Change the material quality with a lesser one	31	48.44
	Working with unsuitable environment	15	23.44
Total		64	100%

Table 16. level of effect of COVID-19 on building construction management

The table below shows the level of significance on how COVID-19 has affected projects of building construction management. It shows that the pandemic has significance effect that could alter the cost, time and quality of project activities.

Level of significance test

DidCOVID-19 Affect your construction project?	Specific effect on					Total
	Cost	Quality	Time	Cost and time	Cost, time and quality	
No	0	0	0	0	1	1
Yes	22	8	31	10	6	77
Total	22	8	31	10	7	78

Pearson chi2 (4) = 10.2746

Pr = 0.036

Table:17. Significance test to show the effect of COVID-19 on building project management

Measures taken to minimize the effect of COVID-19 on building construction management

The study has also addressed the presence of records which are prepared to confirm project delays and measurements that were taken to minimize the effect of COVID-19 on building construction projects. Findings showed that only 50% respondents have tried to take action to address the effect of the global pandemic. On the other hand 62(73.81%) of them have documented temporary records of confirmation that reveals the impact of the pandemic on project time delays.

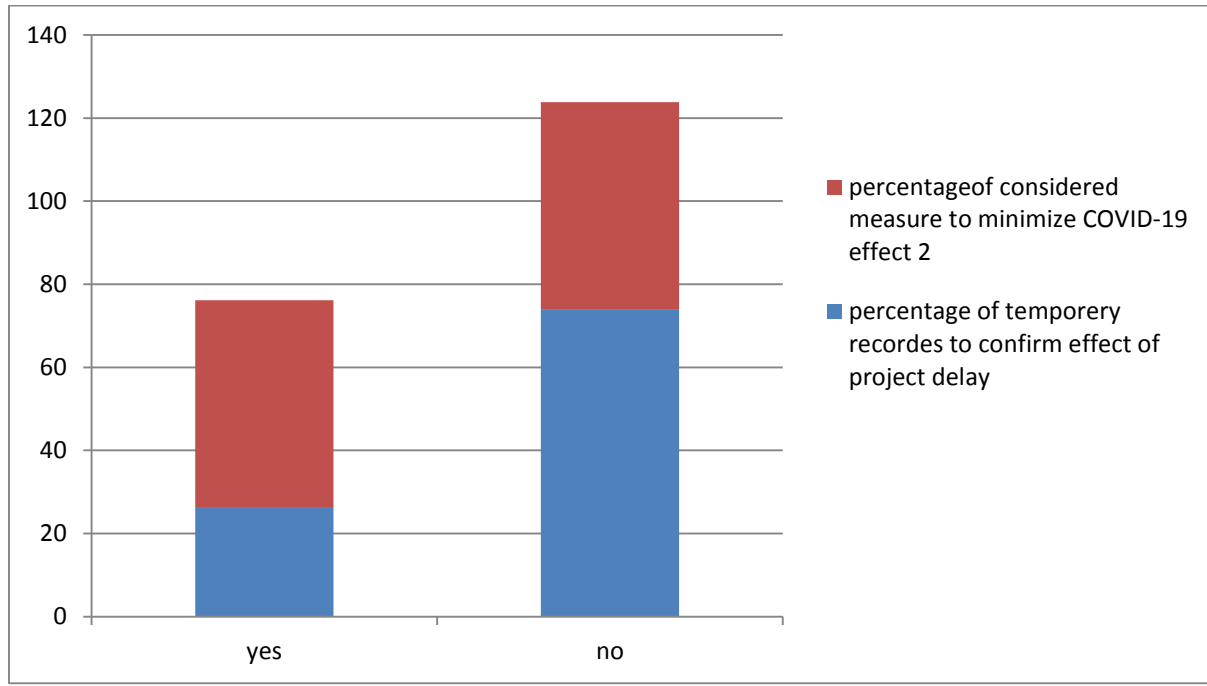


Figure 8. Measures taken to minimize the effect of COVID-19 on building construction projects.

Chapter Five: Discussion, Conclusion and Recommendation

Discussion

This study examines the critical issues of the building construction industry following the COVID-19 using detailed literature review, quantitative and qualitative research approach. The semi-structured interview was conducted with 102 respondents who have valuable experiences in the construction sector. The employees and company owners who are part of the building construction industry are believed to represent the building construction sector in Addis Ababa, Ethiopia.

