IMPROVING CLIENT-CONSULTANT-CONTRACTOR COMMUNICATION IN CONSTRUCTION INDUSTRY THROUGH WHATSAPP APPLICATION

MUHAMMAD HAFIZUL BIN TAIB

RESEARCH PROJECT SUBMITTED TO THE
FACULTY OF BUILT ENVIRONMENT
UNIVERSITY OF MALAYA.

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR
THE DEGREE OF MASTER IN PROJECT MANAGEMENT

2020

UNIVERSITI MALAYA

ORIGINAL LITERARY WORK DECLARATION FORM

Name of Candidate: Muhammad Hafizul bin Taib
Registration/Matric No: BQB 180024
Name of Degree: Master of Project Management

Title of Research Report ("this Work"):

Improving Client-Consultant-Contractor Communication in Construction Industry Through WhatsApp Application

Field of Study: Project Management

I do solemnly and sincerely declare that:

(1) I am the sole author/writer of this Work;
(2) This Work is original;
(3) Any use of any work in which copyright exists was done by way of fair dealing and for permitted purposes and any excerpt or extract from, or reference to or reproduction of any copyright work has been disclosed expressly and sufficiently and the title of the Work and its authorship have been acknowledged in this Work;
(4) I do not have any actual knowledge nor do I ought reasonably to know that the making of this work constitutes an infringement of any copyright work;
(5) I hereby assign all and every rights in the copyright to this Work to the University of Malaya ("UM"), who henceforth shall be owner of the copyright in this Work and that any reproduction or use in any form or by any means whatsoever is prohibited without the written consent of UM having been first had and obtained;
(6) I am fully aware that if in the course of making this Work I have infringed any copyright whether intentionally or otherwise, I may be subject to legal action or any other action as may be determined by UM.

Candidate's Signature Date:

Subscribed and solemnly declared before,

Witness's Signature Date:

Name:
Designation:

IMPROVING CLIENT-CONSULTANT-CONTRACTOR COMMUNICATION IN CONSTRUCTION INDUSTRY THROUGH WHATSAPP APPLICATION

ABSTRACT

A smooth and effective communication is very important in construction industry to prevent iteration and rework which will cause money. Since there are a lot of parties involve in construction, it is important to have a good communication platform. In the current world, people are using the technology advancement to enhance the effectiveness of communication amongst people who work in construction industry. Though there are a lot of mobile application designed for construction purpose, *WhatsApp* is the most commonly used by all. However, there are no studies done to identify the effectiveness of it. This thesis will gather respond from client, consultant and contractor who are working in construction industry on the effectiveness of *WhatsApp* for the main communication platform. This thesis will also suggest on improvement to the mobile application by adding some features that the respondents think are useful to improve communication.

Keyword: WhatsApp, communication, construction

MENINGKATKAN TAHAP KOMUNIKASI PEMAJU-KONSULTAN-KONTRAKTOR DALAM INDUSTRI PEMBINAAN MELALUI APLIKASI WHATSAPP

ABSTRAK

Komunikasi yang lancar dan berkesan adalah sangat penting lebih-lebih lagi dalam bidang pembinaan bangunan untuk mengelakkan perubahan dalam pembinaan atau pembinaan semula. Sebuah platform komunikasi yang baik adalah sangat penting kerana banyak pihak yang terlibat dalam bidang pembinaan ini. Didalam era kemajuaan kini, semua orang menggunakan teknologi untuk menambah baik keberkesanan komunikasi dikalangan orang yang terlibat dalam industri pembinaan. Terdapat banyak aplikasi mudah alih yang dicipta khas untuk bidang pembinaan. Akan tetapi, aplikasi *whatsapp* adalah aplikasi yang paling banyak digunakan bukan sahaja untuk penggunaan peribadi malahan untuk tujuan kerja dalam bidang pembinaan. Sehingga kini, tiada penyilidikan dijalankan untuk mengkaji keberkesaan aplikasi mudah alih ini. Tesis ini akan mengumpul data daripada orang yang bekerja dalam bidang pembinaan dari pihak pemaju, perunding dan kontraktor untuk memahami sejauh mana keberkesanan *whatsapp* untuk digunakan sebagai platform komunikasi untuk bidang pembinaan. Tesis ini juga akan mencadangkan cara-cara untuk menambah baik aplikasi mudah alih *whatsapp* dengan menambah beberapa ciri-ciri kepada aplikasi ini dengan mengambil kira cadangan dari responden-respoden daripada kajian ini.

Kata Kunci: whatsapp, komunikasi, pembinaan

ACKNOWLEDGEMENT

In the name of Allah, Most Gracious and Most Merciful. Peace be upon Prophet Muhammad S.A.W., his family, his companions and followers of his guidance. Praise be to Allah for with Allah's blessings and guidance; I manage to finish writing this thesis. My thank you note goes to my wife and family who have supported me in many ways and keep me motivated and moving forwards. This thesis is dedicated to my lovely late daughter whom passed away on 9th May 2020, which is the semester I am writing this thesis.

I would like to express my appreciation to my supervisor, Dr. Nur Mardhiyah binti Aziz who has always guide me in throughout the writing process and provide me with good reference to refer from. Without her, this thesis might not be submitted and completed. I would also like to thank my course mates who have always give motivation and guidance. They always check on my progress and make sure we complete the thesis and graduate together. A thank you note to all the respondents who are willing to spend some time to answer the questionnaire survey and offered their invaluable contributions in carrying out this research.

I really hope this thesis will be helpful to those who are looking for information on the subject matter. I also hope this thesis will be developed and continued in the future and contribute to the body of knowledge.

TABLE OF CONTENTS

ORIGINAL LITERARY WORK DECLARATION FORM ii

ABSTRACT iii

ABSTRAK iv

ACKNOWLEDGEMENT v

TABLE OF CONTENTS vi

LIST OF FIGURES viii

LIST OF TABLES ix

LIST OF SYMBOLS AND ABBREVIATIONS x

LIST OF APPENDICES x

CHAPTER 1: INTRODUCTION 1

1.1 Introduction 1

1.2 Research Background 1

1.3 Problem Statement 4

1.4 Research Gap 4

1.5 Research question 6

1.6 Research Aim and Objective 7

1.7 Research Methodology 7

1.7.1 Stage 1: Literature review 7

1.7.2 Stage 2: Questionnaire survey 7

1.7.3 Stage 3: Data analysis 8

1.8 Research Scope 8

1.9 Thesis Structure 10

CHAPTER 2: LITERATURE REVIEW 12

2.1 Introduction 12

2.2 Communication 12

2.3 Communication in Construction 14

2.4 Communication Management in Construction Industry 17

2.5 The use of *WhatsApp* in Construction Industry 20
2.6 Summary 23
CHAPTER 3: RESEARCH METHODOLOGY 24
3.1 Introduction 24
3.2 Purpose of research 25
3.3 Process of research 26
3.3.1 Qualitative Research 27
3.3.2 Qualitative Research 29
3.4 Research Methodology Adopted 29
3.4.1 Literature Review 29
3.4.2 Quantitative Survey 30
3.6 Data Analysis 41
3.6.1 Percentage Method 41
3.4 Summary 42
CHAPTER 4: RESULTS AND DISCUSSION 43
4.1 Introduction 43
4.2 Modes of Data Collection 43
4.3 Section A – Demographic Data 44
4.4 Section B – Communication Problem in Construction Industry 50
4.5 Section C – The Use of *WhatsApp* In Project Construction 63
4.6 Section D – Deficient of *WhatsApp* Application & Improvement That Can Be Done to be Used as Communication Tool for Construction Industry 74
4.7 Discussion on Communication Problems That Often Happen in Construction Project 77
4.8 Discussion on Lacking of *WhatsApp* application as a tool of communication in current construction industry 79
4.9 Discussion on Strategy to Improve *WhatsApp* Application to Increase Its Effectiveness as Communication Medium Amongst Client-Consultant-Contractor .80
4.10 Summary 81

CHAPTER 5: CONCLUSION 82
5.1 Introduction 82
5.2 Meeting research objective 82
5.3 Limitations of Research 86
5.4 Recommendation for Future Work 87
5.5 Closure 88
REFERENCE 89
APPENDIX 1 92

LIST OF FIGURES

Figure 3. 1 Diagram of Research Process adopted from Kumar (1999) 27
Figure 3. 2 Diagram showing research process & objectives are translated into specific questions (Naoum, 2007) 33
Figure 3. 3 Table for determining sample size of known population (Krejcie & Morgan, 1970) 46
Figure 4. 1 Gender of Respondents 45
Figure 4. 2 Pie Chart on Age of Respondents 46
Figure 4. 3 Respondents' designation or possition in company 47
Figure 4. 4 Company the Respondent Working With 48
Figure 4. 5 Respondents' Years of Experience 49
Figure 4. 6 Education Background of Respondent 50
Figure 4. 7 Experience on Communication Problem at Work Place 51
Figure 4. 8 Ways to improve communication problem in construction industry 60
Figure 4. 9 Years of using Whatsapp as the main communication tool 62
Figure 4. 10 Number of whatsapp group for one construction project 65
Figure 4. 11 Do you usually have another Whatsapp group excluding certain party for better discussion 66

Figure 4. 12 How do you keep track will all the messages/ info/ instruction in Whatsapp 67

Figure 4. 13 Have you or other parties missed information from the Whatsapp group chat due to too many chats/ replies? 68

Figure 4. 14 Other mobile application used besides from Whatsapp.....69

Figure 4. 15 Thoughts on effectiveness of Whatsapp application for communication in project construction.....73

LIST OF TABLES

Table 4. 1 Respondent's feedback percentage.....45

Table 4. 2 Gender of Respondents 46

Table 4. 3 Age of Respondents 47

Table 4. 4 Respondents' designation or possition in company.....48

Table 4. 5 Company the Respondent Working With 49

Table 4. 6 Respondents' Years of Experience.....50

Table 4. 7 Education Background of Respondent.....51

Table 4. 8 Experience on Communication Problem at Work Place.....52

Table 4. 9 Can Communication Problem be Solved? 54

Table 4. 10 Ways to improve communication problem in construction industry.....55

Table 4. 11 Ways to improve communication problem in construction industry 2.....61

Table 4. 12 Usage of Whatsapp as medium of communication.....62

Table 4. 13 Years of using Whatsapp as the main communication tool.....62

Table 4. 14 Do you think Whatsapp application is very useful?.....63

Table 4. 15 What is whatsapp used for 64

Table 4. 16 Number of whatsapp group for one construction project.....65

Table 4. 17 Do you usually have another Whatsapp group excluding certain party for better discussion 66
Table 4. 18 How do you keep track will all the messages/ info/ instruction in Whatsapp 67
Table 4. 19 Have you or other parties missed information from the Whatsaoo group chat due to too many chats/ replies? 69
Table 4. 20 Other mobile application used besides from Whatsapp 70
Table 4. 21 What are the advantages of other application you used compared to Whatsapp? 71
Table 4. 22 Advantages of other mobile application compared to Whatsapp.....73
Table 4. 23 Thoughts on effectiveness of Whatsapp application for communication in project construction 73
Table 5. 1 Advantages of Other Mobile Application to Whatsapp 79
Table 6. 1 Comparison Between Telegram and Whatsapp 83

LIST OF SYMBOLS AND ABBREVIATIONS

BIM – Building Information Modelling

C&S – Civil and Structure

M&E – Mechanical and Electrical

RIBA – Royal Institute of British Architect

PAM – Persatuan Arkitek Malaysia

BQSM – Board of Quantity Surveyor Malaysia

QS – Quantity Surveyor

GB – Giga byte

MB – Mega byte

HQ – Headquarters

LIST OF APPENDICES

Appendix 1: Questionnaire Survey Form

CHAPTER 1: INTRODUCTION

1.1 Introduction

This chapter contains the introduction to the issue and research background that leads to the initiation of the research project. It concerns with the aim and objective of the study, scope of research, outline of the research project and the structure of the research project.

1.2 Research Background

Communication is a way of transmitting information from one person to another. It will involve two parties where there is sender and there is receiver. The word 'communication' derived from the Latin word 'communicare' which translates 'to make common' (Gruneberg, 1997). Communication is a process that involves the transmittance of a message from a sender to a receiver through a communication channel that should be agreed by both parties (Othman & Hussien, 2018). Merriam-Webster Online Dictionary on the other hand defines communication as "a process by which information is exchanged between individuals through a common system of symbols, signs, or behaviour" (Merriam-Webster, n.d.). Communication is a vital process in our everyday life. It allows us to connect with another person, to convey information, to gain knowledge and also allows us to make connection with new person that we did not know of before. Through communication, people can work together, share ideas, debate on issue, exchange opinion and so many things.

Communication can happen in many ways. It can be verbal, non-verbal, direct or indirect. Verbal communication is when we talk to another person face to face. A non-verbal communication on the other hand does not need to be spoken. It can be the facial expression, body language, voice intonation, physical distance and even silence (Mc

Shane & Glinow, 2018). However, a non-verbal communication enhances verbal communication so that a verbal communication will be better understood. A combination of both verbal and non-verbal communication is the best way to communicate or to convey our message or information to the receiver. Communication can also be indirect such as through email, social media, text message, voice message, *WhatsApp*, video conference, and phone calls. Indirect communications can sometime mislead the receiver because we cannot understand the intonation or facial expression of the sender. This can lead to misunderstanding by the receiver or the reader. This is because it has low media richness which is enhancing the communication.

In construction industry, communication is very important. Reason being is, construction industry is an information-intensive industry (Chen & Kamara, 2011) whereby information flow happens in a very active manner. In one project construction involves hundreds of people of different scopes of work varying from the general worker, main contractor, sub-contractors, project manager, project engineer, project coordinator, consultants and clients. A construction set up cannot afford to have problem or hick up in communication as it can lead to awful implication. Any miscommunication or communication breakdown might cost a big amount of money and delay to the project. According to a research by BRE group, most of construction companies in the UK are still spending approximately £20 billion per year on rebuilding and repairing the construction defects caused by miscommunication (Charles, 2004)

In today's advancement of technology, there are many mediums of communication that can be used by the construction industry practitioners to improve communication. Construction industry are now frequently discussing about the concept of Building Information Modelling (BIM) which is considered as one of medium of communication. These softwares are created to reduce discrepancy or miscommunication so that

construction runs smoothly. However, there are still communication breakdown happening in a construction project. Most construction professionals are conscious in inefficiency of communication in construction project compared to other industry (Zerjav & Ceric, 2009)

Communication breakdowns in construction project can happen in various stages. It can be either at client to consultant level, consultant to contractor level, contractor to subcontractor level or contractor to construction worker level. Miscommunication can even happen on the same level. For instance, architect and civil and structure engineer having miscommunication resulting to discrepancy between structural drawing and architectural drawing. This discrepancy is usually detected by the contractor during construction phase.

The flow of information through communication is vital because a construction project involve many people. A good medium of communication is a must to ensure no discrepancy and good information flow. According to Harstad, Laedre, Svalestuen, & Skhmot (2015), there is still lack of adequate communication tools in construction industry and it leads to information losses. When there are information losses, contractor will experience iteration which is a double work due to miscommunication and this will incur cost.

Presently, it is common to see in construction project that everyone is using *WhatsApp* as a medium of communication between client, consultant and contractor. *WhatsApp* is used to update on site progress through pictorial report, report of any incident or accident, request for info by contractor to consultant, inquiry by contractor if any discrepancy in drawing and site monitoring. The use of *WhatsApp* or other social media in general is broadly due to its feature of improving communication process within organization (Ahmad Pozin, Mohd Nawi, Othuman Mydin, Mehdi Riazi, & Imran, 2019)

However, there are weaknesses of using *WhatsApp* in construction project. This is because the *WhatsApp* mobile application is not designed specifically for project construction use. This research project will discuss on how *WhatsApp* application can improve communication between client, consultant and contractor in project construction.

1.3 Problem Statement

Communication breakdown is one of a major problem in construction industry. Communication problems happen in a project construction because there are many people involve in one single project. In Malaysia, poor communication is one of the reasons of poor performance of construction sector (Olanrewaju, Yeow Tan, & Foo Kwan, 2017). According to Sambasivan & Yau (2007) and James D, et al. (2014), communication problem is among the top 10 causes of construction delay.

Nowadays, technology is very helpful in daily human activity. However, in construction industry, communication technology has not been fully utilized. According to Blokpoel (2003) agreed by Harstad, Laedre, Svalestuen, & Skhmot (2015), lack of adequate communication tools is one of the factors of information losses that leads to iterations or rework. It is also identified that majority of the construction companies are still relying on manual and traditional communication platforms (Nourbakhsh, Mohamad Zin, Irizarry, Zolfagharian, & Gheisari, 2012).

1.4 Research Gap

A research by Liu, Mathrani & Mbachu (2015) have done an in-depth research on mobile application for construction use in New Zealand. From the research, they have short listed few most common mobile application for New Zealand construction industry which are construction industry, including BuilderTREND, Procore, PlanGrid, Co-construct, 360 Panorama, BuildIT, Basecamp, Harvest, Timelines, Workflow max,

BIMx, Aconex, Builders Buddy, Adobe Photoshop, ZeroHarm, JobFLEX, CONQA, Corecon, T-Sheets, Box, Dropbox, Xero, MetService, HazardCo, BuilderTREND, My Inspection, MYOB, iAuditor, BIMx, LocknLoadHub, Handyman Calculator and AutoCAD 360. These mobile apps range from project management, calculators, safety, integrated construction cost and accounting, construction site operations, computer aided design (CAD), estimating and building information modelling (BIM). However, the listed mobile applications are not commonly used for Malaysian construction industry.

In Malaysia, *WhatsApp* mobile application is the most common mobile application for communication not only used for social purpose but also widely used in construction industry. Ahmad Pozin, Mohd Nawi, Othuman Mydin, Mehdi Riazi, & Imran, (2019) in their research acknowledged that WhatsApp application is extensively used among project teams for flow of technical and managerial information. It is an efficient tool for decision-making process and speedy execution. In this respect, WhatsApp mobile application proved to be major communication tool which can overcame communication barriers between teams.

On the other hand, Kim, Park, Lim & Kim (2013) in their research titled "Mobile Computing Platform for Construction Site" proposed a mobile computing system to be used by construction site personnel. However, the system is too focusing on site monitoring, task management and information sharing. This is not sufficient to the need of site engineer. It is proposed that in-depth construction scheduling and resources planning to be integrated to meet the need of site engineer and to improve management process of construction project (Kim, Park, Lim, & Kim, 2013).

Apart from that, current mobile application has not included any detailed 3d information model in mobile application. Kim, Park, Lim & Kim (2013) proposed in

future to study on how to implement detailed building information model (BIM) through mobile computing technology.

Other than that, Son, Park, Kim & Chou (2012) had done a research on understanding the acceptance of mobile computing devices in South Korea. Son, Park, Kim & Chou (2012) suggested that a further study to be done which take into consideration of the moderating effects of incentive, different positions and experience related to the mobile computing device to better understand the construction professionals' acceptance behaviour on mobile computing device.

There is also another research done on mobile application prototype for on-site information management in construction industry by Nourbakhsh, Mohamad Zin, Irizarry, Zolfagharian, & Gheisari (2012). Though, the research does not investigate the required fields of mobile application and elaborate in detail in order to design and develop the mobile application.

1.5 Research question

This thesis is written to answer three (3) research questions. They are:

i. What is the communication problem that often happen in construction project that can be improve by mobile application?
ii. What are the lacking of *WhatsApp* application as a tool of communication in current construction industry?
iii. How to improve *WhatsApp* mobile application to increase effectiveness of communication amongst client-consultant-contractor?

1.6 Research Aim and Objective

To propose an additional function in *WhatsApp* mobile application to suit for construction management and communication amongst client, consultant and contractor.

The research objective of this thesis is to identify

i. To identify the communication problem that arise in construction project that can be improve by mobile application.
ii. To analyse the lacking of *WhatsApp* application as a tool of communication in the construction industry
iii. To propose additional function to improve *WhatsApp* mobile application to increase effectiveness of communication amongst client-consultant-contractor

1.7 Research Methodology

There are three methods that were applied in order to achieve the research aim and objectives. Those methods are literature review, questionnaire survey and data analysis.

