A STUDY OF CAUSES AND EFFECTS OF PROJECT CHANGE IN CONSTRUCTION INDUSTRY

JEE KEE LIH

PB10030

BACHELOR OF PROJECT MANAGEMENT

UNIVERSITY MALAYSIA PAHANG

A STUDY OF CAUSES AND EFFECTS OF PROJECT CHANGE IN CONSTRUCTION INDUSTRY

JEE KEE LIH (PB 10030)

Thesis submitted in fulfillment of the requirements for the award of the Bachelor of Project Management with Honors

Faculty of Technology

UNIVERSITI MALAYSIA PAHANG

DECEMBER 2013

APPROVAL DOCUMENT

UNIVERSITI MALAYSIA PAHANG

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I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the degree of Bachelor of Project Management.

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I hereby declare that the work in this report is my own except for the quotations and summaries which have been duly acknowledged. The report has not been accepted for any degree and is not concurrently submitted for award of other degree.

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DEDICATION

This thesis is dedicated to my parents and friends who support me all the way during my study.

I would like to dedicate this thesis to my supervisors, Mr.Lee Chia Kuang who give me lots of advice and suggestion throughout my study

ACKNOWLEDGEMENTS

I am thankful and would like to express my sincere gratitude to my supervisor Mr .Lee Chia Kuang in providing his germinal ideas, invaluable guidance, continuous encouragement and constant support in succeeding this study. Mr Lee has always impressed me with his professional in whom it relates to this study and his belief that a PHD program is only a start of a life-long learning experience. I appreciate his advices during the time of my study. He advises me that this study's purpose is not only to fulfill the final year project but also for the future use which may relate to my career.

My sincere thanks also go to all my course mates who share their knowledge with me in writing and conducting my study. There are many obstacles I faced during this study, but I manage to keep this on until I manage to finish the study. This is because of the advices given by a precious friend in UMP.

I acknowledge my sincere indebtedness and gratitude to my parents for the love, dream and sacrifice throughout my life. I also acknowledge the time sacrificing by my lover who understands that it is inevitable to make this study possible. It is hard to express out all my appreciation for their devotion, faith and support in my ability to succeed my goals.

ABSTRACT

The problem of project change in construction industry frequent occur and result in cost overrun, project delay, quality defects and other negative impact. In this study, it discusses about the causes and effect of project change in construction industry. The scope of this study is focusing on construction industry in order to examine the causes and effect of project change. The most important causes and effect will be ranking .Besides that, in this research the empirical relationship between causes and effects of project change will also be examined. A questionnaire survey was conducted to find out the causes and effect of project change. The field survey conducted included contractor, consultant and developer. About 45 respondents had participant in this research.

Keywords: causes change, effects change, construction industry, correlation analysis

ABSTRAK

Masalah perubahan projek dalam industri pembinaan kerap berlaku dan mengakibatkan kos terlebih, kelewatan projek, kecacatan kualiti dan impak negatif yang lain. Dalam kajian ini, ia membincangkan tentang punca-punca dan kesan perubahan projek dalam industri pembinaan. Skop kajian ini memberi tumpuan pada industri pembinaan untuk mengkaji punca-punca dan kesan perubahan projek. Punca-punca yang paling penting dan kesan akan kedudukan. Selain itu, dalam kajian ini hubungan empirikal antara sebab-sebab dan kesan perubahan projek juga akan diperiksa. Satu tinjauan soal selidik telah dijalankan untuk mengetahui punca-punca dan kesan perubahan projek. Kaji selidik yang dijalankan bidang termasuk kontraktor, perunding dan pemaju. Kira-kira 45 orang terlibat dalam kajian ini.

Kata Kunci: punca perubahan projek, kesan perubahan, industry pembinaan, hubungan empirikal

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

This chapter provides overview and it extends to explain the phenomena of the dissertation. The problem background and problem statement of causes and effect of project change in construction industry will be carry out in this chapter. Besides that, research objective, research question ,scope of study, hypothesis, significance of study and the last part of chapter 1,expected result will be also propose in this chapter.

1.2 BACKGROUND OF STUDY

Construction industry is one of the sectors that play essential role in the Malaysia's economic. According to Malaysia Economic Report (2012), the construction industry contributes 3.3 % gross domestic product (GDP) in year 2012.The Construction sector has the high influences and ability to affect the development of country. In addition, construction industry will help to create wealth and improve the quality life of Malaysian. Thus, it is important to sustain deliver successful construction projects in Malaysia.

However, construction industry involves a complex processes; it is not an easy things to deliver a project within time and cost. There is various uncertainty and challenges in managing a project due to the construction vary in size, duration and complexity. Project changes are the vital challenges faced in construction project environment (Charkhakan and Heravi, 2012). Construction projects usually take a long duration, involve complex relationship between stakeholders and might have appeared

many uncertainties. In construction, change can be defined as any addition, subtraction or adjustment to the scope and goal of project, whether increase or decrease the project schedule (Ibbs, 1994).

There are many types of changes can be found in construction project. The common changes are change in scope of project, change in schedule and cost, technological change and design change. There are many reasons why the changes occur in project. The changes in scope due to owner requirement are the main causes of project change (Ibn-Homaid et al., 2011). Besides that, that planning and design change is also the major factors usually appear in project change (Hsieh et al., 2004). Furthermore, the causes of the project change also maybe consultant's poor knowledge in available materials and equipment, defective workmanship, unavailability of equipment and so on. These changes are always resulting in several consequences. These changes in construction project often impact in time delays, cost overruns, poor quality and other negative impact (Sun and Meng, 2009). Besides cost and schedule impact, project change may also bring negative impact to labor productivity and decrease the quality of project.

This unwanted situation can be minimizing, if the factor of the project change are consistency analyzed and understand (Hsieh et al., 2004). Hence, project management team play important role to determine the causes and effect of change in order to minimize the adverse impact to project.