The emergence of COVID-19 abruptly changed the work routine in many industries [6, 7]. Various studies have revealed that the effect of the global pandemic COVID-19 hasn't been confined to health areas, although the immediate cure of people who contracted the disease was the most urgent concern[3].

The increased wave of COVID-19 effect has also vibrated on other economically significant business sectors among which construction is the major one[10].

The construction industry, as a massive body with high inertia, was among industries that were hit by the pandemic with a delay[17]. The current study aimed first to explore effect or impact of COVID-19 on the building construction industry in Addis Ababa, Ethiopia.

Exhibiting clear and understandable evidence on the impact of COVID-19 is believed to help all stakeholders engaged in the building construction to prepare more effective response plans, considering global and local aspects.

In the present study a total of 102 respondents participated in the research study. Among the total respondents 64.71% of the males and 35.29% of them were females. Majority of the study participants ranges within the age of 30-40 having percentage of 34%.

On the other hand 45(51,14%) of them holds a bachelor degree and 30(34.09%) of them holds master degree.

Besides year of work experience of participants were assessed showing 26.47% part of them has <5years and 22.55% of them to have 5-10years and 21.57% of them to have 10-15 years of experience. The fact that the study participants are diversified from different year in working experience is believed to give a logical picture of the concept from different perspective. Regarding their current employment of involvement in project status there were 101 participants who gave answer for this question among which 18(17.82%) of them are building construction company

owners and majority of the respondents 34(33.66%) are permanent employees. This ratio provides a common ground for meaningful comparison through a project management lens since among those who filled the survey majority of the respondents were in senior positions, such as site engineer, consultants or project manager roles representing 20%, 18.89% and 14.44% consecutively.

Regarding the COVID-19 infection status, a total of 96 study participants have responded among Which 39(40.63%) of them have confirmed that they have been infected with the disease.

On the other hand 19(19.79%) of them believe that they might have been infected with COVID-19 and the rest 38(39.58) responded that they haven't been diagnosed with COVID-19. Such serious impact of the pandemic on the construction sector different studies have also come up with similar findings.

A study conducted in Iraq to capture and identify a comprehensive and validated list of construction themes and factors affected by the pandemic in developing countries have shown that the construction sector is among the major economy that have been affected by the pandemic[6].

Similar finding have been observed in a study conducted to understand problems caused by COVID-19 in the building construction industry and mechanisms to reduce COVID-19's negative impact[10].

Another study done in Ethiopia to assess impact of COVID-19 on the overall construction business have also identified the significant long term and short term impact of the pandemic on the industry[4]. From this it is possible to come up with the conclusion that the COVID-19 outbreak and the subsequent measures taken to contain it have had a profound impact on every industry including the building construction project.

On the other hand the present study also showed that more than half percentage (52.50%) of respondents who have been infected by COVID-19 being absent from work place for 16-30 working days. It is known that the construction projects are dependent on the flow of materials, equipment, and labor along supply chains.

A disruption at any level has the potential effect of delaying delivery and increasing costs [6]. Studies show that the disruption in the labor flow in addition to the supply shortage as in the current study has directly led the economic activity to resume making contractors to face the challenge of financing increased costs[17] and the uncertainty of whether those are covered by contract clauses and can be recovered[18].

Another critical finding in this study includes the challenge contractors and building construction company owners has faced. Delay in monthly salary, adjusting to the new work schedule and losing job were among the commonest challenges faced by contractors.

On the other hand, cost overrun and financial impact, material price fluctuation and shortage of material supply with increasing expense for the idleness of resources like equipment or machinery are some of the challenges mentioned by company owners. It shows a significant percentage of impact that the industry has faced as 96.51% of the survey respondents have clearly mentioned that the global pandemic COVID-19 has significantly affected their building construction project and only 3.49% said that their building construction project hasn't been affected by the disease.

Similar finding have been observed showing that COVID-19 is causing operational and financial issues, while financial aids and complete information is needed to overcome those impacts[2].

This has been further seen on a study done in Ethiopia implying scarcity and increasing cost of construction materials, hard currency shortages, reduction productivity, shortages of labors, delay of projects (extension of time), and incurring additional cost being the major challenges in Ethiopian construction industry[4].