1.7.1 Stage 1: Literature review

Literature review is done to understand what are the mobile application or other than *WhatsApp* that is currently used in construction industry. At the same time, the thesis will also discuss on the additional features that *WhatsApp* can improve in their application so that it can be used to improve communication between client, consultant and contractor in construction.

1.7.2 Stage 2: Questionnaire survey

The questionnaire survey was conducted to understand what are the common communication problem in construction industry especially focusing on client, consultant

and contractor. Questionnaire will also try to get the latest trend on mobile application that is used in construction industry other than *WhatsApp*.

From these questions, the questionnaire will also get suggestion from correspondence on how to improve *WhatsApp* so that it can improve communication in construction.

The survey will try to understand what are the need of user to improve the application. For instance, correspondence might suggest the application to have a better documentation system so that everyone involve in the project can easily access to the file required.

1.7.3 Stage 3: Data analysis

From the literature review and questionnaire survey done, data analysis is done to synthesise or conclude the thesis. Method of data analysis used are percentage method and statistical significance. Data are analysed using analytical and logical thinking to study each element of data gathered from data collection.

As the last research method done, the result answers the three research questions laid out on previous chapter.

1.8 Research Scope

According to the Royal Institute of British Architect (RIBA), there are 8 common stages of project construction. They are:

i. Stage 0 – Strategic definition / prefeasibility

ii. Stage 1 – Preparation & briefing

iii. Stage 2 – Concept design

iv. Stage 3 – Developed design

v. Stage 4 – Technical design

vi. **Stage 5 – Construction**

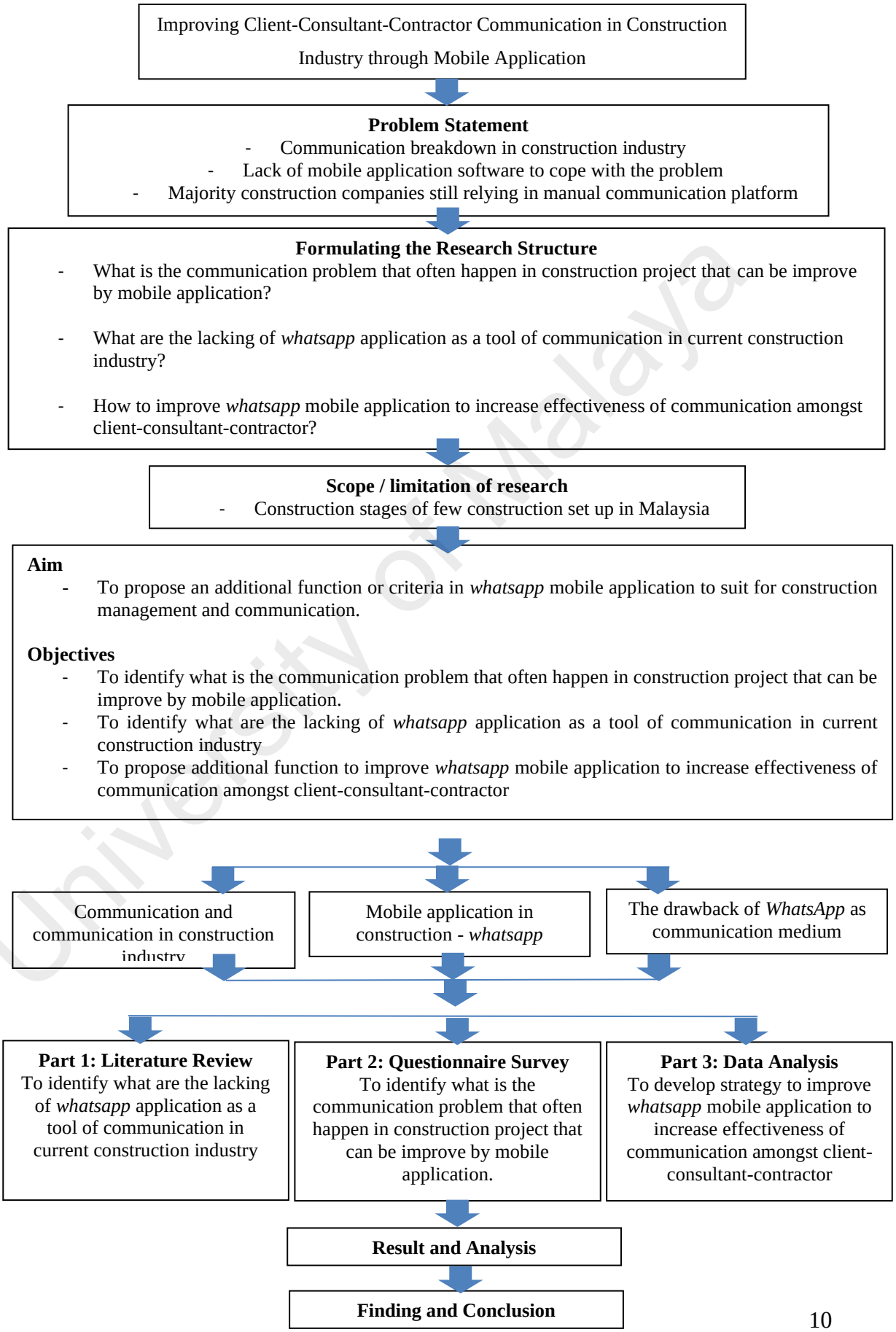
vii. Stage 6 – Hand over & Close out

viii. Stage 7 – In Use

This thesis will only focus on stage 5 which is construction stage. This is because this stage involves 3 parties which are the client, consultant and contractor. This stage is also the stage where the communication intensity is at the highest and communication needed to be very smooth. In this stage, this thesis will identify the common problem of communication, what are the medium used for communications and what are the improvement that can be done to ensure communication is smooth.

This thesis will focus on residential projects in Klang Valley area. Hence, the respondents from consultant which are architect, engineer and quantity surveyor are selected from consultant that is practicing in Klang Valley and in charge of residential projects in Klang Valley area only.

1.9 Thesis Structure



1.10 Summary

This chapter presented the outline of the study by understanding the context of research, main issues and problem that led to the initiation of the research project. The aim and objectives of the research has been presented throughout the chapter. Detail out of the research methodology will be further explained on chapter 3, research methodology.

This chapter will be followed by literature review which will further explain about the context of the subject matter and also to answer the first research question.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter will be discussing on the literature review or background study of the research topic. This chapter is one of the research methodologies to answer the research question as per elaborated on Chapter 1 earlier.

2.2 Communication

According to online dictionary Merriam-Webster, communication means “a process by which information is exchanged between individuals through a common system of symbols, signs, or behaviour”. According to Mc Shane & Glinow (2018), communication refers to process by which information is transmitted and understood between two or more people. There are two main points from these two different definitions.

First one is a process of exchange information through symbol, sign and behaviour. It can be understood that communication can happen not only via verbal but can also occur using symbol, signs and behaviour. Mc Shane & Glinow (2018) explained further in the book Organizational Behaviour – Emerging Knowledge Global Reality (Eight Edition) that there is also non-verbal communication which is facial gesture, voice intonation, physical distance and even being silence. These non-verbal communications help to enrich a normal verbal communication. Through non-verbal communication, we can get more understanding of the speaker or listener for example, we can know that the listener agrees with the idea when he/she do small nodding gesture few times. A non-verbal communication can be using body language such as making eye contact, smile, sitting posture, playing with hair or play with something on the table, firm or weak handshake, or crossing arms over chest (Mc Shane & Glinow, 2018). Different body language will convey different massage to the listener.

The second point that we can gather from the communication definition is communication is a transfer of information that is understood by two or more party. A good communication is when the listener understands what the speaker is saying and vice versa. If the receiver does not understand what is the speaker is talking or misunderstood what the speaker is conveying, it means communication is not successful.

Besides from verbal and non-verbal face to face communication, there are other medium of communication that people use to ease communication especially when the other person is in distance. Other medium of communication are such as emails, letter, message, phone call, video conference, reports, drawings and many others.

Other medium of communication aside of face to face communication may have some deficiency. Each communication channel varies in the level of media richness. Media richness is the medium data carrying capability – the volume and variety of information that can be transmitted during a specific time (Mc Shane & Glinow, 2018).

It cannot be denied that face to face communication carries the most media richness as verbal communication can be supported by non-verbal communication like facial expression, voice intonation and body language. Unlike email for instance, it carries little amount of media richness. A simple email might be misinterpreted if it is not well explained. That is why it is common for an email to be followed up with a phone call to explain on the matter. It is also common for people to write an email right after a face to face communication, discussion or meeting to ensure everything is recorded. These practices are done to reduce miscommunication and to smooth out the flow of information.

The said communication mediums are commonly used by everyone regardless of the industry they are in. The same communication medium is also used by people in construction industry.

2.3 Communication in Construction

Communication in construction happens in a very intense manner. Reason being is that, in construction phase information flow is very rapid and it involves a lot of people. “Construction is a diverse industry handling both productions on-site and also services such as engineering, design, management in order to achieve a unique project with variety of teams brought together” (Blayse & Manley, 2004).

There are three main parties that involve in construction project. They are interrelated and needed to always have communication in order for a project to success. They are the client, consultant and contractor. A client is anyone who has construction work carried out for them. Basically, they are the highest person in the hierarchy of construction. They are the paymaster for both contractor and consultant. They are the owner of the construction.

On the other hand, consultants are the professionals that work for the client. They will advise client on the area that they are professional in. They also give their service in design matter. They are many consultants that involve in a project – architect, mechanical and electrical (M&E) engineer, (C&S) civil and structure engineer, landscape architect, and specialist.

Lastly, contractor is the one who work at site to build what is designed by the consultant. They also work for the client and paid by the client. However, they only take instruction from consultant as consultants are the client representative. These three parties will always have discussion with each other throughout the project timeline.

Project timeline varies based on the size of project. It started with initiation of a project by the client up to the handing over the building back to the client when it is completed.

According to the Royal Institute of British Architect (RIBA), construction stages can be divided into 8 stages. Those stages are:

i. Stage 0 – Strategic definition / prefeasibility
ii. Stage 1 – Preparation & briefing
iii. Stage 2 – Concept design
iv. Stage 3 – Developed design
v. Stage 4 – Technical design
vi. Stage 5 – Construction
vii. Stage 6 – Hand over & Close out
viii. Stage 7 – In Use

Stage 0 to stage 4 is the initial stage where all the design and estimate costing is done. At these stages, consultant has to understand design brief from the client and need to understand client aim and objective of a project. Consultant is also the one that come out with the design together with estimated costing to present to the client. These stages involve intense communication between consultant and client. At the same time, consultant is also having rapid communication with other external parties that is related to the approval, submission or other body that involve in building requirement such as the local authority, fire department, and the land office.

Starting form stage 5 to stage 7, another party involve which is the contractor. Once all the estimated costing and building design is set, client with the help of consultant will tender out the design to get a contractor to build the building. A contractor is selected based on the best price, construction period, performance from previous completed project and strong financial. At this juncture, the communication intensity starts to spike.

Once the project is commenced on site, the flow of communication needed to be well managed as there will be more people involved. Contractor themselves will come with

large team if the project is big. They also have subcontractors that work with them. At this stage, client, consultant and contractor will speak frequently.

This research project will only be focusing only on the stage 5 which is construction stage to limit the scope of study.

Similar to other industry, communication in construction project is very important. This is why project communication management is one of the ten knowledge area in A Guide to Project Management Body of Knowledge (PMBOK Guide) Sixth Edition (2017). Communication in construction stage happens through many non-verbal medium. What is special in construction industry is a drawing is also one of medium of communication.

Each consultant who does design – architect, M&E engineer, C&S engineer, and landscape architect – will come out with their own design drawing. An architect will come out with the main drawing where it describes more on the design of the physicals of the building. A C&S engineer also has drawing that describe on the structural design of the building. An M&E engineer has another design that defines the mechanical and electrical design such as the air conditioning ducting position, air conditioning unit position, lighting position, speaker position and firefighting equipment position. There are other consultants that also have their own design and drawing such as landscape architect, interior designer and acoustic designer. These consultants need to speak to each other in order to prevent any discrepancy.

During the construction period, all the discrepancy between all consultants' design will be identified. The reason being is, when the contractor constructs the structure of the building, structural drawing will be referred. After structure is completed, contractor will start with architectural finishes. Should there be any discrepancy between structural and architectural drawing, only at this stage will the contractor notice the discrepancy of

design. This will become a problem as there will be alteration to the design or to the building that has been constructed. If alteration in design can be done, a revised drawing will be given to contractor and to other consultants. If the building that has been constructed needed to be altered, the changes process is more tedious. The changes will incur cost and time which will need to be communicated with client to get approval. Once the client agreed, a revised drawing will be issued, an instruction will be issued and there will be variation order.

The example above is one of thousands of issues that require communication between few parties before a decision can be made. When there is such an issue, a meeting is required so that the issue can be resolved as soon as possible. However, there are some cases that are urgent and require urgent attention and decision. A good and common medium of communication is required to solve such issue. It does not require everyone to attend meeting sit down and discuss. James D, et al. (2014) is his research lay out the causes of project delay and put in rank. From the findings, there are 3 of 15 issues pertaining communication. The issues are slow decision making, lact of effective communication among the parties involved, and lack of adequate infromation from consultant. These problem can be solved quickly if there is a good medium of communication used to solve the issue.

2.4 Communication Management in Construction Industry

Before the site enters into construction phase, consultant should already resolve all design matters. Thorough checking between all consultants' designs and technical & coordination meeting have to be done before the construction phase starts. This is merely to avoid any discrepancy from one consultant to another. All finalized drawings will be used as tender drawings and bond in contract documents.

However, there will sometime be discrepancy found by contractor at site during construction. Should this case happen, a revised drawing will be issued by consultant to contractor. At this stage, document control department of the contractor needs to be systematic so that all documents are well arrange and easy to be referred by all. The latest revision drawing will be referred based on the latest revision date and revision number. This is the common practice in the industry.

Apart from drawing documentation at site, construction communication also involves transfer of communication through email, meeting discussion, phone calls memo, report, instruction, order, photo, schedule, video recording and voice recording. There are many information that needed to be arranged and transmitted throughout construction stage, hence, a good medium of communication is vital in order to ensure communication is smooth.

Khelifi & Hyari (2016) identified few reason of communication problem at construction site.

i. There is a lot of information that needed to be transferred during the construction phase of projects
ii. The spatial dispersion of project teams and construction activities as well as frequent changes of work site locations
iii. The nature of the industry that engage many stakeholders from the owner, consultants, contractors, subcontractors and suppliers which creates gaps in information flow
iv. The separation between site offices and work sites
v. The need for timely transfer of information as the construction industry is categorised by firm deadlines and costly delays
vi. The increased dependence on subcontractors to perform construction work

Othman & Hussein (2018) also added in their research 30 causes of poor communication in construction projects. They are:

No.	Causes
1	Physical Barriers
2	Linguistic barriers
3	Cultural barriers
4	Lack of Honesty
5	Unconscious message distortion
6	Conscious message distortion
7	Poor Feedback
8	Work Pressure
9	Poor role clarity
10	Poor coordination
11	Poor communication management
12	Poor project management skills
13	Ineffective communication
14	Poor shareholders identification
15	Unclear communication channels
16	Unclear Responsibilities
17	Unclear objectives
18	Dissatisfied and unmotivated employees
19	Difference in experience
20	Inexperienced stakeholders
21	Interaction between different professions
22	Different levels of education
23	Greed over project control
24	Lack of training
25	Lack of knowledge
26	Multi organizational interactions
27	Poor communication platform
28	Deficient support to use communication technologies
29	Technology malfunctions
30	Complexity of the construction project

From the above communication listed, people tend to look for alternative way to improve communication. Currently, it can be seen that people start to use mobile application as a communication medium for construction project. To be precise, the use of *WhatsApp* application is broadly used in construction.

2.5 The use of *WhatsApp* in Construction Industry

WhatsApp has become a popular platform of communication since it was first founded in May 2009. In Malaysia, it started to be widely used together with the use of smartphones. It can be said as a user-friendly application as it is used by all generations from toddlers to elderly. Due to the simplicity and efficiency, it is also being used as the main communication platform in businesses and office setup. Construction industry is one of the industries that is common and widely using *WhatsApp* as medium of communication.

There are certain characters of *WhatsApp* that is beneficial to be used by client, consultant and contractor to improve communication. Aside of it is commonly used by everyone, it is also convenient to gather all people in one *WhatsApp* group and get discussion done. *WhatsApp* has become a popular social media used globally. It is available on all smartphones as long as it is connected to the internet.

WhatsApp provide variety of functions that are beneficial to the use of people that involve in construction industry. It can gather people virtually for discussion and does not need people to sit together physically on meeting. It can also gather information from site to progress to people that work at office. This saves so much time as staff working at office does not need to commute to site to monitor site progress. It also provides voice call function, video call function, sending file, sending images, sketching over image and sending files in any formats. Consultant can send drawing or instruction to contractor via *WhatsApp* (Ahmad Pozin, Mohd Nawi, Othuman Mydin, Mehdi Riazi, & Imran, 2019).

There are few advantages of using *WhatsApp* as medium of communication for construction project. Ahmad Pozin, Mohd Nawi, Othuman Mydin, Mehdi Riazi, & Imran (2019) have listed out seven efficeincy of *WhatsApp* messenger.

i. *Whatsapp* is over boundry communication. It changed the face to face communication to virtual communication

ii. It encourange co-operation wherby the application allow group of people to work together and share the same aim and objective.

iii. *Whatsapp* increase the connectivity and networking amongst all team member.

iv. *Whatsapp* is cost and time efficent. For instance, it saves the time and cost for travelling to site to monitor site progress

v. Free information access for all team member through *whatsapp*. All information is available online.

vi. It allows virtual team building

vii. Allows timely feedback from all team member.

This application has overcome communication barriers between project teams and resulted in deliverable fast technical decision making, information and speedy execution. (Bajaj & Jindal, 2015). However, we must acknowledge that there is still lacking in *WhatsApp* mobile application. The disadvantages of *WhatsApp* are as following:

i. It has limited storage which is subject to the user's phone internal memory

ii. The data and information are not arranged in a proper storage. Hence, it is not convenient for people to search for an info that they have in the *WhatsApp*. For instance, one has to search for the key word to fine the desired info.

iii. There are abundance of information in *WhatsApp* that one might miss out. Unlike email that each of conversation can be arranged to our preferred arrangement, *WhatsApp* is limited in term of that. Someone might miss out any info that is informed through *WhatsApp*. For instance, one might miss the notice of meeting cancellation that is announce in *WhatsApp* group.

Many complex and modern technologies have been applied in current construction set up. There are many examples of successful technologies applies such as 3D scanning, 3D model printing, Augmented Reality (AR) and Mobile Computing. However, construction project stakeholders are still facing communication challenges when applying ICT in their project. Among the challenges they face are fragmentation of the industry and lack of integration between the design and production process. This can be overcome by getting the right information to the right place (Alsafouri & Ayer, 2017).

Even though construction industry in some country have started to use mobile computing device to improve communication, there are still some limitation or barrier in implementing it. Chen & Kamara (2011) identified 3 barriers of mobile computers in construction. Firstly, mobile computers have limited display screen size, screen visibility, processing capability and input methods. Second barrier is the characteristics of construction site itself where sometimes high temperature, high humidity and dust. Lastly, barrier in term of organizational issues such as industry's fragmentation and low risk tolerance.

Nourbakhsh, Mohamad Zin, Irizarry, Zolfagharian, & Gheisari (2012) have identified the shortcomings of whatsapp or any mobile application that can be implemeted to improve *whatsapp* function. These are selected information that is important to be included in the mobile application software. They are:

i. Design intent and clarification
ii. Report violation
iii. Report QA/QC problems
iv. Accident reporting
v. Productivity information
vi. Report inspection result

vii. Progress photo

viii. Change order

ix. Daily report

x. Schedule update

xi. Site instruction

xii. Variation order

There are certain criteria that the mobile application should have. Firstly, it should be capable of monitoring the site by understanding the current status of the construction project. Secondly, the system should provide information of the work task at site for the site engineer to manage the resources effectively. Lastly, it should be able to have the real-time information sharing to facilitate effective interaction among construction participant (Kim, Park, Lim, & Kim, 2013).