1.3 PROBLEM STATEMENT

Many construction projects are suffering in delay, quality and cost overrun problem. While project change is one of the essential causes lead to those project problems occurs. In construction project involves complex processes which have probability to change (Ijola and Iyagba, 2012). Once the project had bid, the tendency of changes occurs in project will be high and likely. In addition, the changes usually might occur in each phase of the construction project .This is because, project involves various uncertainties and some is unforeseen conditions and unexpected situation. In addition, changes have a dynamic and complex process thus it makes difficulties in assessment,

which require accurate identification method to analyze it. During construction process, emerge of changes might have obviously and unexpected impact on its organization and management. Changes during construction will particular impact on cost and time consuming problem. According to Kadir et al. (2005), in Malaysia, project changes made by consultants was ranked the third factor causing low labor productivity .The changes might occur due to design error during planning stage. For instance, changes in design are time consuming and affect the workers motivation. The design error has significantly impact to the low labor productivity problem. Besides in Malaysia, other country also had faced the negative impacts due to project change occur. According to Haseeb et al. (2001), change in government rule and change in design are one of the main causes project delay. Thus, project change issues have attracted a lot researcher to find out the causes of the project change. This is because project changes have bring various negative impacts to project success. By the way, there are many parties whose will directly and indirectly affect the project. Hence, the causes of project change can be categorized into contractor related, consultant related, developer related factor and other related.

The earlier the changes are being recognized, the lesser negative effect it will have toward the project (Hwang and Low, 2012). The project changes problem can be reducing if recognize the possible changes will occur in early stage. Thus project management need to have ability to respond and recognize change effectively so that can reduce the impact of change. However, there is not a simple job; there was a big challenge for researches to gain understanding in project changes especially the causes and effect of project change (Sun and Meng, 2009). This is because the vary size and complexity of the project so it contribute a big challenges for researcher. In addition, the project duration may be long and there will be lot of uncertainty and changes might be appearing in each phase of project. Besides that, there is also a serious lack of understanding about the impact of changes (Thomas and Napolitan, 1995). Therefore in this study, there is needed to understand the causes and the effect of the project change, so that can further find out and understanding the project changes issues. Besides that, it is also needed to study the relationship between the causes and effect of project change. With having information of causes and effect of the project change, the project team

may able to develop a change management process to managing the project change issues.

1.4 RESEARCH OBJECTIVES

i. To identify the causes of project change in construction industry.
ii. To find out the effects of project change in construction industry.
iii. To examine the relationship between the causes and effects of the project change.

1.5 RESEARCH QUESTIONS

i. What are the causes of project change in construction industry?
ii. What are the effects of project change in construction industry?
iii. What is the relationship between causes and effects of project change?

1.6 SCOPE OF STUDY

The scope of study is to find out the causes and effect of project change in construction industry. So, in this study will be focus on construction area and will be conducted in Pahang state. The survey method will be carrying out to collect data. The survey will carried out in Pahang state areas and will emphasize on professional in construction industry, which included contractor, developer, and consultant. This group of population is chosen because the information that we collected will be more reliable and qualify due to their experience, high knowledgeable and skillful of them.

1.7 SIGNIFICANCE OF STUDY

The most significance of this study is to identify the causes and effect of project change in construction industry. The result of the study can be as a guideline in construction industry. Besides that, a good understanding on the causes and effect of project change can help to develop an effective change management. This is because, after find out the possible causes and effect of project change, project manager just can

develop strategies to manage the change. In addition, the effectiveness of change management just can lead the project success. Meanwhile the result of the study can also help to minimize the impact of project change and increase the probability success of the project.

1.8 EXPECTED RESULT

The expected of this survey is to find out more causes and effect of project change in construction industry. Besides that, we will also expected can analyses the major causes and major effect of project change based on the information that we collect. Furthermore, we will also expect to determine whether there are strong positive between consultant, contractor and developer in assessing causes and effect of project change. In last, this study will determine also whether there is a relationship between those causes and effect of project change.

1.9 OPERATIONAL DEFINITION

1. Gross Domestic Product (GDP) is use to determination the economic production within a country, how well the country in growth and development.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter will cover what is project change, type of changes in contract, causes and effect of project change and in the last will develop a change management plan to reduce the impact of change.

2.2 WHAT IS PROJECT CHANGE

According to Project Management Body of Knowledge (PMBOK Guide), fifth edition, project can be explain as a temporarily effort undertaken to create a unique product, service, or result. Project are unique, each project are different and have their own characteristic, besides that project is temporary, they have their own started and end date. Mostly, all projects are complex and have their own risk; it is not easy to complete the contract work within time and cost. In Malaysia, 92% of construction projects were delay and only 8% of project can be finish within budget and time of contract (Rahman et al., 2010). In fact, there are many reason affect the project can't complete within time and budget. Project changes are one of the reasons that affect the project delay and cost overrun. A change can be defined as the contract requirement set in original statement which establish at the time bid is different with the statement when the project undergo or start (Oracle, 2009).According to Wu et al. (2005) ,design change which is the main factor cause of project delay and cost overrun. Besides that, change also can be define as addition, deletion or alters the work that was established in the original building plans and specifications (William, 2005). Normally, the differences between contract work will be recognize when the actual construction project have start.

Changes can be arising by the owner, contractor and any stakeholder whose can affect directly or indirectly to project. Changes will almost occur in every project, they might change the quantity of the work and material and ways of construction process (Ibn-Homaid et al., 2011). Apart from that, changes in design, scope, quality or schedule of project also consider as project change. In short, in this paper, the following definition will be used. Any changes either increase, reduce, delete or any adjustment in the work of the project which different from the original agreement is consider as project change.

2.3 TYPES OF PROJECT CHANGE IN CONTRACT

Changes are always occurring in project especially in large projects. Normally, the contract document or agreement will be require or develop in a project and all parties are involve in the agreement. Contract document can be defined as lawful agreements, specifications and plan, or other written data that represent the agreement between the owner and the contractor (Oracle, 2009). The examples of content included in contract are as follow:

- **Type of contract-** what type of contract has been used in this project.
- **Contract requirement** – determine the legal rights and purpose, or the rules by which each party (developer, contractor) must follow.
- **Bill of amount**– a list of materials, equipment labor and their costs that are added in the contract. The bill is helpful in changes and can be evidence in the preparation process of claims
- **Design document**– the drawing or plan of the building design
- **Plan** – set out the requirements of the work. They depict the requirements for materials and workmanship of project ,in drawings, scope time and cost
- **Other documents** – including technical and cost plan

There are many type of project change in construction industry .According to Joseph et al. (2012), he categorized change into three types which are cardinal change, constructive change and directed change. It might sometimes confuse constructive change between and cardinal change (Neamah, 2011).