Though participants in the current study were asked regarding personal protective materials they have mentioned that following lock down, using face mask, using hand sanitizers and use of material sanitizers are the most unsuitable personal protective equipment's for them. This shows irrespective of social distancing, the supply of PPEs and sanitizers, alternative arrangements for transportation, facilities, working hours for staff, and labor are among the mechanisms being done minimizing the effect of the pandemic was not as such an easy task[4].

Besides the effect of COVID-19 on the general building construction project its effect on timeliness, overall project cost and project quality has also been evaluated. The finding has showed that the disease has significantly affected the project time and cost more than project quality in the building construction industry.

Such studies with similar findings have been observed in other studies[10, 11]. For instance a study done in Nepal has addressed the deteriorating financial situation of the contractors, late payment, and over cost runs of the projects as a financial impact due to COVID-19[9].

Eventually study participants were further asked regarding the issue of keeping temporary records to confirm the effects of project delays and the consideration of possible measures from their perspective to minimize the effect of the disease on building projects.

Following this point even though majority of the respondents mention that they have kept a record to confirm COVID-19 effect on their project delay only 50% of them have tried taking a considerable measure to minimize the effect of the pandemic on their building construction project. Such challenge has also been addressed in a study conducted to address impact of COVID-19 in Ethiopia mentioning the occurrence of disruptions on the supply chain of construction resources due to difficulties in mobilizing especially importing materials like cement, steel, aluminum, and their products[4].

However regarding the measure taken in Ethiopia, the study shows that there is poor effort. In contrast to this, a study conducted in wuhan, china to identify strategies to address COVID-19 in the construction industry identified that adhering to a product, organization, and process (POP) modeling approach combined with building information modeling allowed for the ultra-rapid creation, management, and communication of project-related information, resulting in the successful achievement[19].

This shows the need for government support in preparing guidelines that could help in mitigate such catastrophic challenges in the future[10].

While addressing the qualitative questions to further address detailed issues on the effect of the pandemic, participants have raised several points. Some of those points regarding the mitigation mechanisms to overcome the challenge of time over run and shortage of material supply during the pandemic include working very late more than the usual working hour with a lesser quality material and the use of lesser quality building material were the major ones.

The respondents have also addressed that the significant shortage in material supply has been diverting their focus more on its availability than the quality of supply which in return compromised the quality of the project work. Similar results were seen in a qualitative study conducted in Malaysia showing material delay issues due to cross-country procedures and shortens of supplies due to the supplier company's operations being suspended leading to high demand for supplies[10].

Finally the findings from this research work will help policymakers improve existing strategic plans and create new policies to cope with the circumstances caused by COVID-19 among building construction organizations.

In addition to the current countermeasures, the government could provide other mechanisms to reduce the impact of COVID-19 in the building construction industry. This includes developing standard operating procedures that could be used in such emerging challenges

Conclusions

This paper was able to identify the effect of COVID-19 on building construction projects in Ethiopia by considering the case of building construction projects in Addis Ababa, Ethiopia. Ethiopia has faced unprecedented challenge, similar to many other countries. The response to the COVID-19 crisis was intended to ensure public health and safety, with minimal impact on necessary industries. However the building construction industry is among the most highly affected sector by the COVID-19 global pandemic. This study could be additional supporting document to the existing ones to show that the pandemic has caused a significant effect on the building construction industry.

Various factors have been identified. There is a deteriorating financial situation and cost inflation of construction materials and supplies compromising time and cost of projects. Moreover, contractors faced the problem of late payment and over cost runs of the projects. Likewise, the operational level impact is related to delay in project completion, supply chain problems, difficulty in workforce management, and maintaining health and safety of the workforce.

This paper briefly reported the results of a study on the impact of COVID-19 among selected possible stakeholders in building construction in Addis Ababa, Ethiopia.

The findings help construction managers and policymakers to adopt a national approach when there is a relative consensus.

Eventually the construction industry was one of many impacted by COVID-19. Undertaking a construction project requires a significant amount of planning: beginning with a conceptual plan and ending with a detailed design, it is necessary to make thorough preparations about labor; the provision of costs and resources; and the purchase of construction materials and machinaries.