2.6 Summary

The chapter discuss on literature review related to communication and communication in construction industry. It also explained on the current trend of construction where mobile application such as *WhatsApp* is used broadly. The advantages and disadvantages of *WhatsApp* is discussed in the chapter.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Introduction

This chapter will be describing the research methodology used to answer the research question that has been earlier explained in Chapter 1. This chapter will be divided into a few subtopics – research question, research design and research procedure used. The structure of the research will be divided into 3 stages – literature review, questionnaire survey and data analysis. The purpose of this chapter is to inform the reader on the method used to collect data and generate the data finding.

The purpose of this research project is to answer three research question identified on the earlier chapter. Each research question will be answered through different research methodology that is suitable respectively.

The first research question identified is "What is the communication problem that often happen in construction project that can be improve by mobile application?". Before starting to find out the usage of *WhatsApp* and the lacking of *WhatsApp* that can be improved, firstly this research is trying to identify what is the common communication problem that is happening in construction project between client-consultant-contractor.

The second research question is "What are the lacking of *WhatsApp* application as a tool of communication in current construction industry". Though mobile communication application such as *WhatsApp* is widely used in current construction practice, there are still short comings of it. This research question is important to identify feedback from the users who work in construction industry that is using *WhatsApp* as their medium of communication.

Lastly, the final research question is "How to improve the mobile application/software to increase effectiveness of communication amongst client-consultant-contractor?" This is the core of the research which is try to suggest how to improve current *WhatsApp*

application so that it can be used as the main medium of communication for construction. From the literature review, it shows that *WhatsApp* is the most common mobile app used for communication. Hence, this research will identify from the suggestion of the correspondent on ways to enhance and improve the application.

3.2 Purpose of research

According to Merriam-Webster online dictionary, a research can be defined as careful or diligent search, studios inquiry or collecting information about one particular subject. It can be inferred that a research is a thorough study about an issue or a matter that the researcher which to understand further. A subject is researched through few methods that can suit the subject. It can be done by experiment, interview the expert of the subject matter, case study or questionnaire. A research is done to proof a hypothesis that might be correct or wrong.

Aim of a research is generally to expand the knowledge. A good research will be focusing on few aspects of a subject and will search for answer to the specific question, solve a problem or test a hypothesis. (Naoum, 2007).

A research can be initiated by our daily practice or our professional day to day work (Kumar, 1999). It started with the feeling of curiosity of a certain matter that might be a norm but no one question why it happens to be that way. Our mind will be eager with more questions like thinking of alternative way of doing one task or if there is any way to improve the process. For instance, someone who is working in healthcare industry, the mind can sometime be wild with questions like:

i. How many patients do I attain daily?

ii. What are the health needs of a community?

iii. How do I demonstrate the effectiveness of my service?

iv. What do my patients think about my service? (Kumar, 1999)

Many other questions will always be asked in the mind of someone. Simple question as the example above, if we design properly and put in research matter, it will be beneficial to other people or researcher.

3.3 Process of research

There are many ways of conducting research. Some researcher divided the research process to seven stages, eight stages or some up to eleven stages. Basically, the aim of research is the same which is to expend the knowledge and to contribute to the body of knowledge. For this research project, a research process from Kumar (1999) is adopted. The process of research is divided into three phases namely deciding what to research, planning a research study and conducting research study. The three phases comprise of eight steps or process of research. The research processes are:

i. Formulating a research problem

ii. Conceptualising a research design

iii. Constructing and instrument for data collection

iv. Selecting a sample

v. Writing a research proposal

vi. Collecting data

vii. Processing and displaying data

viii. Writing a research report

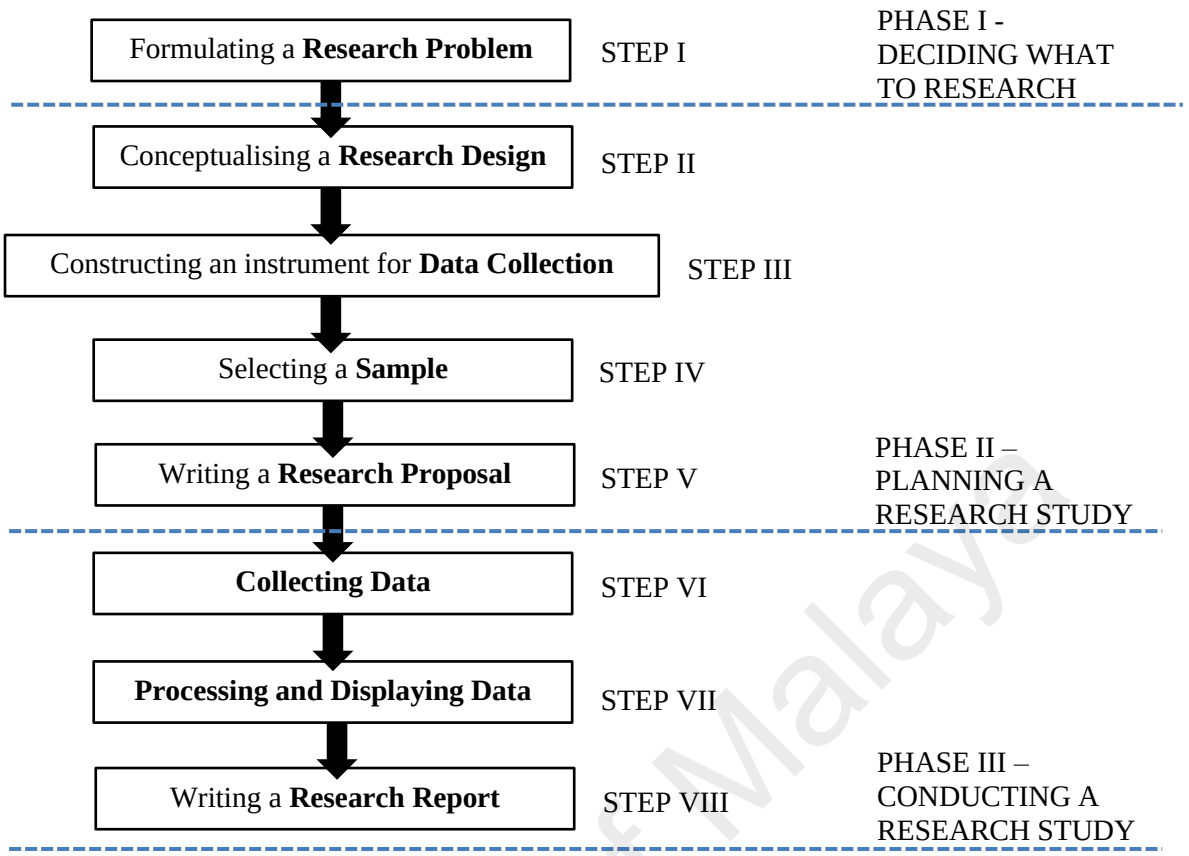


Figure 3. 1 Diagram of Research Process adopted from Kumar (1999)

3.3.1 Qualitative Research

According to Harwell (2006), qualitative features are aimed to create understanding of data analysis as a result of which often determines the form of the hypothesis, the quantity, and the scope of the required data. It is a systematic subjective approach used to describe life experiences and give them meaning to gain insight, explore the depth of certain thing, and complexity inherent.

a) Action Research

Action research or also called as problem-solving approach. It is a method where the researcher reviews the current situation, identifies the problem, gets involved in introducing some changes to improve the situation and, possibly, evaluates the effect of his/her changes.

This type of research is more attractive to practitioners, industrialists and students from the professional backgrounds who have identified a problem during the course of their work and wish to investigate and propose a change to improve the situation.

b) Case Study

Case studies method is used when the researcher is trying to support his/her argument with an in-depth analysis. It is done when there is an unclear conclusion to a subject matter. Case study provides an in-depth analysis of a specific problem.

There are three types of case study designs:

i. The descriptive case study which is similar to the concept of the descriptive survey
ii. The analytical case study which is similar to the concept of the analytical survey, except it is applied on detailed case(s).
iii. The explanatory case study which is the theoretical approach to the problem. It explains causality and tries to show linkages among the objects of the study.

c) Ethnographic

Ethnography, emerging from anthropology, and adopted by sociologists, is a qualitative methodology that lends itself to the study of the beliefs, social interactions, and behaviours of small societies, involving participation and observation over a period of time, and the interpretation of the data collected (Denzin and Lincoln, 2011; Reeves, Kuper and Hodges, 2008; Berry, 1991)

d) Grounded Theory

In quantitative type of research, hypotheses, research questions and objectives can be better understood when they are grounded in a theoretical framework. A theory is commonly understood to have certain characteristics. Kerlinger (1979) defined a theory as a set of interrelated constructs (variables or questions), that presents a systematic view of phenomena by specifying relationships among variables, with the purpose of explaining natural phenomena.

3.3.2 Qualitative Research

According to Harwell (2006), qualitative features are aimed to create understanding of data analysis as a result of which often determines the form of the hypothesis, the quantity, and the scope of the required data. It is a systematic subjective approach used to describe life experiences and give them meaning to gain insight, explore the depth of certain thing, and complexity inherent.

Qualitative research is done in two methods namely:

a) Experiments
b) Survey

3.4 Research Methodology Adopted

In this research project, quantitative research method is adopted. It begins with a literature review and followed by the questionnaire survey.

3.4.1 Literature Review

For this research project, literature review is very important to get an overview of the subject that is chosen. Firstly, the literature reviews the communication in general and

common communication problem. Basic understanding about construction and construction stages is also described to ensure the reader understand about the matter discussed. Next, this research project explained on communication in construction industry, issues related to communication in construction and the challenges of it is elaborated. This is to answer the first research question which is "what is the communication problem that often happen in construction project that can be improve by mobile application?".

Literature review then focuses on communication technology that is applied in current construction to improve communication and resolve conflict in communication. This will help further for research question 2 and 3 which are "what are the lacking of *WhatsApp* application as a tool of communication in current construction industry?" and "how to improve *WhatsApp* mobile application to increase effectiveness of communication amongst client-consultant-contractor?".

3.4.2 Quantitative Survey

Questionnaire survey is done to support the finding from literature review. It is also done to answer the research question identified by the writer which is what is the common the communication problem that is faced by client, consultant and contractor in construction phase. Through this questionnaire, this thesis will identify ways to improve *WhatsApp* application so that it can be used by client, consultant and contractor as a medium of communication.

The survey will identify what are the needs of user are to improve the application. For instance, correspondence might suggest the application to have a better documentation system so that everyone involve in the project can easily access to the file required.

A questionnaire set of question is derived from the research objective and literature review (Naoum, 2007). The target of questionnaire survey is to answer the second and third research question. The questionnaire survey is designed to get suggestion from the respondent on how to improve the current mobile application in order to assist communication in construction for example what are the items that is missing in the current application that can be included in.

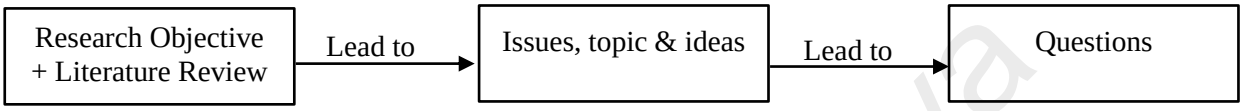


Figure 3. 2 Diagram showing research process & objectives are translated into specific questions (Naoum, 2007)

The questionnaire surveys are distributed to the three groups – Client, consultant, contractor. A questionnaire is a written list of questions, the answers to which are recorded by respondents. The difference between an interview and a questionnaire is that interviewer who asks questions (and if necessary, explains them) and records the respondent's replies on an interview, and in questionnaire answers are recorded by the respondents themselves.

a) Purpose of Questionnaire

The questionnaire survey is designed to answer the research questions laid out in the earlier chapter. It is designed by referring to the literature review done at chapter 3 which relates to common communication problem and communication problem among people who work in construction industry. In this study, the questionnaire survey cover page explains on the purpose of the study to make the respondents understand what is expected from them and the purpose of the study.

b) Design of the questionnaire

The questionnaire is designed to collect end users experience on the usage of *WhatsApp* among people who work in construction industry – client, contractor

consultant. survey is taken by selecting a group of people to consider them as representative of the entire group. The questionnaire is subdivided into 4 different sections, section A, B, C and D.

Section A

Section A of the questionnaire consists close ended question to identify the background of the respondent's demographic background which are their gender, age group, designation or post in the company they work with and nature of business either property development, consultant or contractor. Other details are also collected from respondents which are their years of experience in construction industry and level of education.

Section B

Section B is a combination of open ended and closed ended questions. The questions in this section are designed to understand respondents' view on communication problems that they face in their workspace and work environment. Their thoughts on how this problem can be solved are also gathered. The questions are using multiple choice questions (question 7 – 9) and also open-ended question (question 10).

Section C

In section C, the current situation on usage of WhatsApp amongst people who work in construction industry is collected. In this section, their years of usage of WhatsApp, what they use WhatsApp for and frequency and effectiveness of WhatsApp is asked. Question in this section are also a mix of close ended multiple-choice question (question 11 – 19) and also one open ended question (question 20).

Section D

Lastly, in section D, the lacking or deficient of WhatsApp from the view of end user (client, consultant and contractor) is collected. They are also given the choice to suggest what can be improve in WhatsApp so that communication is better and WhatsApp can be fully utilized as the main medium of communication for project construction use. This section is also a mix of open ended and close end questions. An open-ended question is used to identify the respondents' opinion on one subject matter that is discussed. For instance, in this section question number 22, the questionnaire survey is asking on features that they think can be added to WhatsApp to improve it. There are 4 answers given that they can select from and on open answer so that they can give more answers based on their knowledge and experience.

c) Sampling Design

Sampling is the process or skill of choosing an appropriate sample that is representative to the population taken (Singh, 2007). The researcher is able to save time and money by using samples as the data collected from the samples can be almost as precise as those for the whole census of the population being considered.

In this study, stratified random sampling is adopted. This type of sampling involves assigning the population into homogeneous groups call strata that are based on different indicators such as characteristic or geographical factor. Using stratified random sampling is advantageous if the researcher wants to obtain comparative results between strata. Therefore, the result is more reliable and comprehensive than those random sampling if the characteristic or nature of the population are taking into consideration.

The sample size needed in this study is, derived from the three categories which are property developer, contractor and consultant. For both property developer and contractor, companies that are public listed are selected.

Target of population for this research is gotten from public listed company for both property developer company and construction company. Three main consultants are selected for this research which are architect, engineer and quantity surveyor. The list of company is gotten from Persatuan Arkitek Malaysia (PAM) website for both architect and engineer. For QS, the list retrieved from registered QS company with Board of Quantity Surveyor (BQSM) from the BQSM website. There are a total of 589 companies selected as the population of study.

Below are the list of companies selected to become the research study population.

NO	PROPERTY DEVELOPER	NO	PROPERTY DEVELOPER
1	ACME HOLDINGS BERHAD	53	MENANG CORPORATION (M) BERHAD
2	AMCORP PROPERTIES BERHAD	54	MERIDIAN BERHAD
3	ARK RESOURCES HOLDINGS BERHAD	55	MAJUPERAK HOLDINGS BERHAD
4	ASIAN PAC HOLDINGS BERHAD	56	MKH BERHAD
5	AYER HOLDINGS BERHAD	57	MK LAND HOLDINGS BERHAD
6	BCB BERHAD	58	MALAYSIA PACIFIC CORPORATION BERHAD
7	BINA DARULAMAN BERHAD	59	MALAYSIAN RESOURCES CORPORATION BERHAD
8	BERTAM ALLIANCE BERHAD	60	MULTI-USAGE HOLDINGS BERHAD
9	BERJAYA ASSETS BERHAD	61	MUI PROPERTIES BERHAD
10	COUNTRY HEIGHTS HOLDINGS BHD	62	NAIM HOLDINGS BERHAD
11	CRESCENDO CORPORATION BERHAD	63	ORIENTAL INTEREST BERHAD
12	COUNTRY VIEW BERHAD	64	OSK HOLDINGS BERHAD
13	DAMANSARA REALTY BHD	65	PARAMOUNT CORPORATION BERHAD
14	DPS RESOURCES BERHAD	66	PASDEC HOLDINGS BERHAD
15	EASTERN & ORIENTAL BERHAD	67	PARAGON GLOBE BERHAD
16	ECOFIRST CONSOLIDATED BHD	68	PEGASUS HEIGHTS BERHAD
17	ECO WORLD DEVELOPMENT GROUP BERHAD	69	PLB ENGINEERING BERHAD
18	ENCORP BERHAD	70	PLENITUDE BERHAD
19	ENRA GROUP BERHAD	71	RAPID SYNERGY BERHAD
20	EUPE CORPORATION BERHAD	72	SAPURA RESOURCES BERHAD
21	EWEIN BERHAD	73	SBC CORPORATION BERHAD
22	ECO WORLD INTERNATIONAL BERHAD	74	SELANGOR DREDGING BERHAD
23	FARLIM GROUP (MALAYSIA) BHD	75	SEAL INCORPORATED BERHAD
24	GLOMAC BERHAD	76	SHL CONSOLIDATED BHD
25	GROMUTUAL BERHAD	77	SIME DARBY PROPERTY BERHAD
26	GLOBAL ORIENTAL BERHAD	78	SOUTH MALAYSIA INDUSTRIES BERHAD
27	GUOCOLAND (MALAYSIA) BERHAD	79	SENTORIA GROUP BERHAD
28	HCK CAPITAL GROUP BERHAD	80	S P SETIA BERHAD
29	GRAND HOOVER BERHAD	81	SUNSURIA BERHAD
30	HUA YANG BERHAD	82	SYMPHONY LIFE BERHAD
31	I-BERHAD	83	TADMAX RESOURCES BERHAD
32	IBRACO BERHAD	84	TA GLOBAL BERHAD
33	IDEAL UNITED BINTANG INTERNATIONAL BERHAD	85	TALAM TRANSFORM BERHAD
34	IGB BERHAD	86	TAMBUN INDAH LAND BERHAD
35	IOI PROPERTIES GROUP BERHAD	87	TANCO HOLDINGS BERHAD
36	IVORY PROPERTIES GROUP BERHAD	88	THRIVEN GLOBAL BERHAD
37	ISKANDAR WATERFRONT CITY BERHAD	89	TIGER SYNERGY BERHAD
38	JIANKUN INTERNATIONAL BERHAD	90	TITIJAYA LAND BERHAD
39	JKG LAND BERHAD	91	TROPICANA CORPORATION BERHAD
40	KEN HOLDINGS BERHAD	92	UEM SUNRISE BERHAD
41	KERJAYA PROSPEK PROPERTY BERHAD	93	UOA DEVELOPMENT BHD
42	KSL HOLDINGS BERHAD	94	WMG HOLDINGS BERHAD
43	LAND & GENERAL BERHAD	95	Y&G CORPORATION BHD
44	LBI CAPITAL BERHAD	96	YNH PROPERTY BERHAD
45	LBS BINA GROUP BERHAD	97	YONG TAI BERHAD
46	LIEN HOE CORPORATION BERHAD		
47	MAGNA PRIMA BERHAD		
48	MAH SING GROUP BERHAD		
49	MALTON BERHAD		
50	MATRIX CONCEPTS HOLDINGS BERHAD		
51	MB WORLD GROUP BERHAD		
52	MCT BERHAD		