Directed changes

Directed changes are initiated by owner and are; they understand directed changes will change to contract document. In addition, the changes need to complete through a formal directive issued by the contracting officer. For example the contractor have an order from owner in order to deleting, adjust, adding the work from the contract or change the method of construction work. Besides that, owner requires to change contract duration and revision to material specification also the example of directed changes.

Constructive change

Constructive changes which is opposite from directed changes. Owner does not directed changes but still affect contractor execute extra work which might difference from original contract. Constructive changes might happen due to owner directly or indirectly action and mostly happen are not expected by owner. For example, contractor lack in inspection, failure to provide material information, and owner disturb on the progress of work. Constructive changes are usually solved with using a fair accommodation to the contract cost.

Cardinal change

A cardinal change is a change that contractor need to perform work which different from the work that the parties agreed when the contract was bid and awarded. Cardinal changes usually change the scope in contract. A cardinal change can be said as a change which cannot be solving within the contract by a fair adjustment to the contract cost. The goal of the "cardinal change" is for contractors to correct the situation which directed by the developer to perform work which is not under the scope of the contract. For example of a cardinal change might be an owner’s instruction to remove rock or hazard work found on the project when the contract documents defined no such materials and did not approve for their removal.

2.3.1 The Changes in Contract

Any deletion or modification in contract can be considered as change. There are various changes in contract that can be found in construction work process. For example, change in design, scope of work, technology change and change in cost and scheduled of project (Qi et al., 2008). The explanation of each type changes in contract are as follow:

2.3.1.1 Scope change

Scope can be defined as project's description and its outcome. Besides that, scope also can be further explained as project's requirement, purpose and the deliverable of the project. Any changes in project functionality in any stage can be considered as scope change (Nayya, 1994). There are various factor results in change in scope. Scope change might be initiated by consultant, developer and contractor. For example, the developer want to add extra work or additional requirement in the project might result in scope change. The changes in scope might impact the budget and schedule delay. According to Asaaf and Hejji (2006), change in scope and design is the factor impact project delay. Therefore, effective scope management plan are important to reduce the impact when in scope changes occur. . The scope statement will be developing so that cans all project stakeholder can more understand the project scope and project objectives. The scope statement details the vision of the project. It describes the project purpose, the outcome, and documents that can look overall of what the project is (Helmand, 2009).

2.3.1.2 Schedule change

All project have their own started and completion time and each task or activity have their own duration to complete it. Effective scheduling is the crucial point for project success. Therefore it is require developing a schedule in project to manage activities needed to accomplish, estimating the duration of each activity, and placing them in a logical sequence. Change in schedule can consider as there is difference between the initial contract agreement of the project schedule or time with the current

work situation. Construction project are challenges, there may occur lot of uncertainty affect the project success. Developer require to accelerate or shorten the time of project might cause the project schedule change. The inadequate planning by contractor, poor in site management by contractor, contractor lack of experience are the causes directly affect the project finish time and cause overrun (Sambasivan and Soon, 2007). Besides that, error and omission in design, whether condition, labor and equipment shortage, all have the possible affect the schedule change .Rework is one of the issue affect the project schedule change. This might affect the schedule change which differences with the original contract agreement. According to Al-Dubaisi (2000), design errors and omissions are also other possible causes of changes in construction. Rework not only affects changes in schedule and also will cause large amount of money. Besides this, there are still have many causes will affect changes in schedule. This will be further explaining in part of causes of change.

2.3.1.3 Design change

Changes in design are commonly occurring in construction project. Design change occurs may affect scope of project and in result affect project cost and time (Hindmarch et al., 2010). Therefore, there is important of design changes management to delivery successful construction project (Langroodi and French, 2012). Design change can be classified into three categorize which are as following:

1. Design changes due to improve the design of the project .For example design and construct reviews, technological improve are causes change occur.

2. Design changes cause by developer. Examples are developer require to add or subtract on scope of work so affect the design change.

3. Design changes cause by Engineer or Consultant .Examples are additions of pumps, material that will affect the progress of the project.

2.3.1.4 Technological change

Nowadays, construction industry will drive technological development (Motawa, no date). Therefore technological changing is very common in construction industry. Technologies keep changing in construction industry in order to increase productivity and quality of project. However, sometime inappropriate technologies may cause costly and waste. This is because some technology not suitable for project process or the technology is not enough advances to use for construction project due to select wrong technology by project manager. Therefore careful selecting technologies are important; this is because new technologies are costly and complex.

2.4 CAUSES OF PROJECT CHANGE

2.4.1 Project Internal Factors

There are several parties whose those directly involve in construction project such as consultant, contractor and developer (Charkhakan and Heravi, 2012). In construction project, all these parties are dependencies with each other, if one party faced problem it will affect the progress of the project. The involvement and coordinated between all the parties are the key of the project complete within time and budget. Therefore, it is important to understand how these different parties affect the project change before attempting to minimize the impact (Hwang and Low, 2012).

2.4.1.1 Consultant/design Related Factor

1. Error and omission in design

Design error also can call as design deficiency. An error in design can be defined as the element inconsistence into design which the work doesn't not perform as expected. Whereas omission can be defined as the necessary work does not include in the project scope work. For example, the pipe drainage does not include in project due to omission design.

Often, the incomplete or error in design are mostly will be found in the stage of construction project has start. There are many reasons the error and omission design problem occur. Designer or architecture lack of construction knowledge and experience, inadequate time to create quality document, human fault, lack of coordination between stakeholder and unclear work detail are the factor that contribute to design error . Designer will make wrong estimation in design due to poor in construction knowledge and experience. For a successful project, professional's experience and judgment are needed (Clough and Sears, 1994; O'Brien, 1998). This is because if don't have enough experience they can't able to judge and make right decision efficiency and effectively

.