Furthermore the study has identified the problems caused by pandemic COVID-19 on the building construction industry, and the need for considerable measure to minimize its devastating negative impact. This is because the damage will proceed by impacting the building construction industry by causing operational and financial issues. The operation is effected as project timelines due to shortening the time of construction activities and late approvals by related authorities.

Besides, the shortage of skilled workers and supplies, logistic issues will directly and indirectly affect the building construction project operation.

Recommendation

Consequently, emphasizing the impact of COVID-19 and the strategies to address those problems in the building construction industry becomes vital. Thus, this research objective is to identify problems caused by COVID-19 in the building construction industry and mechanisms to reduce COVID-19's negative impact.

In addition to the current countermeasures, the government could provide other mechanisms to reduce the impact of COVID-19 in the building construction industry. This includes developing standard operating procedures that could be used in such emerging challenges.

subcontractors, and suppliers are experiencing COVID-19 impacts, it is critical to perform a schedule assessment or time-impact analysis, including examining the status of material procurement on your projects, to identify latent delays in the schedule. Further though the building construction industry experiencing COVID-19 impacts, it is critical to perform a schedule assessment or time-impact analysis, including examining the status of material procurement on your projects, to identify latent delays in the schedule.

In addition to that identifying causative and attributable factors could help when projects face challenges in delay that could lead to suspension. Not only that but also revising resource planning across project stakeholders (owner, project manager, architect, engineer, contractor, a subcontractor) and identifying current key resources as well as those required for the duration of the project could provide an updated data on the progress of the project. Finally stakeholders engaged in the building construction projects should continuously conduct risk analysis by considering the various situations that could suddenly emerge and affect the project.

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Annexes

1. Annex one: tables

- a. **Table 1-** Age of study participants
- b. **Table 2-** sex of study participants
- c. **Table 3 -** Educational status of study participants
- d. **Table 4 -**Marital status of study participants
- e. **Table 5 -** Year of working experience of study participants
- f. **Table 6 -** Current employment or involvement in the company status of study participants
- g. **Table 7 -** COVID-19 infection status among study participants
- h. **Table 8 -** Number of work absent days due to COVID-19 infection among study participants
- i. **Table 9 -** Average number of absent days due to COVID-19 infection
- j. **Table 10 -** workers position placement during absence from work due to COVID-19 infection
- k. **Table 11-** challenges faced by contractor during the COVID-19 pandemic
- l. **Table 12 -**Challenges faced by company owners during the COVID-19 pandemic
- m. **Table 13 -** effect of COVID-19 on building construction project
- n. **Table 14 -** effect of COVID-19 on building construction in terms of cost, time and quality
- o. **Table 15 -** effect of COVID-19 on specific types of building construction project
- p. **Table 16 -** level of effect of COVID-19 on building construction management
- q. **Table 17-** Significance test to show the effect of COVID-19 on building project management

2. Annex two : figures

- **Figure one-** Conceptual framework for the effect of COVID-19 on building construction project management in Addis Ababa, Ethiopia
- **Figure two -** Study methodology flow chart for the effect of COVID-19 on building construction project management
- **Figure three -** role of respondents in their organization based on their sex
- **Figure four -** Respondent's status of ever being infected by COVID-19

- **Figure five** - COVID-19 vaccination status of study participants
- **Figure six** - bar chart on percentage of un preferable/not suitable/ COVID-19 protection methods
- **Figure seven** - bar chart showing percentage of respondents representing party
- **Figure eight** - Measures taken to minimize the effect of COVID-19 on building construction projects

Appendix: Questionnaire

Effects of COVID-19 on building construction projects in Addiss Ababa, Ethiopia

Please respond the following questions by marking on the provided boxes and write explanations on some questions.

Please feel free to call for unclear questions by the following number.