NO	CONSTRUCTION COMPANY	NO	CONSTRUCTION COMPANY
1	ADVANCECON HOLDINGS BERHAD	53	WIDAD GROUP BERHAD
2	AGESON BERHAD	54	ZECON BERHAD
3	AME ELITE CONSORTIUM BERHAD	55	ZELAN BERHAD
4	AHMAD ZAKI RESOURCES BERHAD		
5	BENALEC HOLDINGS BERHAD		
6	BINA PURI HOLDINGS BHD		
7	BREM HOLDING BERHAD		
8	CREST BUILDER HOLDINGS BERHAD		
9	DKLS INDUSTRIES BHD		
10	ECONPILE HOLDINGS BERHAD		
11	EKOVEST BERHAD		
12	FAJARBARU BUILDER GROUP BHD		
13	GADANG HOLDINGS BHD		
14	GAMUDA BERHAD		
15	GABUNGAN AQRS BERHAD		
16	GDB HOLDINGS BERHAD		
17	GEORGE KENT (MALAYSIA) BERHAD		
18	HO HUP CONSTRUCTION COMPANY BHD		
19	HOCK SENG LEE BERHAD		
20	IJM CORPORATION BERHAD		
21	IKHMAS JAYA GROUP BERHAD		
22	INTA BINA GROUP BERHAD		
23	IREKA CORPORATION BERHAD		
24	JAKS RESOURCES BERHAD		
25	KERJAYA PROSPEK GROUP BERHAD		
26	KIMLUN CORPORATION BERHAD		
27	LEBTECH BERHAD		
28	MELATI EHSAN HOLDINGS BERHAD		
29	MERCURY INDUSTRIES BERHAD		
30	MGB BERHAD		
31	MITRAJAYA HOLDINGS BERHAD		
32	MTD ACPI ENGINEERING BERHAD		
33	MUDAJAYA GROUP BERHAD		
34	MUHIBBAH ENGINEERING (M) BHD		
35	GAGASAN NADI CERGAS BERHAD		
36	OCR GROUP BERHAD		
37	PIMPINAN EHSAN BERHAD		
38	PESONA METRO HOLDINGS BERHAD		
39	PROTASCO BERHAD		
40	PINTARAS JAYA BHD		
41	PUNCAK NIAGA HOLDINGS BERHAD		
42	SC ESTATE BUILDER BERHAD		
43	EVERSENDAI CORPORATION BERHAD		
44	STELLA HOLDINGS BERHAD		
45	SUNWAY CONSTRUCTION GROUP BERHAD		
46	SYCAL VENTURES BERHAD		
47	TRC SYNERGY BERHAD		
48	TSR CAPITAL BERHAD		
49	UNI WALL APS HOLDINGS BERHAD		
50	VIZIONE HOLDINGS BERHAD		
51	WCE HOLDINGS BERHAD		
52	WCT HOLDINGS BERHAD		

NO	ARCHITECTURE FIRM	NO	ARCHITECTURE FIRM
1	A.H. TEE ARCHITECT	54	AIB ASSOCIATES ARCHITECTS SDN BHD
2	ADJ ARCHITECTURE SDN BHD	55	AKIPANEL ARCHITECTS SDN BHD
3	AF CONSULTANT ARCHITECT	56	AKITEK BERSEKUTU MALAYSIA
4	AHMAD PAUZI ARCHITECT	57	AKITEK C'ENTRA
5	AKITEK HABITAS	58	AIB ASSOCIATES ARCHITECTS SDN BHD
6	AKMAL GOH ARCHITECT	59	AKIPANEL ARCHITECTS SDN BHD
7	AKP ARKITEK SDN BHD	60	AKITEK BERSEKUTU MALAYSIA
8	ALIZAR ARCHITECT	61	AKITEK C'ENTRA
9	ALVIN THAM ARCHITECT	62	ArAH DESIGN Partnership
10	ANUAR AZIZ ARCHITECT	63	ARCHIMATRIX SDN BHD
11	ANWAR SALLEH ARCHITECT	64	ARCHITECTONIC DESIGN
12	AQIDEA ARCHITECT	65	Architects 61 Sdn Bhd
13	ARC PARTNERSHIP	66	ARCHIWORKS SDN BHD
14	ARCH IMPEC	67	ARKITEK AXIS
15	ARIANI ARCHITECT	68	ARKITEK DATARAN
16	ARKIPAC SDN BHD	69	ARKITEK KARYA BUDI SDN BHD
17	ARKITEK M_E_L	70	ARKITEK M. GHAZALI
18	ARKITEK ALAMSEKITAR SDN BHD	71	Arkitek Pital
19	ARKITEK HL	72	Arkitek Rancangbina
20	ARKITEK MAJU BINA SDN BHD	73	BDA ARCHITECTS SDN BHD
21	Arkitek N Kang	74	BING ARCHITECT
22	Arkitek Samsudin	75	BK CHAN ARCHITECT
23	ARKITEK W H NEO	76	DESIGN CIRCLE ARCHITECTS SDN BHD
24	BERNARD LOW ARCHITECT	77	DON CHEONG ARCHITECT
25	BH LEN ARCHITECT	78	DP ARCHITECTS SDN BHD
26	BTA ARCHITECT	79	GMC ARCHITECT
27	CH&I Architecture Sdn Bhd	80	GOH HOCK GUAN & ASSOCIATES
28	CS CHEW ARCHITECTS SDN BHD	81	JLA ARCHITECT
29	DAMANSARA ARCHITECT	82	JO ARCHITECTS
30	DESIGN COLLECTIVE ARCHITECTS	83	K LIM ARKITEK
31	EADIE VOON ARCHITECT	84	K SEE K ARCHITECT
32	GARIS ARCHITECTS SDN BHD	85	KSBAH ARCHITECT
33	K.O Koay Chartered Architect	86	L3 ARCHITECTS SDN BHD
34	KKNG architect	87	LARAS ARCHITECTS SDN BHD
35	KWAN KIM HUAH ARCHITECT	88	MJKANNY ARCHITECT
36	LANDESIGN ARCHITECT	89	MODE ARCHITECTS SDN BHD
37	LAURENT LIM ARCHITECT	90	nk@ NGAI ARCHITECT
38	LEESIONG ARCHITECT	91	NR ARCHITECT
39	MARC ARCHITECTURE SDN BHD	92	NRY ARCHITECTS SDN BHD
40	MASYERIN M.N. ARCHITECT	93	PAKATAN AKITEK SDN BHD
41	MK O ARCHITECT	94	PAKATAN REKA ARKITEK SDN BHD
42	MUNINN CHAN ARCHITECT	95	QUEK C2 ARCHITECT
43	PARADiGM Architects Sdn Bhd	96	RIDZUWAN ZAIHAN ASSOCIATES SDN BHD
44	T+Y Architects	97	T & T ARCHITECT ASSOCIATES
45	T. O. HEW ARCHITECT	98	TLC ARCHITECT
46	Walter & Jo Architect Associates	99	URUSREKA ARCHITECT
47	YHSA SDN BHD	100	W&W ARCHITECTS
48	ZAINAL A. KHALIM ARCHITECT	101	WANG HC ARCHITECT
49	ZO ARCHITECT	102	WONG C S ARCHITECT
50	ADL ARCHITECT	103	ZAINI MUFTI ARCHITECT
51	ADP CONSULTANT	104	ZAP GROUP ARCHITECTS SDN BHD
52	ADZLEE ARCHITECT	105	ZON DESIGN REKABINA SDN BHD
53	AHA ARCHITECT		

NO	QUANTITY SURVEYOR	NO	QUANTITY SURVEYOR
105	PERUNDING SENIKOS	157	CPK ASSOCIATES
106	PERUNDING UKUR BAHAN CGH	158	CS PERUNDING JURUKUR BAHAN
107	PERUNDING UKUR BAHAN CS	159	DCC CONSULT SDN BHD
108	PERUNDING ZEQ	160	DESIGN COST CONSULTANTS
109	PLC QS CONSULT SDN BHD	161	ECONCOS CONSULTANTS SDN BHD
110	PRO KOS KONSULT SDN BHD	162	EFCT KONSULT
111	QS 98 CONSULTANTS SDN BHD	163	ELP QUANTITY SURVEYORS SDN BHD
112	QS ASSOCIATES	164	ENTRUSTY MANAGEMENT SDN BHD
113	QS FOCUS SDN BHD	165	FAR CONSULTANT
114	QSP CONSULTANTS SDN. BHD.	166	FENDI CONSULT
115	QST CONSULT	167	H3A CONSULT SDN BHD
116	QUANTICONSULT SDN BHD	168	HAH ASSOCIATES
117	QUANTUM SURVEYORS SDN BHD	169	HALIM ASSOCIATES
118	QUBIC QS CONSULT SDN BHD	170	HASHIM DAN LIM SDN BHD
119	R-QS TEAM	171	HD QS CONSULT
120	RSL & ASSOCIATES	172	HMR & ASSOCIATES
121	S & H QUANTITY SURVEYORS SDN BHD	173	HMR & ASSOCIATES SDN. BHD.
122	SANG QS CONSULT	174	HR ASSOCIATES
123	SC QS CONSULT	175	ICS INTEGRATED COST SURVEYORS
124	SCS QS CONSULT	176	INTRACOST CONSULT
125	SE QS CONSULT	177	JUB CENTRAL SDN BHD
126	SG CONTRACT SERVICES	178	JUB PADU
127	TAQ-SURVEYORS	179	JUB SEKUTU SDN BHD
128	TL ASSOCIATES	180	JUBC SDN BHD
129	TQS KONSULT	181	JURUKUR BAHAN AAR
130	TRES IQS CONSULTANCY SDN BHD	182	JURUKUR BAHAN BERSATU
131	TT QS CONSULT	183	JURUKUR BAHAN FPS SDN BHD
132	UNITECH QS CONSULTANCY (KL) SDN. BHD.	184	JURUKUR BAHAN H & A
133	VERTEX QS CONSULT SDN BHD	185	JURUKUR BAHAN L & T
134	VESCOPE SDN BHD	186	JURUKUR BAHAN PENDITA SDN. BHD.
135	VINCENT TAN ASSOCIATES	187	JURUKUR BAHAN Q&C SDN BHD
136	VINCENT TAN ASSOCIATES SDN BHD	188	JURUKUR BAHAN UTAMA
137	VQS PRAKTIS SDN BHD	189	JURUUKUR BAHAN HRM
138	WLT ASSOCIATES	190	JURUUKUR BAHAN PROJEK
139	YF LEE QUANTITY SURVEYORS	191	KA ASSOCIATES
140	YONG DAN MOHAMAD FAIZ SDN. BHD.	192	KCL QS KONSULT SDN BHD
141	YUSOF ASSOCIATES JURUKUR BAHAN	193	KH ALLIANCE QUANTITY SURVEYORS SDN BHD
142	ZRR DAN RAKAN-RAKAN SDN BHD	194	KPK QUANTITY SURVEYORS (SEMENANJUNG) SDN BHD
143	ZUL-QS CONSULT		
144	ACQS	195	KRISTAL PADU KONSULT
145	ADAM QS CONSULTANCY SDN. BHD.	196	KUMPULAN SEPAKAT KONSULT
146	ALPHA-OMEGA MATRIX	197	KWK CONSULT
147	ARH JURUKUR BAHAN SDN. BHD.	198	LCG QS CONSULT
148	ASA-CM JURUKUR BAHAN SDN BHD	199	MA QUANTITY SURVEYORS
149	ASRI QS CONSULT	200	MHI QS CONSULT
150	ASSOCIATED AURA (M) SDN BHD	201	MSAY TECHNICAL VENTURES
151	AT ASSOCIATES	202	O & Z ASSOCIATES
152	AZATECH QUANTITY SURVEYORS SDN. BHD.	203	PAKATAN INTERNATIONAL MD ISAHAK & RAKAN-RAKAN SDN BHD
153	BAHARUDDIN ALI & LOW SDN BHD		
154	BIZREKA GROUP SDN. BHD.	204	PCM KOS PERUNDING SDN BHD
155	CKP NIZARUDDIN JURUKUR BAHAN SDN	205	PERUNDING DMA SDN BHD
156	CNH JURUKUR BAHAN SDN BHD	206	PERUNDING KOS CSS

NO	QUANTITY SURVEYOR
207	PERUNDING KOS GKS
208	PERUNDING KOS T & K SDN BHD
209	PERUNDING NFL SDN BHD
210	PERUNDING PCT SDN BHD
211	PERUNDING PQS
212	PERUNDING SHS
213	PERUNDING SL
214	PERUNDING UKUR BAHAN RB SDN BHD
215	PERUNDING UKUR BAHAN TSY
216	PERUNDING UNIKON
217	PERUNDING UNIKON SDN BHD
218	PQS KONSULTANT SDN BHD
219	Q & C JURUKUR PERUNDING
220	QSNGSB
221	QSUN QUANTITY SURVEYORS SDN BHD
222	QYN QS CONSULT
223	RD QS CONSULT
224	RIVER GREEN QS SDN BHD
225	RK PARTNERSHIP
226	RL BERSEPADU SDN BHD
227	RM ASSOCIATES
228	SLQS CONSULT SDN BHD
229	SM LIM QS CONSULT
230	SR EXPERT PRACTICE SDN. BHD.
231	STANLEY CHIN QS CONSULT
232	THL CONSULTANTS
233	UKUR BAHAN KELANA SDN BHD
234	UKUR BAHAN KONSULT
235	UPUM SDN BHD
236	VA QS CONSULT
237	VERITAS CONTRACTS SDN BHD
238	WT PARTNERSHIP (M) SDN BHD
239	YANG QS CONSULT
240	YCL CONSULT
241	YQS CONSULTANCY SDN BHD
242	YSCA CONSULTANCY SDN BHD
243	ZAMS QS CONSULT

A total of 589 public listed property development and construction companies, architecture, engineer and quantity surveyor consultant companies from Klang Valley were called to participate in the survey.

Nature of Business	Number of Office	Percentage
Property Developer	97	16%
Construction Company	55	9%
Architecture Firm	105	18%
Engineering Firm	89	15%
Quantity Survey Firm	243	41%
Total	**589**	**100%**

Referring to the Sample Size Table of Krejcie and Morgan (1970) below, the sample size for this group of 589 should be 234. This means, the respond rate gotten from the questionnaire survey distributed is only 56.4% which is only 132 numbers of responds.

Table 3.1

Table for Determining Sample Size of a Known Population

N	S	N	S	N	S	N	S	N	S
10	10	100	80	280	162	800	260	2800	338
15	14	110	86	290	165	850	265	3000	341
20	19	120	92	300	169	900	269	3500	346
25	24	130	97	320	175	950	274	4000	351
30	28	140	103	340	181	1000	278	4500	354
35	32	150	108	360	186	1100	285	5000	357
40	36	160	113	380	191	1200	291	6000	361
45	40	170	118	400	196	1300	297	7000	364
50	44	180	123	420	201	1400	302	8000	367
55	48	190	127	440	205	1500	306	9000	368
60	52	200	132	460	210	1600	310	10000	370
65	56	210	136	480	214	1700	313	15000	375
70	59	220	140	500	217	1800	317	20000	377
75	63	230	144	550	226	1900	320	30000	379
80	66	240	148	600	234	2000	322	40000	380
85	70	250	152	650	242	2200	327	50000	381
90	73	260	155	700	248	2400	331	75000	382
95	76	270	159	750	254	2600	335	1000000	384

Note: N is Population Size; S is Sample Size *Source: Krejcie & Morgan, 1970*

Figure 3. 3 Table for determining sample size of known population (Krejcie & Morgan, 1970)

d) Distribution of the questionnaire

The questionnaires are done online form which is google doc link send through emails of the selected companies. The emails of the company are retrieved from website of the company. Some emails are also retrieved from Persatuan Arkitek Malaysia (PAM) website list and Board of Quantity Surveyor Malaysia (BQSM) website.

The questionnaire survey cannot be handed through hard copy due to Movement Control Order (MCO) announced by the Malaysian government to control the spreading of Covid-19 virus. All the companies listed are not working due to the MCO.

The responds time given are 2 weeks. A follow up emails were sent to all respondent companies as a reminder for them to respond to the questionnaire survey.

3.6 Data Analysis

All the data collected were analysed using descriptive analysis to summarize the data and identify pattern in the answer from the respondents. The primary and secondary data gathered were used to further discuss the findings. are collected, reviewed and analyse to the finding and come out with conclusion.

3.6.1 Percentage Method

Percentage method is a simple and easy method to analyse data received from questionnaire survey. The result gotten from the questionnaire survey is tabulated in the form of percentage by getting the frequency of the answer divided by total number of respondent/ answer times by 100. From the percentage, the data will be presented in a form of graft for a clearer analysis of data. This kind of method is used whenever a multiple-choice question comes such as close-ended or yes or no question. The percentage is calculated by using the formula as below.

$$\text{Percentage} = \frac{\text{Frequency of respondent}}{\text{Total number of responden}} \times 100$$

Sample calculation to analyse data is as follows:

Example

Say, total number of respondents is 30.

Sample question: Do you accept fresh graduates in your firm?

Respondent's feedback:

a) Yes : 20 respondents

b) No : 10 respondents

By following the formula shown previously, the percentage can be calculated as below:

A respondent who said yes, percentage = $\frac{20 \text{ respondents X } 100}{30 \text{ respondents}}$

= 66.67%

A respondent who said No, percentage = $\frac{10 \text{ respondents X } 100}{30 \text{ respondents}}$

= 33.33%

Then, the data will be transferred into the table form as shown below:

Respondent	Frequency	Percentage (%)
Yes	20	66.67
No	10	33.33

3.4 Summary

The chapter explained on the research methodology that is used in the study to answer the research question. Available methodology of research is discussed and the best research method is selected suits with the finding that is targeted to be achieved.

CHAPTER 4: RESULTS AND DISCUSSION

4.1 Introduction

This chapter explains the results which are commonly presented in the form of text, figures and tables, complete with data analysis.

The analysis is based on feedback that is gotten from questionnaire survey distributed to 589 property developer, contractor and consultant offices. However, there are only 144 respondents received. However, there are 12 repeated respond which result to only 132 responds in total.

The survey is held to find out data related to communication problem in construction industry. As briefed on earlier chapter, the research objective of this thesis is as followings:

i. To identify what is the communication problem that often happen in construction project that can be improved by mobile application.
ii. To identify what are the lacking of *WhatsApp* application as a tool of communication in current construction industry
iii. To develop strategy to improve *WhatsApp* mobile application to increase effectiveness of communication amongst client-consultant-contractor.

4.2 Modes of Data Collection

The researcher collected data gathered from the respondents. From the responds, it shows that there is only 56.4% of respond rate. Only 132 respondents answer to the questionnaire survey and 102 did not reply to the invitation to participate in research email. The detail of respond rates as per followings table.

Table 4. 1 Respondent's feedback percentage

Respondents' Feedback	Frequency	Percentage (%)
Response	132	56.4
No Response	102	43.6
Total	**234**	**100**

4.3 Section A – Demographic Data

Before starting with question that is related to the research, firstly, the questionnaire survey is asking with basic background of the respondents from gender, age group, experience in construction industry, education background and position / designation. These questions are grouped in one section of the questionnaire which is Section A, demographic data.

First question asked is gender. Gender of the respondents is important as it reflect in the way the respondents react to the questions. From the data received, there is a balance of 50-50 from male and female respondents. There are 66 males and 66 female respondents.