Besides that, effective communication between various must be build up at planning stage because communication is the crucial factor project success (Soon and Sambasivan, 2007). Poor in communication with stakeholder may cause misunderstand the requirement of client and wrong assumptions on key project aspect. Consequently, defect design will occur after the project start. Design errors can significant impact on project performance, cost and schedule overrun due to rework and accidents (Couto, 2012). Error and omission in design might result the design change. This is because the design plan needs to change, redesign and recalculate due to the error and omission in design. The original requirement in the contract has been modification and change. According to Motawa (2005), errors in design can impacts over the project life cycle. The changes in design might directly impact on rework and work delay. Therefore in order to reduce the impact of design error, the factor affect design error needed to be finding out and reduce it.

2. Consultant's poor in material and equipment knowledge

In the construction industry, there have a lot of materials that may not common use, so if the consultant's poor in materials and equipment knowledge can cause changes during in project phases (Arain and Pheng, no date) .This is because they don't know which equipment and material should be used in which phase or part of project. Furthermore, consultant or designer those who poor in material and equipment knowledge may ineffective using material in construction process and in result need to rework and change the material to meet requirement. Furthermore, it might also affect

the progress of the project and impact on cost and schedule change. Using equipment selection effectively and good in material handling system and facility can increase productivity and reduce project's operation cost (Yaman, 1999). Therefore, it is important to understand and improve the knowledge in handling material so that can utilize the material and equipment effectively.

3. Design Complexity

According to Keane (2010), more complex of the construction design, the higher probability of change will occurs. Some of the developer demand to develop a unique or special design of building, hence they will require designer to draw a unique building plan. However, the complex design is needed unique skill and construction method to complete it; it is not an easy thing to manage a complex construction design. The technology and resources might be change due to the complex design. For example more advance technology might be used to meet some requirement of work. Ineffective manage the complex construction design will adversely affect on the process of the construction activities and result in schedule delay and cost increase.

4. Lack of coordination between contract parties

There are many player involve in construction project which included contractor, consultant, developer and other stakeholder. Clear communication and coordination between contract parties are important to project success. The involvement of the different parties is important in project progress and managing changes. Hence, lack of coordination will impact on the project change. Stakeholder will change the project work due to the insufficient communication and coordination between stakeholders. According to Assaf *et al*. (1995), difficulty in coordination between the parties is one of the factors that contribute to delay. This is because other stakeholder might not clearly how the project going and lack of information from consultant. In a result stakeholder feel dissatisfaction and require changing. Besides that, conflict between stakeholders will occur due to lack of coordination between parties. The inconsistency opinion between parties due to lack of communication will impact on project schedule delay and rework occur. Hence, consultant need to update the information of the project to

stakeholder, so that they understand and clear how the project progress. Meeting, feedback, progress report, conference can improve the coordination among stakeholder

5. Consultant lacked of required data

According to O'Driscoll and Eubanks (1993), it is very important consultant collect sufficient information and data in process of design. This is because consultant doesn't have sufficient data and information might result in misinterpretation and misunderstand the actual requirement of the project. In a result, rework and schedule change will occur due to the lack of required data. The consultant needs clear and reliable data and information so that can produce the plan that meets the requirement of the stakeholder. Besides that, ambiguous in design also the factor of project change. Besides that, the ambiguous design detail will affect in misinterpreted the design or the perception of stakeholder. In the consequence, rework will need due to error in design and leading the project time and cost overrun.

6. Change in design by consultant

The inadequate communication, poor site investigation and design improvement are the factors that impact the design change by consultant (Wu et al., 2005 and Arain *et al*., 2004). The design change usually will impact on cost and project delays due to the rework occur. According to O'Leary (1992), the design change will mess up the progress of work, and also will bring pressure to contractor and owner due to failure in construction process. Inadequate inspection of site before the design period may cause the design drawing is differing from construction place. Besides that, inadequate communication will cause misunderstand the requirement of the stakeholder and result design change to fulfill or meet requirement of stakeholder.

2.4.1.2 Contractor related factors

1. Financial problem by contractor

Contractor's financial difficulties can be defined as the contractors don't have enough cash to carry out a project. This may include difficulties in pay for worker, material, equipment that used in the construction work. There are several reason contractor faced financial problem. According to Ab.Halim et al. (2012) , not enough in modal and low profit of project are the reason that contractor faced financial difficulties. Contractor used low or cheapest price and promise will produce quality product in order to bid a project. However, the underestimate cost and lower profit of the project had cause contractor faced financial difficulties. Besides that, the late payment by developer also the factor cause contractor faced financial difficulties. Construction work need lot money, it is difficult to carry out the work if late payment by developer. In a result, the changes and quality and the progress of project maybe affected due to the financial problem faced by contractor (Keane, 2010). The delay of payment in worker wage will cause the labor strike and affect the progress of the project. Hence, the original schedule might change due to the financial problem faced by contractor.

2. Contractor's desired profitability

Contractor desired to get additional profitability will cause changes occur in project (Sunday, 2010).Contractor wish to bid a project and get large profit return, however there are too many competitor, and it is difficult to bid a project if don't have enough qualification. Cost or price is one of the evaluation factors to select the contractor (Huang, 2011). Hence, contractor will use as possible lower price to win a project and this may cause contractor earn low profit. In this case, contractor will make changes in project work so that can increase the profitability. For example, contractor will negotiate or directly convince owner to make certain change, in order to get additional profitability from change work. This might change the scope of the original plan due to contractor's desired profitability.

3. Differing site condition

Differing site condition will impact on project change (Keane, 2010). A differing site condition is defined as the site condition is differing from expected. For example, the presence of rock, other subsurface obstructions in substantially greater quantities than had been shown in the bid documents. This will require extra effort for excavation and extra compensation to the contractor. In result, the cost will increase and the schedule will change. This is because the additional cost for labor, machine and material due to the extra work.

4. Lack of involvement in design

Contractor lack of involvement in design will cause the project change (Keane, 2010). This is because contractor less attends the meeting and not clearly understands the design and does not have sufficient communication with designer. The drawing might not consistency with the opinion of the contractor; hence the project change will occur. According to Laryea (2010), that project change will impact on organization's profitability. Besides that, project schedule delay and cost increase due to design change due to different opinion form two parties.