+251911245545

Identification no. _____

A. Socio-demographic questions

1. Age

18-25 ☐ 25-30 ☐ 30-40 ☐ 40-50 ☐ > 50 ☐

2. Sex

F ☐ M ☐

3. Educational Level

Certificate ☐ Diploma ☐ Bachelor ☐ Masters ☐ PHD ☐

4. Marital status

Single ☐ married ☐ divorced ☐ separated ☐ widowed ☐

5. Profession _____

6. Working Experience(in years)

< 5yrs ☐ 5-10 yrs ☐
 10-15 yrs ☐ 15-20 yrs ☐
 20-25 yrs ☐ 25-30 yrs ☐
 > 30 yrs ☐

COVID-19 Related Information

1. Which of the following COVID-19 protection methods are not preferable for you and not applied it at all?

Wash hands more often ☐ use had sanitizer ☐ use material sanitizer ☐
 Social distance ☐ face mask ☐ lock down ☐

2. Have you ever been infected by any of the covid-19 variant?

Yes ☐No ☐

3. If your answer to No.2 is yes, how many days on average were you away from work?

4. Have you got vaccinated?

Yes ☐No ☐

5. Was your place replaced by the equally leveled personnel on your absence?

Yes ☐No ☐

6. Did your replacement was suitable for the position. (Does the person fit the position?)

Yes ☐No ☐

B. Questions to assess Project Related Detail from individual and organizational perspective

1. What type of construction project are you working?

Real estate ☐Service provider project ☐Hospital Building Project ☐Mixed use building ☐Office building ☐Apartment Building ☐

2. Which party do represent?

Client ☐Contractor ☐Sponsor ☐Consultant ☐Subcontractor ☐Supplier ☐

3. What is your current employment status?

Daily laborer ☐Contract employee ☐Permanent employee ☐Consultant ☐Company owner ☐Other ☐

4. What is your role in the organization

Safety engineers ☐Site engineers ☐Subcontractors ☐Administrative staff ☐Consultants ☐Other ☐Contractors ☐Project managers ☐

5. If your answer for question number 3 is contract staff, what challenges have you faced (more than one answer is possible)

- Lack of safe working environment ☐ Other ☐
- Managing a heavier work load ☐
- Monthly salary delay/income ☐
- Losing job ☐
- Adjusting to new work schedules ☐
- Uncertainty of survival ☐

6. If your answer for question number 3 is company owner, what challenges have you faced as an organization (more than one answer is possible)?

- Shortage of material supply ☐
- Workforce shortage /staff turnover ☐
- Time overrun ☐
- Cost overrun and financial impact ☐
- Project suspension ☐
- Material price fluctuations ☐
- Legal issues and interruptions in contractual terms ☐
- Impact on existing accomplished activities ☐
- Increase expenses for PPEs ☐
- Increase expenses for idleness of resources like equipment & machinery ☐
- Other ☐

7. Did the project go up on the time schedule?

Yes ☐ No ☐

8. Did the project go upon the cost schedule?

Yes ☐ No ☐

9. Did the project go upon the quality schedule?

Yes ☐ No ☐

C. Questions to assess Effect of COVID-19 on project management

1. Did COVID-19 affect your construction project?Yes ☐ No ☐**2. If yes, how does covid-19 affect your project management activities?**Time ☐ Cost ☐ Quality ☐**3. If No. 2 is Time, how long does it delay the project?**< 6 months ☐ 6-12 months ☐ 12-18months ☐ 18-24 months ☐ > 24 months ☐**4. If no.2 is cost, how much does it raise from the original?**< 20% ☐ 20-40% ☐ 40-60 % ☐ 60- 80 % ☐ 80-100 % ☐ >100% ☐**5. If No. 2 is quality, which way does it affect the project?**Change the labor type with a lesser experienced one. ☐Change the material quality with a lesser one. ☐Working with unsuitable environment to save time. ☐**6. Have you given appropriate notices in a suitable format regarding the changes in time or quality to the client?**Yes ☐ No ☐**7. Did you have temporary records to confirm and determine the effects of the project delays?**Yes ☐ No ☐**8. If you have additional explanation on No.5 please explain below.**

9. Have you considered any mechanism to minimize the effect of covid -19 on your projects and your project management?Yes ☐ No ☐

10. If your answer to question 9 is yes, what mechanisms were used to minimize the effect? Please explain methods you used.

11. What is the status of safety management practices during the COVID-19 pandemic?

Poor	☐
Fair	☐
Good	☐
Very Good	☐
Excellent	☐

12. How do you judge the government's measures regarding the pandemic from building construction management perspective?

Poor	☐
Fair	☐
Good	☐
Very Good	☐
Excellent	☐