Table 4. 2 Gender of Respondents

Answer	Frequency	Valid Frequency	Percent	Valid Percent	Cumulative Percent
Male	74	66	51%	50%	50%
Female	70	66	49%	50%	100%
Total	**144**	**132**	**100%**	**100%**	

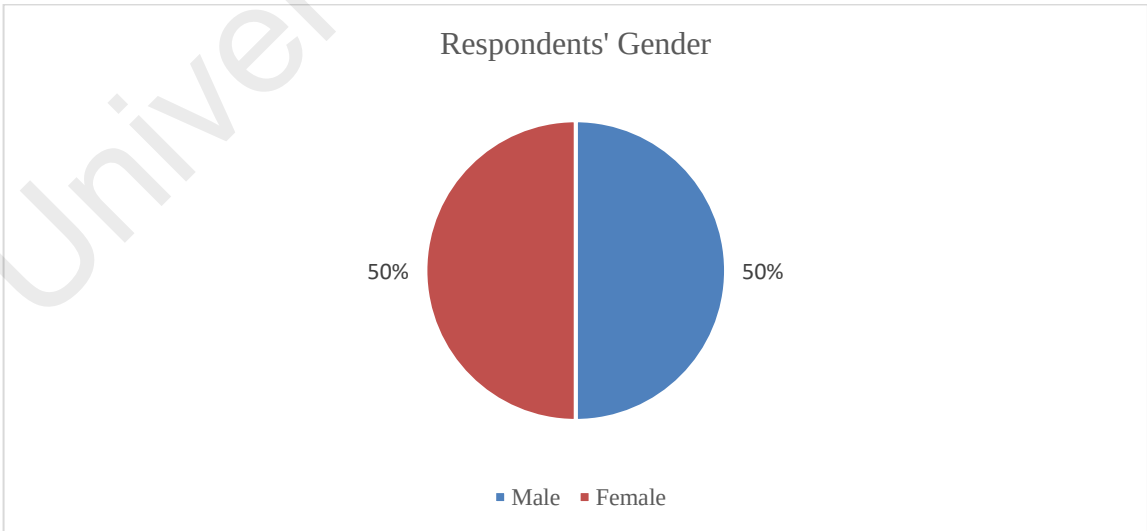


Figure 4. 1 Gender of Respondents

The researcher then tries to gather the data on the range of age of the respondent. Based on table 3, it can be seen that most of respondents comes from the range age of 26 to 40 years old which is 114 persons equivalent to 86% of overall respondent.

This data is important so that we can now the level of maturity of the respondent. Based on the result, it can be concluded that the respondent knows what they are talking about and have a good year of experience in the industry. To get the experience years in the industry, other question is asked. Since this research is talking about communication problem and focusing on *WhatsApp*, it is acceptable to have respondent on a younger age which is 26 years old to 40 years old. Table and figure below will further explain the data gathered.

Table 4. 3 Age of Respondents

Answer	Frequency	Valid Frequency	Percent	Valid Percent	Cumulative Percent
<25 years old	7	5	5%	4%	4%
26-40 years old	123	114	85%	86%	90%
41-50 years old	12	11	8%	8%	98%
>50 years old	2	2	1%	2%	100%
Total	**144**	**132**	**100%**	**100%**	

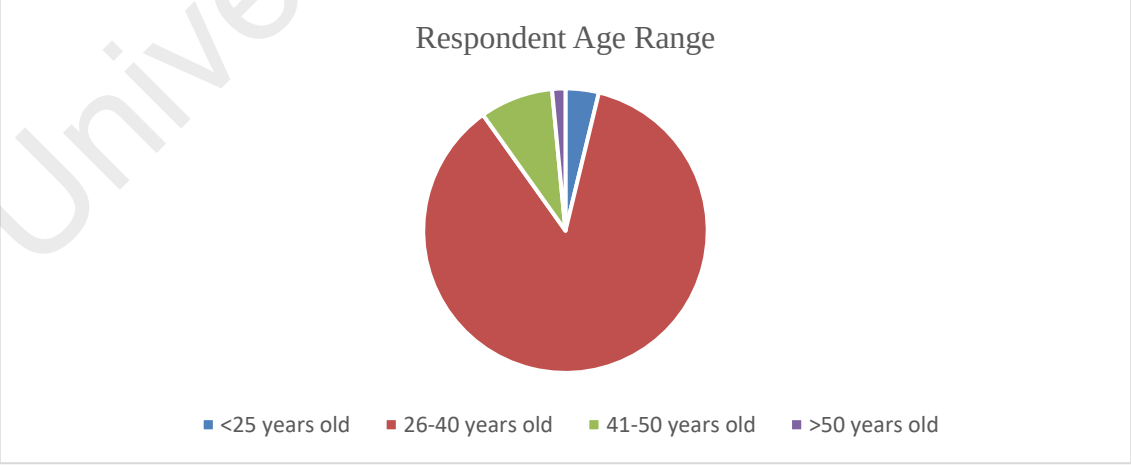


Figure 4. 2 Pie Chart on Age of Respondents

From table below, we can see that most of the respondents comes from architect followed by quantity surveyor, executive manager and engineer. This might be because

they are younger and willing to spend some time to do the questionnaire survey. They might be given by the company to answer the question. The highest percentage comes from architect which are 44 people equivalent to 32% from total respondents. After that followed by QS, executive, manager and engineers which are almost the same number 16, 15, 13 and 13 respectively. This data is tabulated in the below table and bar chat below.

Table 4. 4 Respondents' designation or possition in company

Answer	Frequency	Valid Frequency	Percent	Valid Percent	Cumulative Percent
Architect	46	44	32%	33%	33%
Quantity Surveyor	17	16	12%	12%	45%
Executive	17	15	12%	11%	57%
Manager	16	13	11%	10%	67%
Engineer	15	13	10%	10%	77%
Senior Executive	9	8	6%	6%	83%
Assistant Manager	6	6	4%	5%	87%
Designer	6	5	4%	4%	91%
Director	3	3	2%	2%	93%
Senior Manager	2	2	1%	2%	95%
General Manager	2	2	1%	2%	96%
Head of Department	2	2	1%	2%	98%
Site Supervisor	2	2	1%	2%	99%
Clerk of Work	1	1	1%	1%	100%
Total	**144**	**132**	**100%**	**100%**	

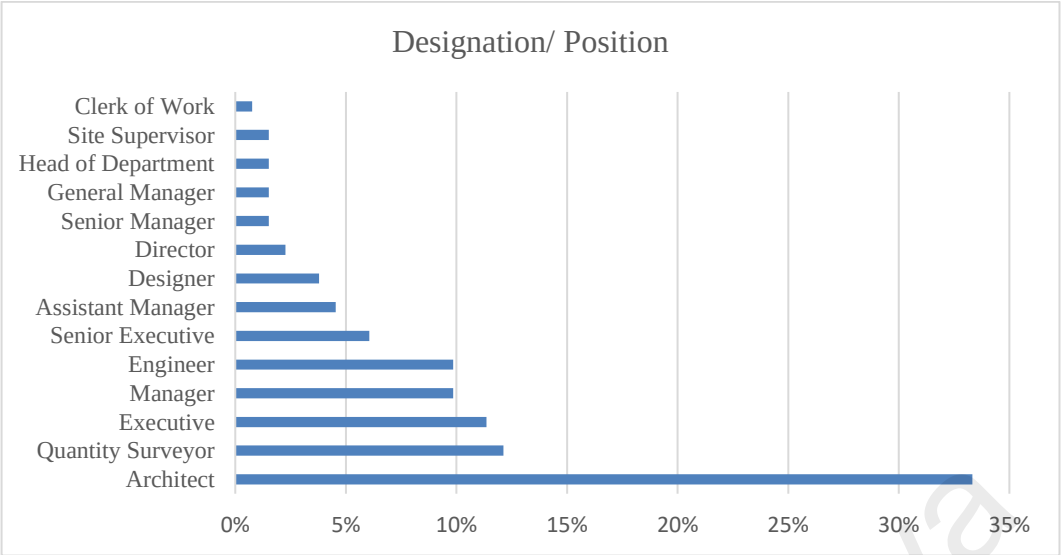


Figure 4. 3 Respondents' designation or possition in company

Next, the question from the survey is trying to gather the nature of business that the respondent is working with either developer, consultant or contractor. This is aligned with the title of the research which is "Improving Client-Consultant-Contractor Communication in Construction Industry Through *Whatsapp* Application". From the table, it can be seen that most of the respondents comes from the office of consultant. This is due to the fact that the questionnaire survey is distributed to mostly consultant office as they have greater number compared to contractor and property developer or in this research called as client. From the previous chapter, consultants' population already make up to 74% of the total population of research where 18% of them are architect, 15% are engineer and 41% are quantity surveyor.

However, there respond gotten from the questionnaire is 64 respondents are from consultant and the rest comes from contractor and property developer. Detail of the data can be seen from table and chart below.

Table 4. 5 Company the Respondent Working With

Answer	Frequency	Valid Frequency	Percent	Valid Percent	Cumulative Percent
Consultant	69	64	48%	48%	48%
Contractor	47	42	33%	32%	80%
Developer	28	26	19%	20%	100%
Total	**144**	**132**	**100%**	**100%**	

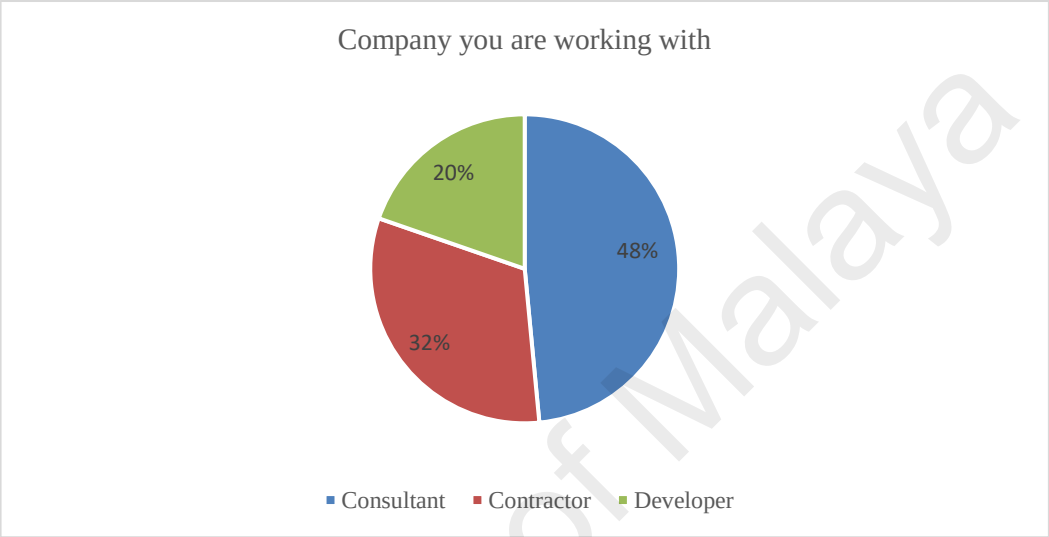


Figure 4. 4 Company the Respondent Working With

Next, the question is trying to understand years of experience of the respondents. From the data tabulated, 42% and 41% comes from people with less than 5 years of experience in construction industry and 6 – 10 years of experience respectively. 42% of respondents are considered as amateur in construction industry as they have less experience which is lesser than 5 years.

Table 4. 6 Respondents' Years of Experience

Answer	Frequency	Valid Frequency	Percent	Valid Percent	Cumulative Percent
<5 years	60	56	42%	42%	42%
6-10 years	61	54	42%	41%	83%
11-15 years	11	11	8%	8%	92%
>15 years	12	11	8%	8%	100%
Total	**144**	**132**	**100%**	**100%**	

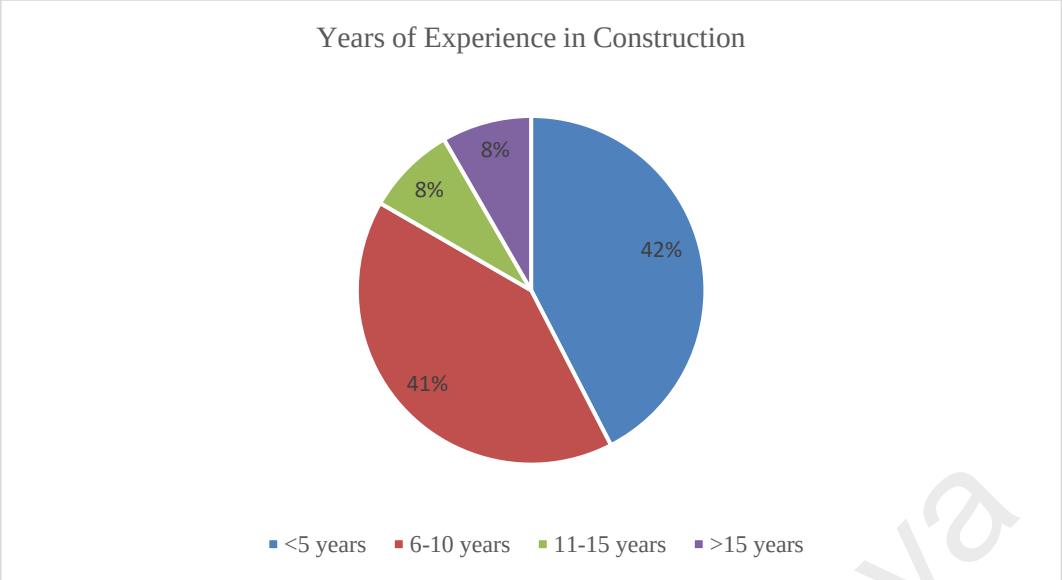


Figure 4. 5 Respondents' Years of Experience

For education background, most of the respondents comes from degree holder which is 87 respondents (67%). It is followed by 36 respondents (26%) and diploma 7 respondents (5%). Amongst the respondents, there is one PHD holder and 1 chargeman.

Table 4. 7 Education Background of Respondent

Answer	Frequency	Valid Frequency	Percent	Valid Percent	Cumulative Percent
Degree	97	87	67%	66%	66%
Master	38	36	26%	27%	93%
Diploma	7	7	5%	5%	98%
PHD	1	1	1%	1%	99%
MCE & Chargeman	1	1	1%	1%	100%
Total	**144**	**132**	**100%**	**100%**	

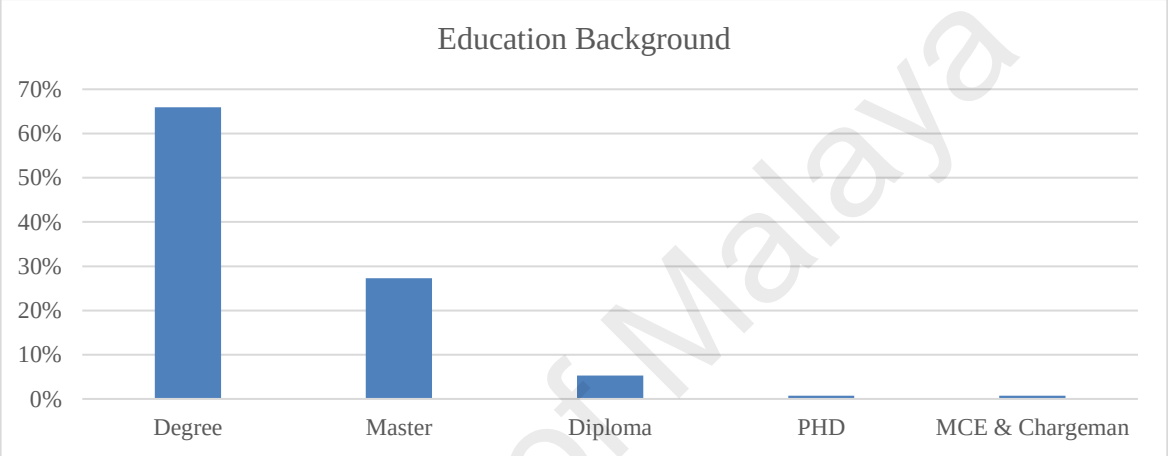


Figure 4. 6 Education Background of Respondent

4.4 Section B – Communication Problem in Construction Industry

After all the demographic data of the respondents gathered, the question related to the research is asked. For section B, the questions are designed to understand what are the common communication problems that is faced by the client, consultant and contractor. Firstly, the questionnaire survey is asking if the respondents have ever face communication problem in their daily work environment related to the construction work.

From the data collected, most of the respondents answered they have been facing communication problem at work. Only 5 respondents answered they have not faced any communication problem and the majority of 127 respondents said they do face communication problem.

Table 4. 8 Experience on Communication Problem at Work Place

Answer	Frequency	Valid Frequency	Percent	Valid Percent	Cumulative Percent
No	5	5	3%	4%	4%
Yes	139	127	97%	96%	100%
Total	**144**	**132**	**100%**	**100%**	

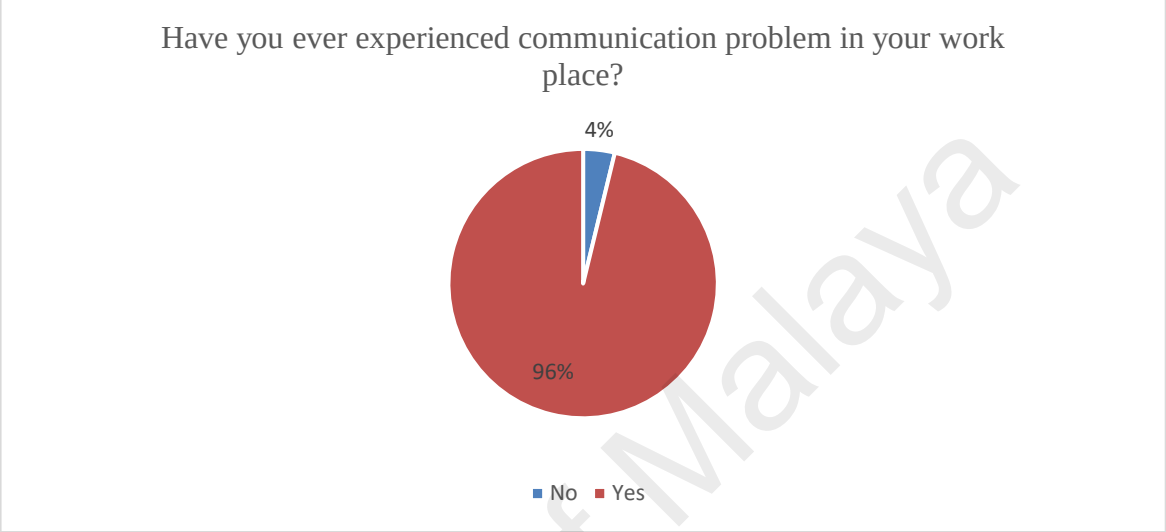


Figure 4. 7 Experience on Communication Problem at Work Place

The next question is then trying to understand what are the communication problem that is faced by respondents. There are 9 common communication problem from literature review and listed in the answer which they can select from. Their answer can be more than one. The 9 listed answers are:

i. Unresponsiveness between and among project team

ii. Loss of information when conveying messages from office to project worker or vice versa

iii. Inability to collaborate effectively among project team

iv. Lack of effective platform to communicate and share project information

v. unstable internet connection at construction site

vi. Misunderstanding in interpreting instruction especially a written instruction

vii. Drawing discrepancy

viii. Language barrier

ix. Lack of open and direct communication due to conflict of interest and contract type.

Apart from the listed common communication problem, respondents are allowed to add more answer of the problem they face. The added answers are:

i. Instruction Keep Changing Between and From the Management

ii. Time consuming coordination & follow direction blindly by client

Of all the problems, the feedback from respondents saying that the top three communication problem they face are unresponsiveness between and among project team (16.3%), loss of information when conveying message from office to project worker or vice versa (12.9%) and inability to collaborate effectively among project team (11.8%).

Answer	Frequency	Valid Frequency	Percent	Valid Percent	Cumulative Percent
Unresponsiveness Between and Among Project Team	104	95	16.5%	16.3%	16.3%
Loss of Information when Conveying Messages	79	75	12.5%	12.9%	29.2%
Inability to Collaborate Effectively Among Project Team	73	69	11.6%	11.8%	41.0%
Lack of Effective Platform to Communicate	55	50	8.7%	8.6%	49.6%
unstable internet connection at construction site	32	30	5.1%	5.1%	54.7%
Misunderstanding in Interpreting Instruction	79	71	12.5%	12.2%	66.9%
Drawing Discrepancy	90	85	14.3%	14.6%	81.5%
Language Barrier	45	41	7.1%	7.0%	88.5%
Lack of Open and Direct Communication	72	65	11.4%	11.1%	99.7%
Instruction Keep Changing Between and From the Management	1	1	0.2%	0.2%	99.8%
Time consuming coordination & follow direction blindly by client	1	1	0.2%	0.2%	100.0%
Total	**631**	**583**	**100%**	**100%**	

From all 132 respondents, majority of them which is 113 respondents believe these communication problems can be solved. On the other hand, only 19 respondents believe that these problems cannot be fixed.