5. Contractor lack of judgment and experience

Capability and experience of the contractor is one of the essential criteria for developer to select a contractor (Herbert and Biggart, 1993). This is because contractor lack of judgment and experience cannot make the right decision and manage the project properly. A good contractor should have an enough construction experience which can make decision more accurate and have own perspective. In addition, experience's contractor may have good construction management skill and many histories involve in construction process. They should be able to ensure project go smooth and the team member work systematically. Besides that, inexperience worker might need people lead or guide to work. They have difficulties in work their daily routine work and might easy fail to forecast the potential problems that might occur in construction work. Therefore,

it is quite important to select a qualified contractor (Huang, 2011). So that can guide and lead inexperience worker and make right decision.

6. Contractor poor in site management

Contractor poor in site management was one of the reason project change occur (Sun and Meng, 2009). Contractor poor in managerial skills, lack of experience or unsuitable management structure have adversely impact on project change. This is because mistake or conflict will be occur if the contractor poor in management skill.

7. Lack of communication with other parties

Insufficient communication and coordination between parties may cause the project change issues occur and adversely impact on project rework and demolition (Arain et al.2004). This is because there might be misunderstand and wrong interpretation of information due to lack of communication and insufficient discussion between several parties. Thus, effective communication is important in project team so that can able to deliver right and accurate information.

2.4.1.3 Developer related factors

1. Slow decision making process

A project is complex and taken long time to complete it. During project time, many decisions have to be made and decide swiftly. The failure in making decision effectively may result in delay and cause changes in project due to cost increase (Keane, 2010). Therefore making right and fast decision by developer is the important key of the project success. Project will behind the schedule was due to the slow decision making in project. The decision of the developer might affect the successful delivery of the project. There are many reason why the developer making slow decision making. One of the reasons is the developer lack of required data and information about the project so they can't make the decision and respond it in short time. Besides that, inexperience developer will also affect the decision making (Ghanaian, 2007). This is because they

less involve in project and not understand the project process so not able to make decision effectively and efficiency.

2. Developer's financial problem

Developer financial problem is the causes of project change (Jawad et al., 2009). The construction projects were too expensive for one developer without support from investors. Construction work needed large amount of money and most of the developer difficult to bear with the larger expenses. Developers will late payment to contractor due to financial problem and this might result on work temporary stop and schedule of work delay.

3. Change in specification by developer

According to Elinwa and Joshua (2001), design change is one of the important factors causing project time overrun in Nigeria. The investigate show that more than forty percent respondent agreed that design changes mostly occur because of the developer continue change on project work. This is because developer wants to reduce the project cost or minimize the existing design mistake so they make changes to meet those requirements. The keep changing in specification by developer might affect the quality of building projects. But if these changes are not managed effectively, it will occur design conflict and resulting in more costly design and seriously will affect design construction process defect (Wang and Soh., 2013). Besides that, change in specification by owner might impact on rework and cause project schedule change.

4. Change is scope, schedule or plan by developer

The changes in project might due to the expectation of developer .They require to changing requirement, decreasing budget and demanding on accelerate the project complete time (Sun and Meng 2009). The developer will require change the scope of work; this is because they might want to decrease the cost of the project. They might not able to afford huge amount of money if without any outsider supporter. Besides that, the developer lack involve in project planning stage or not clear how the project is will also

affect they make changes in scope of project. This is because the previous design drawing or construction work may not satisfied by developer.

2.4.2 Input Factors

Input factors included the material, equipment and labor in a project. A good project management in construction should utilize and manage labor, material and equipment effectively. This is because they might affect the project progress and performance.

2.4.2.1 Material and Equipment Related Factors

1. Material shortage

Malaysia is a fast developing country, the demand worker often more than supply (Soon and Sambasivan, 2007). Therefore shortage problem often occur in construction industry. According to Teoh et al. (2009), poor in planning of ordering and delivering material will increase the probability facing material shortage problem. Due to the error estimation in planning stage, the amount of material needed failure to deliver within the time. This is because some of the materials are not available in short time and needed to preorder. This may cause project schedule change due to material shortage problem.

Besides that, poor in communication with supplier will also affect the material shortage problem in site occur. This is because the misunderstanding and wrong information receive by supplier. As a result, amount of the material delivered by the supplier is less than the unit ordered from the supplier. Therefore, Effective communication is important to ensure the project success (Skendrovic, 2010). There are many stakeholders in a project, and hence effective communication is important in order to deliver message or information correctly. The material shortage will impact the project delay and poor quality project. The schedule will be change and differ from original contract due to material shortage problem.

2. Equipment shortage

Shortage of equipments is also major factor that has significant impact on project schedule and cost. Contractor and consultant poor in planning and lack of experience in handling projects might cause the equipment shortage problem .Sometime, contractor manage many project in simultaneous time, the equipment will be switch from one project to other project. This would also affect the availability of equipments on particular project and result in some project equipment shortage. The equipment shortage affect the progress of the work might be postponed.

3. Changes in material types

According to Sun and Meng (2009), the changes in material, equipment, labor and price fluctuations during the project life cycle can have a large negative impact on project. By the way, there are many reason of the material type change. The wrong estimation cost of original material increase or material shortage will also impact on change in material during project life cycle.

4. Delay in material delivery

Delay in material delivery will affect the project delay (Assaf and Hejji, 2006). The lack of communication between project team and supplier have impact the delay in material delivery. Consequently, material late delivery has affected the progress of project and increase time of project complete.

5. Equipment breakdown

According to Sweis et al.(2008), Equipment breakdown often happened in construction industry. This is because does not have regularly check and maintenance. Equipment breakdown will interrupt the progress of work. Besides that, some equipment need hired expertise to repair it; this will lengthen the time of construction work.

2.4.2.2 Labor Related Factors

1. Shortage in worker

According to business and market (2013), Malaysia's economy grows 5.4 % in 2013. The economic growth has cause the strong demand of labor force. The insufficient skill labor available for construction industry had occurred due to several reasons. The poor in pay and benefits, job safety, supervision treat and poor site condition are the reason why the labor shortage occurs. Besides that, the cost of the foreign worker are more cheap also the reason why the skilled worker shortage. According to Chua (2013)， Malaysia has about 1.9 million foreign workers, who are currently working in Malaysia, which many are from Indonesia Bangladesh, Myanmar, Nepal and other Southeast Asian countries. The unskilled worker are cheaper than the skilled worker, therefore they will hired unskilled worker to reduce the construction work budget. However, the foreign workers that lack of knowledge and inexperience have impact on the project quality and progress. In a result changes in project may occur due to skill labor shortage problem. For example, the schedule of project might postpone due to the insufficient of skilled worker.