Table 4. 9 Can Communication Problem be Solved?

Answer	Frequency	Valid Frequency	Percent	Valid Percent	Cumulative Percent
No	22	19	15%	14%	14%
Yes	122	113	85%	86%	100%
Total	**144**	**132**	**100%**	**100%**	

The next question asked is an open-ended question where they can answer any relevant answer based on their knowledge and experience. The question asked is regarding on how to solve the communication problem they face. All the answers are collected grouped based on key words. There are 16 groups of keywords gathered. They are:

i. Better documentation
ii. BIM
iii. Communicate
iv. Responsible
v. Teamwork
vi. Education and training
vii. PMC
viii. Coordinate
ix. Open and transparent
x. Standard language
xi. Communication platform
xii. Regular meeting/ communicate
xiii. Follow up
xiv. Face to face meeting
xv. Site visit
xvi. Team building

The group of answers are then assembled and tabulated in a table form. Below are the answers received from respondents on the questions.

Table 4. 10 Ways to improve communication problem in construction industry

Answer	better documentation	BIM	Communicate	Responsible	Teamwork	Education & training	PMC	Coordinate	Open and transparent	standard language	communication platform	regular meeting/ communicate	follow up	face to face meeting	site visit	team building
A written record of history to track down latest drawing and instruction. Everyone should able to access the record.	/				/											
Consultants need to be organised and give full cooperation. It is about teamwork				/	/											
All parties need to take up the initiative for problem solving					/											
Consultants and contractor's responsiveness should be based on the scope of work as agreed in the LOA.				/	/											
Awareness, education and implementing the needed changes to achieve better communication. Hiring specialists in running projects and standardizing the communication process within the company is a good starting point.						/	/									
be an active person and always communicate with others			/													
be more responsible				/												
Better communication			/													
Better communication and coordination amongst all parties.			/					/								
Better communication and transparent			/													
Better communication flow			/													
BIM		/														
By communicating clearly, and using one language										/						

Answer	better documentation	BIM	Communicate	Responsible	Teamwork	Education & training	PMC	Coordinate	Open and transparent	standard language	communication platform	regular meeting/ communicate	follow up	face to face meeting	site visit	team building
By having direct communication via phone calls upon identifying the issues.			/													
By improving the communication and platform for discussion			/								/					
By managing good direct communication			/													
by regular meetings/discussions												/				
By setting a barrier or a clear job scope for each project team member. Every personnel need to have a sense of responsibility in undertaking their work.				/	/											
Centralise platform to get information											/					
Clear communication through any platform might works. Frequent follow up & update from time to time											/		/			
Clear communication/information transfer			/													
Clear communication with provide clear information in right time			/													
Common communication platform											/					
Communicate regularly and effectively to spread and update any info												/				
Communicate with any language which both parties understand and messages can be conveyed										/						
Communication			/													
Communication			/													

Answer	better documentation	BIM	Communicate	Responsible	Teamwork	Education & training	PMC	Coordinate	Open and transparent	standard language	communication platform	regular meeting/ communicate	follow up	face to face meeting	site visit	team building
Communication channel											/					
Constant communication and understanding												/				
Contact through an apps in mobile phone											/					
coordination								/								
Coordination meeting								/								
Direct confrontation through phone calls and meet up upon any issues arises														/		
Discussion with all parties involve												/				
Do regular team meeting												/				
Double checking and proper discussion and use BIM as a part of the business		/										/				
Drawing discrepancy - thorough check-ups by PIC Lack of direct communication - firm & strong leadership, communication & negotiating skills				/	/									/		
During CCM												/				
Each can practice better interpersonal skill and acknowledge each other's responsibility					/											
Every level must play their role effectively				/												
Everybody in the project team must play the role, responsible and give full cooperation.				/												

Answer	better documentation	BIM	Communicate	Responsible	Teamwork	Education & training	PMC	Coordinate	Open and transparent	standard language	communication platform	regular meeting/ communicate	follow up	face to face meeting	site visit	team building
Everyone have to communicate and open up to opinions and be respectful			/													
Everyone takes the initiative to make sure the project moving smoothly.					/											
Explain in verbal and follow up in writing.												/	/			
Face to face meeting												/				
Face to face meeting, visualise data, frequent site visit												/			/	
face to face meeting. subject to discussion issue												/				
Face to face or tele conversation												/				
Face to face. written clear document. or application platform	/										/	/				
By discussing with each other, following framework implemented by the company												/	/			
Frequent meeting. After meeting, all information must be put in black and white as a record	/											/				
Full implementation of BIM and relevant software as a medium of communication		/														
Further discussion and meeting. team building												/				/
Go to site and talk to other in Bahasa Malaysia plus English and drawings.										/						
Having a full responsibility to the task given for each staff				/												
Highlight the critical issues in the meeting												/				

Answer	better documentation	BIM	Communicate	Responsible	Teamwork	Education & training	PMC	Coordinate	Open and transparent	standard language	communication platform	regular meeting/ communicate	follow up	face to face meeting	site visit	team building
Honesty & good will intention in each respective party can achieve a good communication towards each other.			/	/												
Willing to listen to others opinion especially if it's from person of different field and expertise. Being egoistic would only bring more difficulties in working as a team and would make overcoming each and every problem that occurred especially on site rather hard and time consuming.					/											
If there is any misunderstanding in communication, one should seek clarification to another.			/													
improve communication frequency												/				
Improving attitude towards the responsibility				/												
Improving method of communication and close monitoring											/		/			
Utilisation of various communication app and translation apps to improve communication.										/	/					
Knowledge n better communication			/			/										
Management of people and training can help to reduce some of the problem						/										
Medium or mutual communication forms that is legally approved											/					
MEETING												/				
Meeting												/				
Meeting												/				

Answer	better documentation	BIM	Communicate	Responsible	Teamwork	Education & training	PMC	Coordinate	Open and transparent	standard language	communication platform	regular meeting/ communicate	follow up	face to face meeting	site visit	team building
Meetings												/				
More ad hoc discussion																
More care should be addressed from project manager to impose the necessary coordination among consultant Project manager should be wary of their instructions so to ensure consultants have exposed a non-biased consultation				/				/								
more communication and respond each other			/													
More coordination meeting								/				/				
more face to face discussion														/		
More site meeting														/	/	
Need Clear direction and always communicate with each other.			/													
Need more communication among every parties			/		/											
Need to conduct meeting with all related parties and bring out the issues one by one. Deliberate with resolution, review periodically until matters resolved.												/	/			
hologram as part of communication											/					
Online meeting												/				
Open communication									/							
Project managers playing the role of head of project should intensively coordinate and monitor their subordinate in ensuring the project runs smoothly				/				/								

Answer	better documentation	BIM	Communicate	Responsible	Teamwork	Education & training	PMC	Coordinate	Open and transparent	standard language	communication platform	regular meeting/ communicate	follow up	face to face meeting	site visit	team building
Proper documentation	/															
proper medium, with clear aim and objectives between entity											/					
Proper/ Thorough project handover from tendering team to project team					/											
Proper/good monitoring and effective communication among team member			/		/											
Providing more training						/										
Quick meeting everyday first thing in the morning to solve any issues.												/				
Research between tender drawing and construction drawing from the beginning						/										
Round table discussion												/				
Sharing and Learning with others								/								
Strategic Communication and good management			/													
Structural back communication direction from top to bottom due standard practised			/													
Suitable training for project team. Main con supply WIFI service. Fair treatment among contractors.						/										
Team work and communication skill and also creative to solve that problems			/		/											
Tete-a-tete (face to face)														/		

Answer	better documentation	BIM	Communicate	Responsible	Teamwork	Education & training	PMC	Coordinate	Open and transparent	standard language	communication platform	regular meeting/ communicate	follow up	face to face meeting	site visit	team building
The English language										/						
The team member must be cooperative					/											
Through direct communication and always have schedule/meeting to update team on progress												/		/		
through discussion and meeting. Everyone should be in hand to solve any problem at site. No problem cannot be solved through discussion between all stakeholders												/				
Through regular meeting/discussion												/				
Through transparent and clear communication									/							
To communicate verbally and in written type.	/													/		
Using other media / tools for effective communication											/					
Weekly discussion and recording each matter in a checklist	/											/				

Table 4. 11 Ways to improve communication problem in construction industry 2

Answer	Frequency	Percentage
Regular meeting/ communicate	31	23%
Communicate	23	17%
Teamwork	13	10%
Communication platform	13	10%
Responsible	11	8%
Coordinate	7	5%
Better documentation	6	4%
Education and training	6	4%
Face to face meeting	6	4%
Standard language	5	4%
Follow up	5	4%
BIM	3	2%
Open and transparent	2	1%
Site visit	2	1%
PMC	1	1%
Team building	1	1%
Total	**135**	**100%**

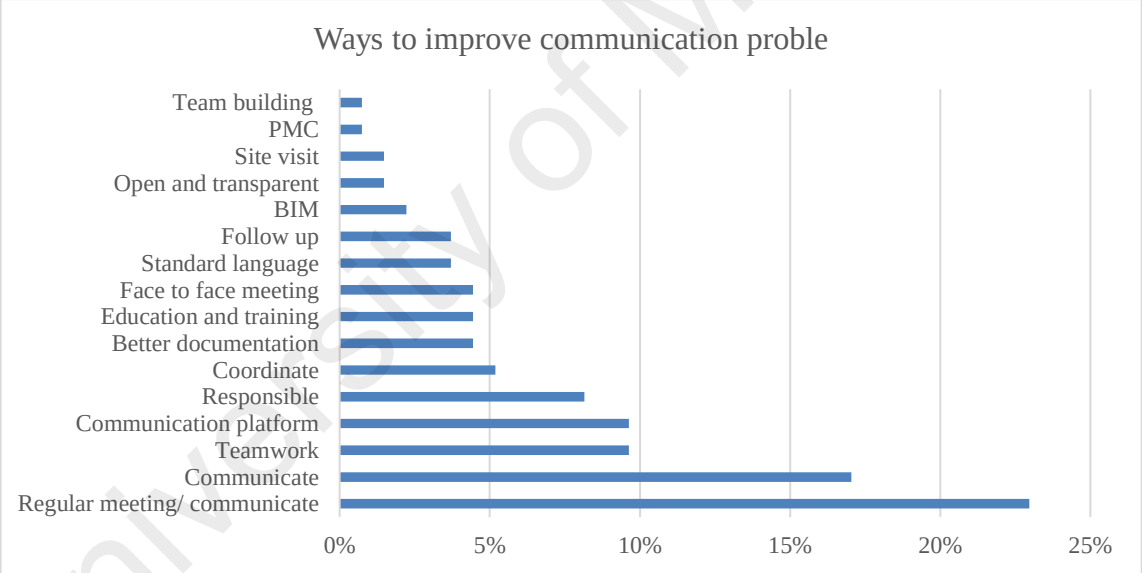


Figure 4. 8 Ways to improve communication problem in construction industry

Most of respondents which is 31 of 135 answers believe that the way to solve communication problem is to have regular meeting and communication. It is followed by to communicate itself as a way to solve communication problem. 13 answers saying that it is important to have a better platform of communication and another 13 answers believe that it is the work of teamwork will prevent from communication problem or breakdown.

4.5 Section C – The Use of *WhatsApp* In Project Construction

For section C, the questionnaire survey is designed to understand what is the current scenario of construction industry in term of usage of *WhatsApp*. In this section, the researcher will know whether *WhatsApp* is broadly used or not, what is it used for and whether or not it is effective as the main communication platform for construction.

The first question asked in this section is "Do you use *WhatsApp* application as medium of communication among all parties involved in construction industry?". Majority of respondents answered yes to the question. Only 3 respondents said they do not use *WhatsApp* as communication medium for work purpose.

Table 4. 12 Usage of Whatsapp as medium of communication

Answer	Frequency	Valid Frequency	Percent	Valid Percent	Cumulative Percent
No	4	3	3%	2%	2%
Yes	140	129	97%	98%	100%
Total	**144**	**132**	**100%**	**100%**	

From there, the questionnaire survey then asks about how many years they have been using *WhatsApp*. This is important so that the respondent will know the context of the question and research. Based on data gotten from the survey, majority of them which are 121 respondents have been using *WhatsApp* for more than 2 years. *WhatsApp* is a simple mobile application that one can master the application in a very short time. Hence, the respondent feedback is good as majority have been using *WhatsApp* for more than 2 years.

Table 4. 13 Years of using Whatsapp as the main communication tool

Answer	Frequency	Valid Frequency	Percent	Valid Percent	Cumulative Percent
I have never used Whatsapp	1	1	1%	1%	1%
1 - 2 years	10	10	7%	8%	8%
More than 2 years	133	121	92%	92%	100%
Total	**144**	**132**	**100%**	**100%**	

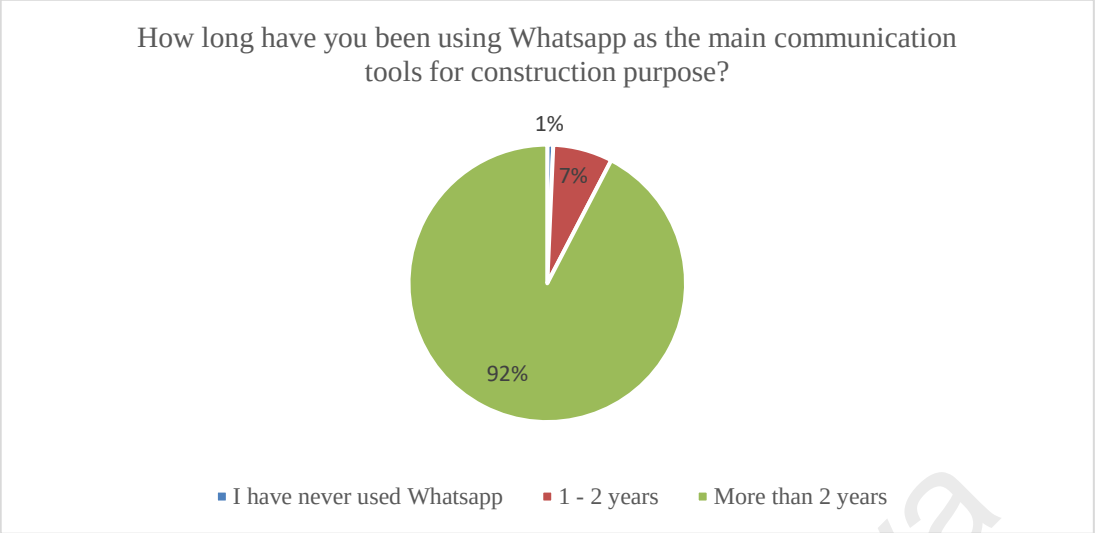


Figure 4. 9 Years of using Whatsapp as the main communication tool

Question number 13 is asking on the usefulness of *WhatsApp*. Majority of the respondents said that the *WhatsApp* application is very useful for them. Only 9 respondents answered that *WhatsApp* is not useful for them. Data collected is tabulated in the table below.

Table 4. 14 Do you think Whatsapp application is very useful?

Answer	Frequency	Valid Frequency	Percent	Valid Percent	Cumulative Percent
No	11	9	8%	7%	7%
Yes	133	123	92%	93%	100%
Total	**144**	**132**	**100%**	**100%**	

The next question in the questionnaire survey is what they use *WhatsApp* for. There are few answers listed and they can select from the answers. The respondents are allowed to answer more than one answer and they can also add their own answer if it is not listed in the answer. The listed answer they can select from are as followings:

i. I have never used WhatsApp
ii. Variation order
iii. Site instruction
iv. Schedule update
v. Initiate inspection
vi. Report inspection results

vii. Reporting QA/QC problems
viii. Employee, material & equipment list
ix. Daily/ weekly/ monthly progress report
x. Material order status
xi. Extension of time
xii. Equipment location
xiii. Letters
xiv. Site meeting minutes
xv. Accident reporting
xvi. Reporting violation
xvii. Contract drawings and specification
xviii. Subcontractor information
xix. Equipment list
xx. Budget & costing
xxi. Visitor's log
xxii. Employee training

From the responds gotten, most of respondents used *WhatsApp* for schedule update. There are 100 answers for schedule update. It is followed by site instruction which is 79 answers and daily/ weekly/ monthly progress report.

Table 4. 15 What is whatsapp used for

Answer	Frequency	Valid Frequency	Percent	Valid Percent	Cumulative Percent
I have never used *WhatsApp*	3	3	0.3%	0.3%	0.3%
Variation order	37	34	3.2%	3.2%	3.5%
Site instruction	87	79	7.6%	7.5%	11.0%
Schedule update	109	100	9.6%	9.5%	20.5%
Initiate inspection	60	58	5.3%	5.5%	26.0%
Report inspection results	74	69	6.5%	6.6%	32.6%
Reporting QA/QC problems	66	61	5.8%	5.8%	38.4%
Employee, material & equipment list	52	47	4.6%	4.5%	42.8%
Daily/ weekly/ monthly progress report	81	75	7.1%	7.1%	50.0%
Material order status	61	56	5.3%	5.3%	55.3%
Extension of time	27	25	2.4%	2.4%	57.6%
Equipment location	39	37	3.4%	3.5%	61.2%
Letters	45	43	3.9%	4.1%	65.2%
Site meeting minutes	56	53	4.9%	5.0%	70.3%

Accident reporting	63	57	5.5%	5.4%	75.7%
Reporting violation	48	45	4.2%	4.3%	80.0%
Contract drawings and specification	46	41	4.0%	3.9%	83.9%
Subcontractor information	56	51	4.9%	4.8%	88.7%
Equipment list	33	29	2.9%	2.8%	91.5%
Budget & costing	34	32	3.0%	3.0%	94.5%
Visitor's log	26	22	2.3%	2.1%	96.6%
Employee training	32	30	2.8%	2.8%	99.4%
To do list	1	1	0.1%	0.1%	99.5%
Transferring image	1	1	0.1%	0.1%	99.6%
Updating Status Location	1	1	0.1%	0.1%	99.7%
Informal communication	1	1	0.1%	0.1%	99.8%
Communication and coordination	2	2	0.2%	0.2%	100.0%
Total	**1141**	**1053**	**100%**	**100%**	

Next, the researcher is trying to understand on the effectiveness of *WhatsApp* group function. It is common for one who uses *WhatsApp* to add few people who have a long discussion regarding one common subject in one *WhatsApp* group. This question is trying to gather information on how many *WhatsApp* group they have to discuss one matter which is one project. The question asked is how many *WhatsApp* group you have for one single construction project. From the respond collected, majority have 4-5 *WhatsApp* group for one project.

Table 4. 16 Number of whatsapp group for one construction project

Answer	Frequency	Valid Frequency	Percent	Valid Percent	Cumulative Percent
I do not have any Whatsapp group for construction project	2	2	1%	2%	2%
1 group	14	12	10%	9%	11%
2-3 groups	65	63	45%	47%	58%
4-5 groups	26	24	18%	18%	76%
More than 5 groups	37	32	26%	24%	100%
Total	**144**	**133**	**100%**	**100%**	

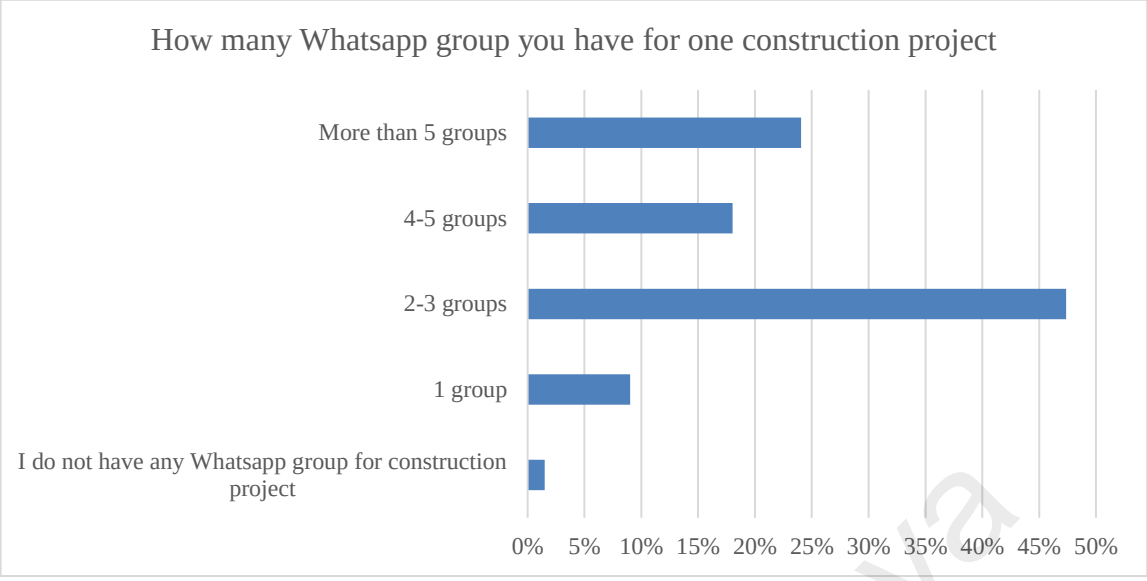


Figure 4. 10 Number of whatsapp group for one construction project

Apart from having too many *WhatsApp* group, it is very common for one to have another group excluding certain party or parties to improve discussion effectiveness. This question is asked to the respondents. The result turns out that majority of them are having separate group excluding certain parties to improve discussion. From total 132 respondents, 114 respondents have another group excluding certain people or party for better discussion efficiency.

Table 4. 17 Do you usually have another Whatsapp group excluding certain party for better discussion

Answer	Frequency	Valid Frequency	Percent	Valid Percent	Cumulative Percent
No	22	18	15%	14%	14%
Yes	122	114	85%	86%	100%
Total	**144**	**132**	**100%**	**100%**	

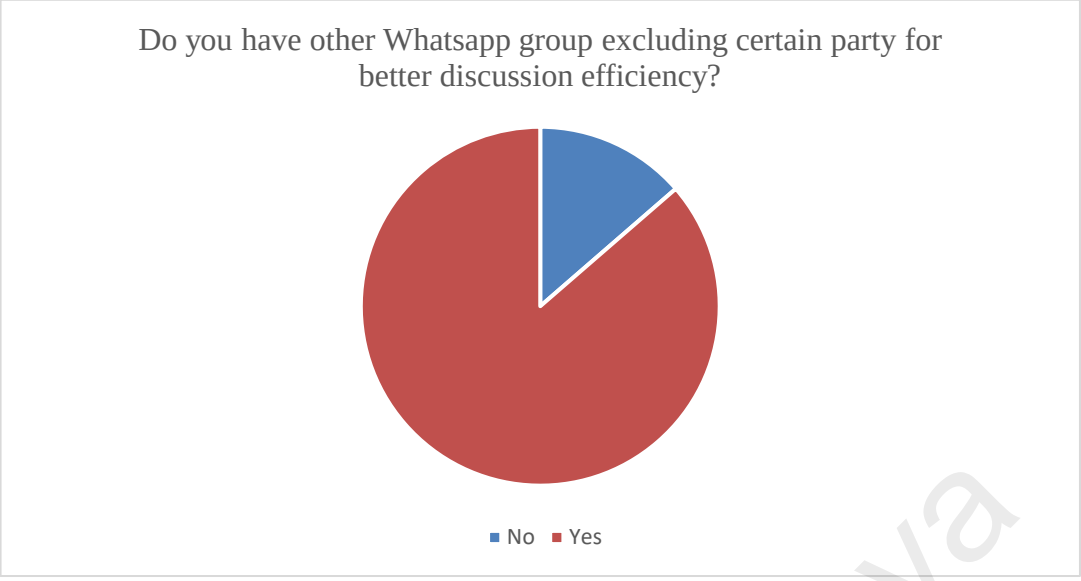


Figure 4. 11 Do you usually have another Whatsapp group excluding certain party for better discussion

Due to too many *WhatsApp* group and chats that come in daily, one must have one way to make sure they are updated and read all important messages without miss. Therefore, respondents are asked on their method to keep track of all the messages. Majority of them (28%) save or file important notes at desktop. This is one of the good features of *WhatsApp* where the application can be opened from desktop. Hence, it is easy to save any file sent via *WhatsApp*. It also become a medium of file transfer. It is much faster compared to email. 24% of them or 72 respondents star all important message so that it can be easily accessed. 58 answers that they need to spend some time at the end of working days to browse through the text one by one to ensure they did not miss any messages. The full answers can be seen in the table below.

Table 4. 18 How do you keep track will all the messages/ info/ instruction in Whatsapp

Answer	Frequency	Valid Frequency	Percent	Valid Percent	Cumulative Percent
Save/ file all important notes at desktop/ laptop	94	86	28%	28%	52%
Star all important messages	81	72	24%	24%	24%
Spend some times in a day to browse through all massages so that none is missed	61	58	18%	19%	71%

Jot down some notes from *Whatsapp* on a physical note pad	60	56	18%	18%	89%
I usually missed a lot of info from *Whatsapp*	30	23	9%	8%	97%
Create one group consist of myself only	1	1	0%	0%	97%
Print Screen and shared with colleagues	1	1	0%	0%	98%
read only important message. follow up with *whatsapp* call	1	1	0%	0%	98%
Prevent talking unrelated matters in *whatsapp*, just order	1	1	0%	0%	98%
Print screen and attached with any instruction form related	2	1	1%	0%	99%
WhatsApp instruction must be followed up with written instructions	1	1	0%	0%	99%
Immediately take action for information / tasks that easy or require less time to complete	1	1	0%	0%	99%
Minutes	1	1	0%	0%	100%
Resend the file and print hard copy	1	1	0%	0%	100%
Total	**336**	**304**	**100%**	**100%**	

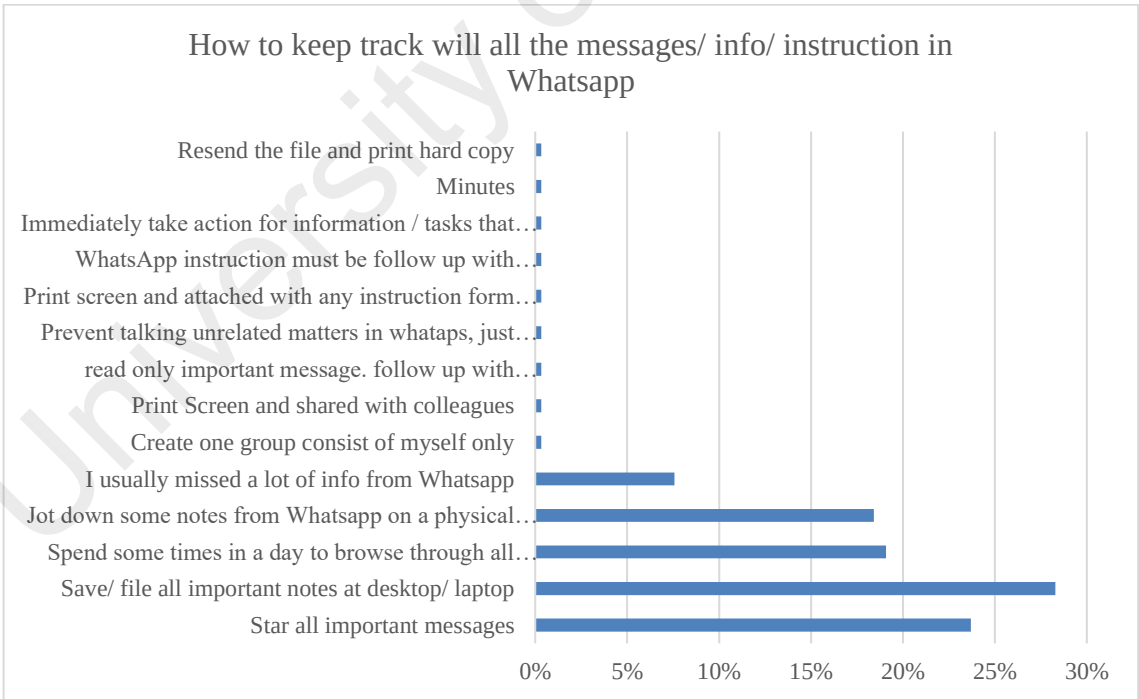


Figure 4. 12 How do you keep track will all the messages/ info/ instruction in Whatsapp

After that, the researcher is trying to proof that communication through *WhatsApp* can sometime be ineffective by asking the respondents if they or others in the *WhatsApp* group

had ever missed any important messages such as missing any instruction or meeting invitation. From all 132 answers, 112 answered that they have missed information or they have witness other parties in the *WhatsApp* group missed important information.

Table 4. 19 Have you or other parties missed information from the Whatsaoo group chat due to too many chats/ replies?

Answer	Frequency	Valid Frequency	Percent	Valid Percent	Cumulative Percent
No	21	20	15%	15%	15%
Yes	123	112	85%	85%	100%
Total	**144**	**132**	**100%**	**100%**	

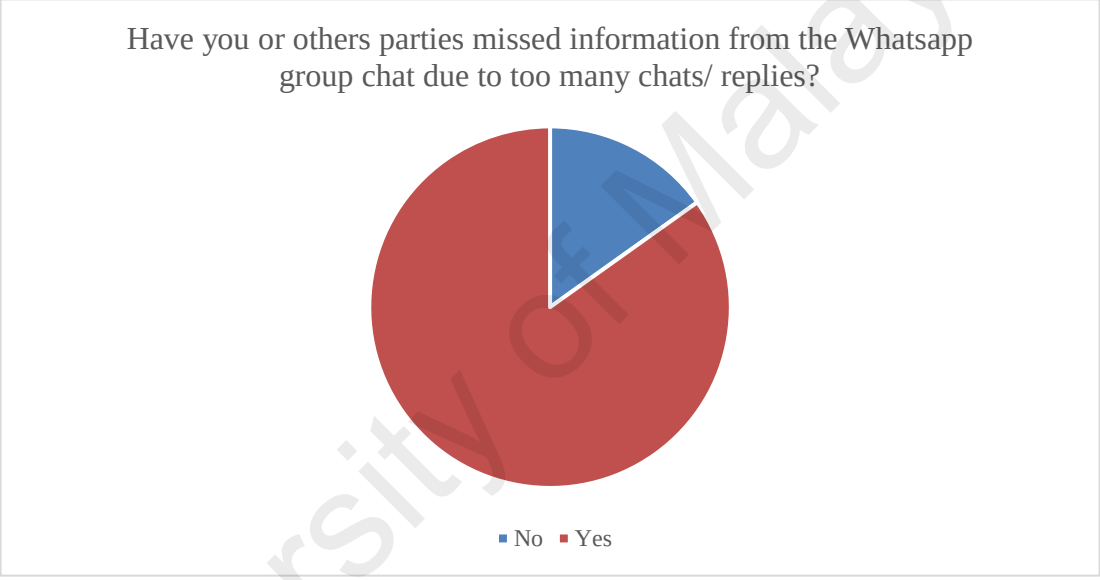


Figure 4. 13 Have you or other parties missed information from the Whatsapp group chat due to too many chats/ replies?

The subsequent question is asking the respondents on what are the other mobile application from *WhatsApp* that they used. The reason this question is asked is that we can gather what are the advantages of other mobile application compared to *WhatsApp*. This can be used as a guide to answer the research question on what can be improve or what feature can be added to the application.

However, what impress the researcher is majority of the respondent do not used other mobile application for communication apart from WhatsApp. This shows that WhatsApp is considered as well established, user friendly and convenient to the user. Most of the

respondents uses telegram which is 37 of them. This is followed by WeChat, email, Autodesk mobile, Snagr, Zoom, Plan Grid, Skype, CAD Pockets, Slack, Asana, Facebook, Trello and Google meet.

Table 4. 20 Other mobile application used besides from Whatsapp

Answer	Frequency	Valid Frequency	Percent	Valid Percent	Cumulative Percent
I have never use other mobile app to communicate	82	76	52%	52%	52%
Telegram	40	37	25%	25%	86%
WeChat	13	12	8%	8%	60%
Email	6	5	4%	3%	94%
Autodesk mobile	4	4	3%	3%	88%
Snagr	2	2	1%	1%	90%
Zoom	2	2	1%	1%	97%
PlanGrid	2	1	1%	1%	90%
Skype	2	1	1%	1%	95%
CAD Pockets	1	1	1%	1%	95%
Slack	1	1	1%	1%	97%
Asana	1	1	1%	1%	98%
Facebook	1	1	1%	1%	99%
Trello	1	1	1%	1%	99%
Google meet	1	1	1%	1%	100%
Total	**159**	**146**	**100%**	**100%**	

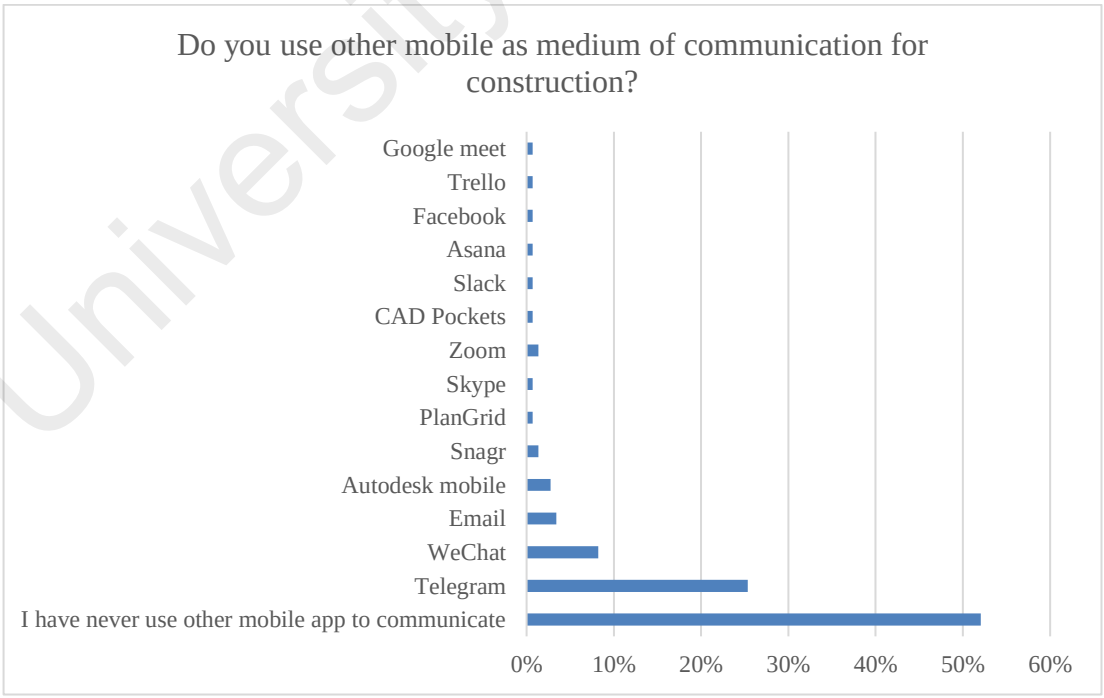


Figure 4. 14 Other mobile application used besides from Whatsapp

From other mobile application respondents used, they are asked what are the advantages of the application from compared to *WhatsApp*. The answer is gathered and tabulated in table below. It can be seen that most of them uses other mobile application to communicate because of its ability to send bigger file size and resulting to better image or file quality. As compared to WhatsApp, there is limitation of file size to be send. Images send through WhatsApp is also compressed to reduce the size. So, the quality of image is compromised.

Table 4. 21 What are the advantages of other application you used compared to Whatsapp?

Answer	see massages before join chat	higher size transfer/ better quality	mark work done	more member in one group	better document storing/ filing	formality	schedule, tasking and automated responses	internationally available	more feature	share screen	one-way communication
Able to see messages before we join the group	/										
Telegram can transfer high resolution picture and bigger file size.		/									
Assign and mark it as work done			/								
Better resolution of image, more group members can be included in		/		/							
Big data transfer				/							
Can send bigger size of attachment		/									
Can view previous message even before you join the group chat	/										
Clearer picture and can send big documents		/									
Easy traceability of information and activity log, easy grouping of documents as well as reduced scrolling time					/						
Formality						/					

Features like schedule, tasking and automated responses.							/				
High resolution image		/									
Internationally available (WhatsApp is banned in some countries) - log in via email address so it's more formal. Decent video call quality.						/		/			
More features									/		
Official submission through email after conversation by *WhatsApp*							/				
Picture resolution		/									
photo quality and document capacity		/									
Screen share										/	
emails are still preferred for any official communications						/					
Sharing bigger data		/									
Able to browse back previous message before joining group, able to send full size media	/	/									
Telegram and email can send bigger projects files.		/									
telegram can share file in large capacity.		/									
Telegram have a big space to safe your data		/									
The size of member in telegram more than *WhatsApp*.				/							
To get only information and announcement											/
Trello app lets you set dateline to complete certain jobs required and shall notify you once the dateline is near			/				/				
Zoom vid call your colleagues to discuss drawings, cam scanner to scan docs										/	

Apart from the ability to share bigger size file, other mobile application such as telegram allow us to read all chats before we join the group. 3 respondents highlight on this matter. Telegram also allows more members in one chat group compare to *WhatsApp*

that only allows 256 participants. Table below show what are the respondents thought on advantages of other mobile application compared to *WhatsApp*.

Table 4. 22 Advantages of other mobile application compared to Whatsapp

Answer	Frequency	Percentage
Higher Size Transfer/ Better Quality	12	38%
See Massages Before Join Chat	3	9%
More Member in One Group	3	9%
Formality	3	9%
Schedule, Tasking and Automated Responses	3	9%
Mark Work Done	2	6%
Share Screen	2	6%
Better Document Storing/ Filing	1	3%
Internationally Available	1	3%
More Feature	1	3%
One-Way Communication	1	3%
Total	**32**	**100%**

4.6 Section D – Deficient of *WhatsApp* Application & Improvement That Can Be Done to be Used as Communication Tool for Construction Industry

In section D, only two questions are asked. This section mainly focusing on the suggestion from respondents on how to improve WhatsApp so that it can be used as the main communication platform for construction industry. From the questionnaire survey feedback, it can be agreed that WhatsApp is broadly used and has become one of the main communication mediums.

The questionnaire survey then asked respondents on their thought on effectiveness of *WhatsApp* as medium of communication.

Table 4. 23 Thoughts on effectiveness of Whatsapp application for communication in project construction

Answer	Frequency	Valid Frequency	Percent	Valid Percent	Cumulative Percent
No	3	3	2%	2%	2%
Yes	141	129	98%	98%	100%
Total	**144**	**132**	**100%**	**100%**	

From the table above, majority of 129 over 132 respondents agreed that WhatsApp mobile application generally does help in communication in construction industry. There are only 3 respondents disagree to the statement.

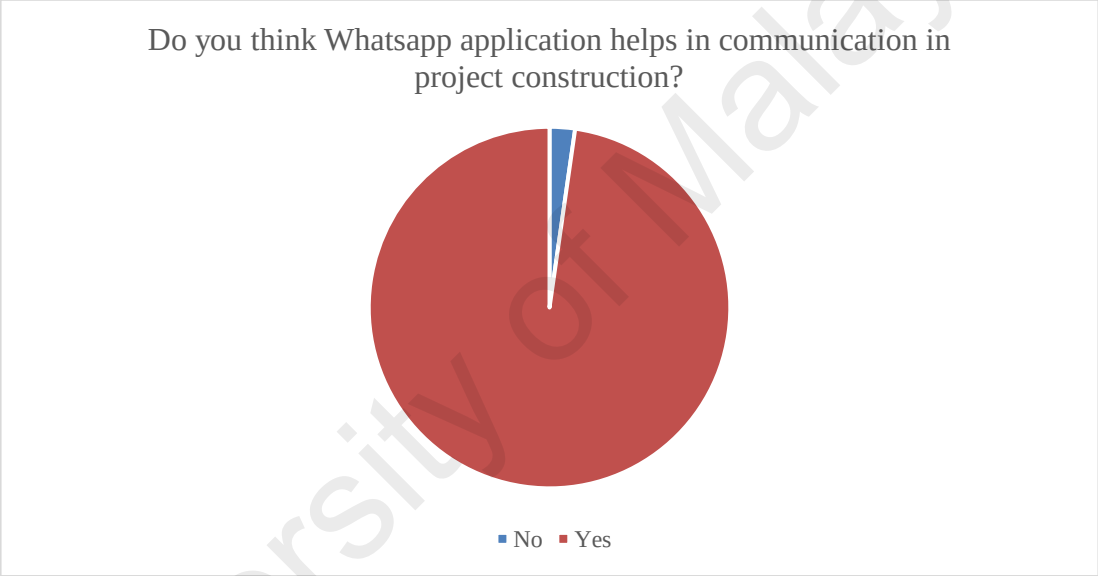


Figure 4. 15 Thoughts on effectiveness of Whatsapp application for communication in project construction

The final question in the questionnaire survey is "What feature do you think can be added to *WhatsApp* to improve it and become a good medium of communication for construction industry?". The respondents are given a multiple-choice question and can select more than one answer to suggest an improvement to the application. They can also type any answer that they think relevant to the questions. Feedback of the survey are tabulated as per table below.