2. Defective workmanship

Defective workmanship is also recognized as a common cause of project change. It may lead the project rework and increase additional cost (keane, 2010). Even quality of the product is good, but the poor workmanship will cause the project not good as expected or intentionally. Poor workmanship is often the cause of construction defects like roof break, window and doors that leak and size are different, broken floor tiles, and other problems. For example, project will be failed not because the quality or defective of the product, it might be due to defective workmanship. In a result, the reworks occur due to the defective workmanship.

2.4.3 External Factors

1. Weather Condition

Whether condition may affect the progress and performance of the outsider construction project (Joseph, 2005).In Malaysia, every year December is raining season, this might affect project progress delay. This is because during raining season, the site will be wet and employee can't work comfort due to safety consideration. Besides that, raining season will affect the site work such as paving and foundation work. Furthermore, the wet condition will also cause the fibrous and porous products such as wood and carpeting damage due to absorb and hold moisture. As a result, this may cause project schedule change to compromise with the weather condition. Therefore, reliable and accurate forecast in weather condition information are important in construction project (Fugro, 2011). This is because effective prediction in project planning can reduce project delay and provide accurate scheduling of operation and increase the safety of work.

2. Natural disaster

According to Wu et al (2005), natural disaster is one of the factor affect project change. On site work usually carried out in an external environment. Therefore natural disaster such as flooding, earthquake might affect the condition of site. In result, due to the natural disaster, the scheduler or cost of the project will change.

3. Using new technology

Currently, the Malaysian construction industry is focusing on change construction processes from conventional building methods to the Industrialized Building System (IBS). This IBS technology change can increase performance and quality of the project. However, there are many challenges faced in technological change. Emerge of new technology might affect the construction process and methods (Keane, 2001). Some of the worker not willing to change, because they think current situation is good. Besides that, changes process is complicate, worker need to learn new

things and may affect their work process. Therefore they not are willing to adapt change in new technology. The new technology changes have affect the original agreement of the project and the scope of work might be alter due to the intro new technology.

4. Change in government rule and regulation

Changes in rule, taxation and change in interest by government might influence the contractor's profitability and will also impact the planning and execution of project (Love et al., 2012). For example the machine and material used in construction project might follow the environment policy set by government in order to avoid produce pollution when constructions carry on. Besides that, developer need to submit a change's project plan to governance department for approve and get permission for the construction work This will consequence of project schedule slow and costly.

5. Change in economic condition

Changes in economic condition might include changing in interest rate, exchange rate and inflation. All of these changes in economic can impact on cost of material and wages of worker increase (Love et al., 2012). Meanwhile, economic condition is significantly affecting the construction industry. Hence, the demand of the material increase might lead the shortage problem and the cost will arise. The increase in cost of material also will directly impact on the cash flow of project.

2.5 EFFECTS OF RPOJECT CHANGE

2.5.1 Cost Related Effects

Cost overrun is a situation where the amount of money used is greater than the initial project cost or estimated cost .Project change might impact on increase in project cost, increase in overhead expenses, material waste, additional payment for contractor and loss of earning (Hwang and low, 2011; Naif et al., 2011; Arain and Pheng, 2005 and Sun and Meng, 2008). The additional requirement, the changes in scope and schedule by developer may impact the project cost increase. According to Swies (2008),

the average cost of change orders on construction, as a percentage of the original project budget, is 5-10%. This is because the additional resources such as material, labor, and equipment are needed to deal with the impact of change. Some of developer wants to accelerate the work in order to prevent the project delay, this might increase the budget. The resource might be added to accelerate the work process so that project can finish within time. For example, the rental fees, fees for employee overtime and hired more employee might increase the work cost and increase the budget of the project. This has altered the original contract requirement; the cost has been increasing which different from original plan.

Besides that, the changes in project will cause material waste problem occur. This is because the material that plan to be use before project start will change due to the requirement, work or plan of project change. For example, owner change the scope of project, he require deleting some of the work of project after construction have going. This might cause the material waste because the works have change, the requirement of material may change to fulfill the new work task. This will increase the cost of project to purchase new material.

Furthermore, additional cash for contractor are top five effect of project change (Jawad et al., 2009). Cost will increase due to additional payment for contractor. Contractors usually will ask for more money to carrying out the required change. This is because the additional work will require, so the cost carry out the project will increase. This budget is difference from the original agreement; therefore, contractor will acquire increase the budget of work.

2.5.2 Time related Effects

Project change usually will impact on project time overrun problem. According to Sunday (2010); Ijola and Iyagba(2012) and Arain and Pheng (2005), time overrun, delay in payment ,delay in procurement process, delay in completion schedule and interruption of continues works are result from project change. Delay in payment might happen due to the time economic crisis and developer face financial difficulties (Nicole, 2008 and Ayudhya, 2012). Developer faces financial difficulties and don’t have cash to

pay for worker, so they will try to postponement the project so that can delay the payment for contractor. This might directly impact on project schedule delay. Time of project complete will extend due to developer face financial difficulties .Besides that, project change due to contractor problem may also cause the delay in payment by developer. Project changes result in late of achievement milestone. Contractor lack in involve in design stage, poor in managerial skill and lack of judgment and knowledge will cause extra work require and affect the original schedule of project. Hence, the contractor will receive the payment late from the developer due to late of achieve milestone. The contractor will only receive the money if milestone of work have been complete or when a new work or task in project start.

Furthermore project change will affect the delay in procurement process and directly affect the project completion date delay. According to Swies et al (2008), change order ranked as second most important factor for project delay. The new material and equipment will required due to project change. However, some of the material may not available from vendor in short time and require extra time to order stock. In result work maybe hold on due to insufficient or late material delivery. For example, the designer or developer require changing different type of roof which differ from original plan due to quality problem, this will cause extra time needed to order new material. The material might not available or shortage in short time, hence, the project will delay due to procurement late.