Answer	Frequency	Valid Frequency	Percent	Valid Percent	Cumulative Percent
To have a system for reminder and appointment	121	110	30%	30%	30%
To have better filing system	106	95	27%	26%	56%
Take up less space to store images and video	82	76	21%	21%	77%
Allow video and voice call with more than 8 people	80	75	20%	21%	98%
To have a portal for each project	2	1	1%	0%	98%
Blinking Notification for any Important Messages	1	1	0%	0%	98%
Quality photos and capacity to upload documents	1	1	0%	0%	99%
Document and discussion finder, similar to search feature	1	1	0%	0%	99%
It is not a good medium. minimize the usage.	1	1	0%	0%	99%
Lesser the group chat	1	1	0%	0%	99%
Bigger data transfer	1	1	0%	0%	100%
To keep the function of the platform used simple	1	1	0%	0%	100%
Total	**398**	**364**	**100%**	**100%**	

Most of the respondents answered that *WhatsApp* needs to have a system for reminder and appointment that links to the calendar. This is easy for all parties to call for meeting and ensure they did not miss any meeting or any important dates set in the reminder. Next, most respondents agreed that *WhatsApp* needs a better filing system. This is easy to retrieve any information they require from the group whenever needed. 76 respondents answered that they require the application to take up lesser space to store images in file in the phone. This feature is similar to telegram application where images and files are not saved in the mobile itself. The picture for instance will load every time it is opened.

76 answers from respondents are to allow video call for more than 8 people. This feature is quite new where previously *WhatsApp* only allows 4 persons in one video conference/ call feature.

Some other answers from the respondents can actually be classified in the same group. 1 respondent said that to have a portal for each group. Another one answered that document and discussion finder that is similar to the search feature. This can be classified as the second answer which is to have a better filing system. Other than that, one answers to have better quality photo and capacity to upload document. Another one is bigger data transfer. This can be classified in the third answer which is take up less space to store images and video.

One answer that attract the attention of researcher is "it is not a good medium, minimize the usage". One of the respondents think that *WhatsApp* should be maintain as what it is. The application should be use for personal communication medium and not adopted as means of communication for formal use or work-related use.

4.7 Discussion on Communication Problems That Often Happen in Construction Project

Based on literature review, there are many reasons communication problem can happen at site. Khelifi & Hyari (2016) identified seven reasons of communication problem at construction site. Othman & Hussein (2018) also added in their research 30 causes of poor communication in construction projects. Among the reason of communication problem in construction project that is related to the research are as followings:

i. There is a lot of information that needed to be transferred during the construction phase of projects
ii. The nature of the industry that engage many stakeholders from the owner, consultants, contractors, subcontractors and suppliers which creates gaps in information flow

iii. The separation between site offices and work sites

iv. The need for timely transfer of information as the construction industry is categorised by firm deadlines and costly delays

v. Poor feedback

vi. Unconscious message distortion

vii. Poor coordination

viii. Unclear communication channel

ix. Poor communication platform

x. Deficient support to use communication technologies

These communication problem causes are related with medium of communication used in project construction. The similar data are also gathered through questionnaire survey. Top three communication problem that is faced by correspondents are unresponsiveness between and among project team, loss of information when conveying messages and inability to collaborate effectively among project team.

These can definitely be avoided if there is a strong communication channel used and communication frequency among project team is high. This is also the reason why *WhatsApp* is commonly used by project team. This can be proven via result of the questionnaire survey where most of them believe that *WhatsApp* is an effective medium communication for project construction. Most of them are also using *WhatsApp* to communicate.

Due to its convenience feature and user friendly, the mobile application is fully optimized.

4.8 Discussion on Lacking of *WhatsApp* application as a tool of communication in current construction industry

To further understand on what are the deficient of *WhatsApp*, a comparison needed to be done. This question is asked to the respondents through questionnaire survey in question number 11 to 20. From the data gotten, it can be concluded that *WhatsApp* is a common application and broadly used by everyone not only for personal use but also for work purpose. However, there are still some disadvantage of it. This can be proven in question number 18 where most of the respondents answered that they have missed important text in *WhatsApp* or see someone in the group chat missed important text. This can also infer another conclusion which is *WhatsApp* have cause information overload as it is very convenient to be used. An important text blast on project construction group *WhatsApp* might be taken as a simple text that people can easily missed. One of the reasons is also there are too many groups created for one project. Majority of respondents have at least 2-3 chat groups for one single project. If they have to take care 3 projects, they already have at least 9 *WhatsApp* groups. If *WhatsApp* is only focusing on work matter, this will be much easier. Problem arises when *WhatsApp* is used both for personal and work matters.

From the survey, it also identified that most of respondents use *WhatsApp* only as communication application. It is followed by *telegram* and *WeChat*. Here is comparison of advantages of other application compared to *WhatsApp*.

Table 5. 1 Advantages of Other Mobile Application to Whatsapp

Function	Other Application	Whatsapp function
TELEGRAM		
File transfer limit	1.5 gb	100 mb
No of member in group	200,000 pax	256 pax
Image quality	1.5 gb	16 mb
Read previous text before join group	Yes	No
Video call	No	8 pax
ZOOM		

Share screen	Yes	No
TRELLO & ASANA		
Set dateline and notification	Yes	No
EMAIL		
Formality	Yes	No

Most of respondents still prefers to used email to follow up any important messages on *WhatsApp* as email is a more formal medium.

4.9 Discussion on Strategy to Improve *WhatsApp* Application to Increase Its Effectiveness as Communication Medium Amongst Client-Consultant-Contractor

The data gathered from questionnaire survey can be fully utilized to answer this research question. From the survey, majority of respondents answered that the *WhatsApp* should have a system for reminder and appointment. This is very useful so that project team will not miss any important date or meeting. This function is somewhat similar to google calendar or calendar invite in Microsoft Outlook. For instance, when a meeting is schedule, the invitation will be sent to all members of the *WhatsApp* group and is link to the calendar. The calendar will give notification when the time is about to come.

Secondly is to have better filing system. This align with one of answered keyed in by respondent which is to have portal for each project. This is very useful whenever the document needed to be referred. Everyone in the *WhatsApp* group can easily access the file anytime they want.

Other than that, *WhatsApp* can implement similar system with *telegram* where files or images are not downloaded direct to the phone. So, this will not take up space especially for those who have very limited memory at their personal phone.

75 respondents on the other hand said that *WhatsApp* should allow video conference or video calls to have more than 8 participants. This is because in one site meeting for

instance, more than 8 participants will join from the client representative, consultants, contractors, sub-contractors and other parties that are related to the projects.

4.10 Summary

From the data analysis and discussion, it can be concluded that WhatsApp is a good communication platform not only for social use but also for work purpose and specifically for communication amongst people who work in construction industry. However, there is some improvement needed to be done to the mobile application so that it can enhance the media richness of it.

Data gathered from respondents are referred for that matter and concluded that few features are suggested to be added to the mobile application. The additional feature to the mobile application will be further discussed on the next chapter.

CHAPTER 5: CONCLUSION

5.1 Introduction

This chapter concludes the aim and objectives of the research from the analysis that has been done along with key research findings. In addition, the limitation and constrain that influence the result of the research will be discussed in this chapter. Hence, it will lead to the outline of recommendation for further research.

5.2 Meeting research objective

To recap back, the aim of this thesis is to propose an additional function or criteria in *WhatsApp* mobile application to suit for construction management and communication. To achieve the aim, the following research objective are formulated:

Objective 1: To identify what is the communication problem that often happen in construction project that can be improve by mobile application.

The objective 1 of the research is achieved through literature review. Khelifi & Hyari (2016) identified seven reasons of communication problem at construction site and Othman & Hussein (2018) also added another 30 reasons of communication problems. From the 37 reasons of communication problem, researcher found out that ten matters are related to communication medium or platform or can be solve through it. The ten reasons of communication problems at site that relates to communication platform and medium are:

i. There is a lot of information that needed to be transferred during the construction phase of projects

ii. The nature of the industry that engage many stakeholders from the owner, consultants, contractors, subcontractors and suppliers which creates gaps in information flow
iii. The separation between site offices and work sites
iv. The need for timely transfer of information as the construction industry is categorised by firm deadlines and costly delays
v. Poor feedback
vi. Unconscious message distortion
vii. Poor coordination
viii. Unclear communication channel
ix. Poor communication platform
x. Deficient support to use communication technologies

Therefore, it is very important to establish a good communication platform so that communication can happen smoothly and can be done frequently or whenever necessary. Since *WhatsApp* is already used broadly among client, consultant and contractor, the application needed to be used wisely.

Objective 2: To identify what are the lacking of *WhatsApp* application as a tool of communication in current construction industry

For research objective 2, it is achieved through literature review and questionnaire survey. However, since the *WhatsApp* is considered quite new and the usage in Malaysia is also new, there are less journals and book relating to the subject matter can be found. Therefore, the finding from questionnaire survey are used to achieve the objective.

Most of the respondents are mostly using only *WhatsApp* mobile application. It can be inferred that the application is already well established. It cannot be denied that *WhatsApp* is easy to be used, very convenient and can easily be learn. It is now commonly used by group age of people from young generation to the elder generation. This shows that the application is very easy to be learn or user friendly.

However, the next mobile application to communicate that is used by respondents are telegram. From there, the research objective 2 can be obtained by comparing the application with *WhatsApp*. Table below shows the advantages of disadvantages to the application.

Table 6. 1 Comparison Between Telegram and Whatsapp

Function	**Telegram**	**Whatsapp**
File transfer limit	1.5 GB	100 MB
No of member in group	200,000 pax	256 pax
Image quality	1.5 gb	16 mb
Read previous text before join group	Yes	No
Video call	No	8 pax

From the table above, there are 4 out of 5 advantages of *telegram* compared to *WhatsApp*. Firstly, the limit of file transfer is 1.5gb for telegram and 100mb only for WhatsApp. Telegram limits any chat group to 200,000 numbers and WhatsApp only 256 numbers can join any chat group.

The image size share using telegram is 1.5gb whereas WhatsApp will compress image sent to 16mb. This is one of the main lacking of WhatsApp where any images sent will be compress to a smaller size. Hence, the quality of image will be compromised. This is not helping for construction working environment where communication between construction site and people working at office happens in a very rapid manner. Most of it are sharing images of site and related to any defects or update of construction progress. Through images send from site staff, people at HQ office can identify or notice any defect

or mistake in construction. By having low quality image, this process cannot be happening optimally.

Besides that, telegram also allow the new joiner of one chat room to browse through chat before he/she join the group. So, he/she will not miss the previous conversation or discussion.

However, telegram does not have video call function. Unlike *WhatsApp* where it allows eight people to have video conversation at the same time. Yet, this function is not commonly used for formal use or work-related matter. Nowadays, people are more prone to using zoom application installed to mobile phone or desktop for video conference. Zoom has one feature which is screen sharing. You can share whatever you view on screen with other participants of video conferencing. Other participants can also scribble on the screen you share. This is very useful for a discussion related to design matter where you need to draw or show reference images for design idea.

Though, telegram is yet to become a common communication medium as it is founded later than whatsapp. Whatsapp was launch in May 2009 whereas telegram was created 4 years later in year 2013.

Objective 3: To develop strategy to improve *WhatsApp* mobile application to increase effectiveness of communication amongst client-consultant-contractor

From both literature review and questionnaire survey, research objective number 3 can be achieved. From the questionnaire survey, improvement that can be done to *WhatsApp* are:

i. Link with calendar and reminder so that people are aware of any important dates and meetings

- This function is good so that people can set appointment or important dates like meeting from the application.
- It automatically links to the calendar so reminder will be sent the event date is near

ii. To have a better filing system so that any documents or file can be easily accessed

- This feature is very important as *WhatsApp* user now have to browse messages one by one to fine notes, chats or document that they wanted.
- It is best if the documents or chat can be filed or arrange in a folder as per our own arrangement

iii. To take lesser space/ memory to send file

- *WhatsApp* is now taking so much space from the mobile memory. This is because all the file sent will be stored to the mobile and taking the memory space
- Unlike telegram, the file is not downloaded so any images or documents have to be loaded every time it is opened.

iv. Allow video calls/ conference more than 8 people

v. To have better picture quality

- As explained above, this feature is very important as people who work in construction industry always share images of site progress or reference images.

5.3 Limitations of Research

During the period of this study being conducted, there is a problem faced by researchers, especially in getting feedbacks from respondents. This is due to the recent

pandemic situation that is happening worldwide which is the spreading of corona virus (covid-19). Consequently, it affects the result of the research. Among the problems are:

i. Limitation of the respondents

The respond rate is very low as most of the office is not operation for almost two months full. People are saying at home and some is not checking the email and willing to participate to the research.

ii. Time constraints

Time constraint has affected the result. The researcher has limited time to distribute the questionnaire to the three parties – client, consultant and contractor. It is become the reason that the respondents' rate is low. Thus, a longer period may also help the researcher to conduct this research.

5.4 Recommendation for Future Work

Finally, the researchers would like to recommend a few researchers to:

i. Comparative study on mobile application

It is suggested that a thorough case study is done and comparing the features from the common mobile application used amongst people who work in construction industry.

ii. Pilot test

A pilot test should be done to the suggested added feature in whatsapp. This can identify whether the feature is good and relevant to the user or not.

iii. Case Study

For future research, it is recommended to do a case study focusing on mobile application that is designed for construction purpose such as SnagR

5.5 Closure

This chapter concludes the overall thesis findings by implementing all the research methodologies. The research finding is concluded with a combination of both the opinion from the practitioner in construction industry gathered through questionnaire survey and from the theoretical part which is gathered from literature review.

REFERENCE

Ahmad Pozin, M., Mohd Nawi, M., Othuman Mydin, M., Mehdi Riazi, S., & Imran, A. (2019). An Ability of Whatsapp Usage in Industrialised Building System (IBS) Construction Project. *International Journal of Interactive Mobile Technology*, 188-197.

Alsafouri, S., & Ayer, S. (2017). Review of ICT Implementation for Facilitating Information Flow between Virtual Models and Construction Project Sites. *Automation in Construction*, 176-189.

Alsafouri, S., & Ayer, S. (2018). Review of ICT Implementation for facilitating Information Flow between Virtual Models and Construction Project Sites. *Automation in Construction*, 176-189.

Bajaj, H., & Jindal, R. (2015). Thinking beyond WhatsApp. *2nd International Conference on COmputing for Sustainable Global Development* (pp. 1443-1447). India: !EEE.

Berggren, C., Soderlund, J., & Aderson, C. (2001). Client, Contractor and Consultant: The Consequences of Organizational Fragmentation in Contemporary Project Environment. *Project Management Journal*, 39-48.

Berry, K. (2011). The Ethnographer's Choice: Why Ethnographers do Ethnography. *Cultural STudies - Critical Methodologies*, 165-177.

Blayse, A., & Manley, K. (2004). Key Influences on Construction Innovation. *Construction Innovation*, 143-154.

Blokpoel, S. (2003). Coorperation and product modelling system - The application of Product Modelling System in the Building Process. *Lulea: Lulea University of Technology*.

Charles, J. (2004). *BRE Guidance on Construction Site Communication.*

Chen, Y., & Kamara, J. (2011). A framework for using mobile computing for information management on constrcution site. *Autimation in Construction*, 776-788.

Denzin, & Lincoln. (2011). *The Sage Handbook of Qualitative Research.* USA: Sage Publication.

Gruneberg, L. (1997). *Construction Economics: An Introduction.*

Harstad, E., Laedre, O., Svalestuen, F., & Skhmot, N. (2015). How tablets can improve communication in construction projects. *Proc. 23rd Ann. Conf. of the Int'l. Group for Lean Construction*, (pp. 391-401). Perth, Australia.

Institute, P. M. (2017). *A Guide to the Project Management Body of Knowlede (PMBOK Guide).* Newton Square,Pa: Project Management Institute.

James D, O., Lekan M, A., C. O., O., P, T.-O., Dele, O., Joy, P., & Ignatious, O. (2014). Causes and effect of delays on project construction delivery time. *International journal of education and research*, 197-208.

Khelifi, A., & Hyari, K. (2016). A Mobile Devices Software to Improve Construction Sites Communication "MoSIC". *International Journal of Advance Computer Science and Applications*, 51-58.

Kim, C., Park, T., Lim, H., & Kim, H. (2013). On-site Construction Management Using Moile Computing Technology. *Automation in Construction*, 415-423.

Kumar, R. (1999). *Reserch Methodology - A Step-by-step for beginners.* London: Sage Publications Ltd.

Liu, T., Mathrani, A., & Mbachu, J. (2015). Hunting the Popular Construction Apps. *2016 3rd Asia-Pacific World Congress on Computer Science and Engineering (APWC on CSE), IEEE* (pp. 205-211). Ministry of Business Innovation and Employment.

Mc Shane, S., & Glinow, M. (2018). *Organizational Behavior: Emerging Knowledge. Global Reality, Eight Edition.* New York: McGraw-Hill Education.

Merriam-Webster. (n.d.). Retrieved from https://www.merriam-webster.com/dictionary/communication

Naoum, D. S. (2007). *Dissertation Research and Writing for Construction Students.* United Kingdom: Elsevier.

Nourbakhsh, M., Mohamad Zin, R., Irizarry, J., Zolfagharian, S., & Gheisari, M. (2012). Mobile Application Prototype for On-site Information Management in Construction Industry. *Engineering, Construction and Architectural Management*, 474-494.

Olanrewaju, A., Yeow Tan, S., & Foo Kwan, L. (2017). Roles of communication on performance of the construction sector. *Creative Construction Conference* (pp. 763-770). Primosten, Croatia: Procedia Engineering.

Othman, A., & Hussien, M. (2018). Cause and Impacts of Poor Communication in the Construction. *2nd International Confrence "Sustainable Construction and Project Management - Sustainable Infrastructure and Transportation for Future Cities"*, (pp. 1-11). Aswan - Egypt.

Project Stages. (2018). Retrieved from Imperial College London: http://www.imperial.ac.uk/estates-projects/project-procedures/stages/

R. Y. Shrahily, B. M. (2015). *Communication framework to support more effective onsite construction monitoring.* WIT Press.

Reeves, Kuper, & Hodges. (2008). Qualitative Research Methodologies: Ethnography. *Britsh Medical Journal*, 337.

Sambasivan, M. &. (2007). Causes and effects of delays in Malaysian construction industry. *International Journal of Project Management*, 517-526.

Son, H., Park, Y., Kim, C., & Chou, J.-S. (2012). Toward an Understanding of Construction Professionals Acceptance of Mobile Computing Devices in South Korea: An Extension of the Technology Acceptance Model. *Automation in Construction*, 82-90.

Zerjav, V., & Ceric, A. (2009). Structuring Communication Within Construction Projects: A Communication Breakdown Structure. *Association of Researhers in Construction Management* (pp. 907-916). Nottingham, England: University of Zagreb.