2.5.3 Time and Cost Related Effects

Rework and demolition is one of the effects that will occur in project change (Arain and Phang, 2005). A rework can arise due to change in scope, quality of the deliverables not up to the mark and change in requirements that is essentially a change in scope. The defect in design, differ site condition, error in quantity estimation may also cause the rework occur. Thus, design and construction errors in projects can lead to serious concerns as the resulting rework and wastages will affect project performance and productivity aspects (Palanesswaran et al., 2007). Any change in scope affects not only the schedule but the cost as well. So, a proper scope change mechanism would take into account the effect to the schedule as well as the costs associated in carrying out the

same. The rework has to be fit into the existing schedule as the project charter specifies timely delivery and hence any change to the schedule would involve changes to the cost of the project. Rework cause the cost overrun and project delay. This is because extra works are needed due to the defect in design and other several reasons. The extra material, labor and equipment are needed to finish up the extra work. For example, worker needs to do overtime work and new material will be procured because of extra work. All of these will not only incur on cost increase, it will also impact on schedule delay.

Besides that, hiring new professional may occur due to project change (keane, 2010). In this technology globalization, technologies are powerful and have the potential to increase the productivity of the production task. However, it is not easy to implement technology change in construction process stage. Technology change will cause the construction process or method change and need hired special skilled technician or professional to manage the new machine or technology product. In addition, some of the worker not familiar with the new technology so needed to attend training classes. The company will hired professional to teaching them use the machine. This might impact on project time and cost increase. The hiring fees, changing new technology, time training worker and hired professional, all of these will result in project delay and increase the budget of project.

2.5.4 Productivity Related Effects

Change may cause the low morale of the project team and this will directly impact on project performance. The overtime work could lead worker low in morale and decrease the productivity of the labor (kadir et al., 2005). Furthermore, the low productivity might impact on project delay or slow in completion task. There is various factor influence the impact of project change on worker productivity. According to Moselhi et al. (2005), time of project duration, intensity (number of changes frequency occur), work type, type of impact, changes in project phase and on site management are the reason productivity degradation.

2.5.5 Quality Related Effects

Quality of work will decrease due to the changes in project. According to Meng et al. (2011), more than 30 % quality defect problem occur in construction project is one of the reason lead the dissatisfaction of the developer. This is because changes in project will impact on extra working occurring and result in cost and time overrun. Meanwhile, if change occurs frequently may affect the quality of work (fisk, 1997). In order to complete the project as fast as possible, the quality of project might be decrease due to cost and time problem.

2.5.6 Other Related Effects

Company reputation is very important, it can be considered as indirect assets of company (Institute of Director, 1999). This is because corporate reputation affects the way in which various stakeholders behave towards an organization, influencing, for example, employee retention, customer satisfaction and customer loyalty. Project change will usually result in claim and disputes and this will affect the reputation of the company (Sun and Meng 2009). This is because the conflict between stakeholders might give a negative image to outsider and damage the firm's reputation. For example, developer and contractor will face conflict problem in contract and may involve in litigation and arbitration. This will affect the image and reputation of company. The project claim might occur due to owner change the schedule, differing site condition, accelerate work and so on. Besides that, developer or contractor faced financial difficulties and cause late payment to the worker, may cause worker dissatisfaction and labor strike. All of these will affect reputation of company's reputation.

Besides that, claim and dispute will occur due to project change. The dispute problem if not solve probably, it might result in arbitration and litigation (Sambasivan and Soon, 2007). This is because the project change will increase the cost of contractor and developer, this might affect the original contract so in result will cause the conflict between two parties. As Arain and Pheng (2005) propose, the strong coordination and communication among professional can reduce the dispute problem. Therefore clear communication and negotiation are important to solve the contract change problem.

Poor safety condition is also the impact of project change (Ibn-Homaid et al., 2011 and Hwang and Low, 2011). The changes in construction method change in equipment and technology will adversely impact on safety and health of worker. According to Health & Safety Executive research report (2003), equipment including machinery or plant brought onto site, was identified as directly involved and deficient in more than half of the accident studies. This is because worker might not very familiar on using the new equipment and construction method. In the construction industry, owners, contractors and designers have the obligation to provide a safe site working environment, and their negligence on safety may cause severe accidents and injuries as well as economic loss (Laufer, 1987).Therefore, additional safety measure and risk management should be implementing to reduce the risk for worker.

Table 2.1 Summary effects of project change

	Effects
Time related effect	Delay in payment Delay in procurement process Delay in completion schedule Interruption of continues work
Cost related effect	Increase in project cost Increase in overhead expenses Material waste Additional payment for contractor
Time and cost related effect	Hiring new professional Rework and demolition
Productivity and quality related effect	Productivity degradation Quality degradation
Other effects	Claim and dispute Low morale of labor Damage to firm's reputation Poor safety condition

2.6 CHANGE MANAGEMENT PROCESS

Project changes have bring various impact toward project. It not only impact on the cost and schedule of the project, it have been also affect the worker productivity (Hanna et al., 1999). Meanwhile, if changes are not solve by using formalized change management process, it may become impact on contract dispute and leading to project failure (Hwang and Low, 2012).Therefore it is important to implement change management system in organization or project to minimize the impact of the project change. The purpose of change management is to identify possible changes that have already occurred, find out solution to minimize impact and execute entire project changes .The change management process introduce by (Ibbs, 2001) are as following:

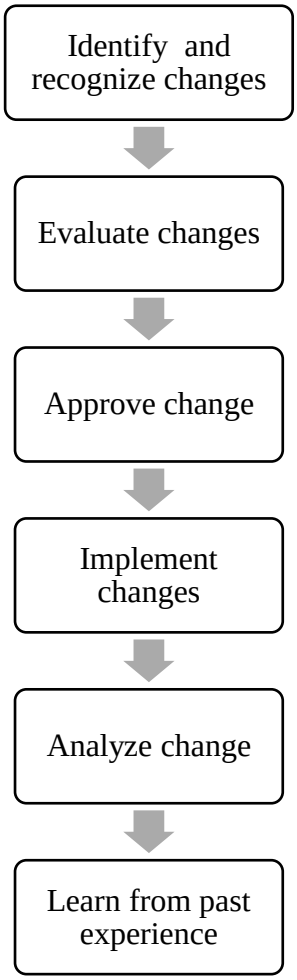

Figure 2.1 Change management process

1. Identify and recognizes the changes

The purpose in this step is, project management team requires determining the changes that will occur or the changes have been already occurring in project. Project management team might use brainstorming, meeting or discussion and review the past information to identify the possible changes. The possible changes can be listed down and project management team will determine which is required or elective. According to Ibbs et al (2001), a required change, such as a variation needed to bring the project design into compliance with a building code, is mandatory and should be reviewed and processed differently than an elective change. Whether it is an elective change or a required change, change itself has effects on the project. These effects can impact cost, schedule, and organization, as reflected in our CMS process model. In the last of this step, the impact of the each change will be identifying.

2. Evaluate and approve changes

Once a potential change is recognize, evaluation needs to be carried out in this step in order to support with the decision-making process. The obligation of this process is to decide either accept or reject the propose change. Project team will prioritize the changes and choose which changes are more acquire to implement. In addition, management team will choose the changes which are necessary and time sensitive. Mostly, the owner often measures the effect of the change by calculating the additional costs and/or time extension required as a result of the change (Joseph et al., 2012). This is because they will like to maximize the profit of the profit of project and minimize the impact of change. After changes have been evaluate and prioritize, there is needed approve by project manager or client. Typically, the contractor and the owner sign the change order as an acknowledgment by both parties that the original contract documents have been modified.

3. Implementation change

Once all parties have reviewed and evaluated the proposed change order, communication between the stakeholders should take place in an attempt to implement

the change. Communication is important in implementation change. According to Victorian Quality Council (2006), a change management process must include an effective communication strategy so that can manage change success. This is because people are generally the most critical resource, supporter, barrier and risk when managing change. Each stakeholder involvement are important in implement change, therefore clear information between stakeholders are important. The schedule of work need to be modifying and the new schedule will be constructing.

4. Analyze change and learn from past experience

Change analysis and system performance is reviewed based on the data collected during the change implementation phase (Qi et al., 2008). Project manager and other parties will analyze the change that have be implementation and the performance of the project. The last stage of the change management process is learning from past experience. The main idea of this principle is to perform root causes and to evaluate the mistakes made so that errors can be systematically corrected. Such analyses should be openly discussed between the team members so that everyone will have a chance to understand the root causes of the changes. The impact of the change might be reduce, avoid and minimize due to past experience

2.7 CORRELATION FRAMEWORK

The relationship between independent variable and dependent variable is summarized into a form of correlation framework which stated below:

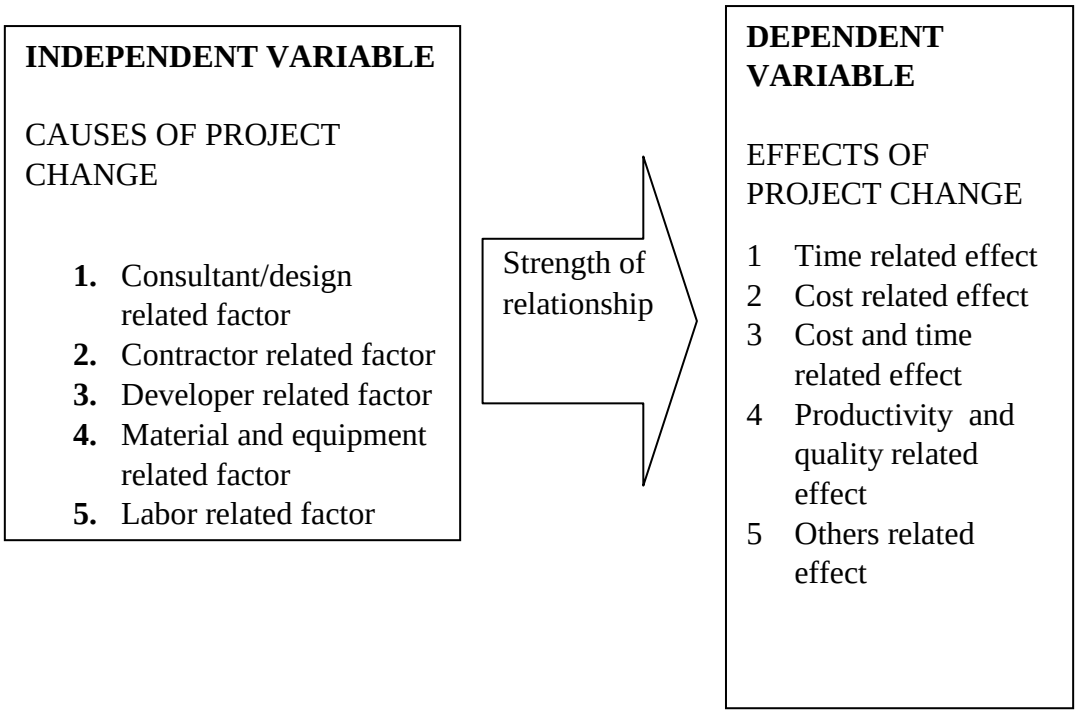

Figure 2.2 Correlation frameworks of causes and effect of project change

Figure 2.2 shows the correlation framework relationship between causes of project change toward the effect of project change. An independent variable is the variable that can be manipulated by researcher to determine its relationship to observed phenomena. Whereas the dependent variable is the variable depend on the independent variable. The independent variable for this study is causes of project change, "what are the factors affect project change?" It will be categorized into six groups as show as above. Whereas, in the dependent variable is to study the effects of project change. "What are the impacts of project change?" The effect of project change will also be group into five categorized which shows at figure 2.2. The relationship between those causes and effect of project will be carry out in this study. For example, does the consultant/design related factor have significant impact on project time? This type of relationship will be finding out in this research.

2.8 CONSLUSION

In conclusion, there are many causes of project change in construction industry. Project change might bring a lot of negative effect or impact to project. For example,

impact on schedule delay, cost increase, decrease productivity of worker and so on. If the consequences is significant serious, then the project might will failure. Therefore, the potential causes of project change should be identifying so that can minimize the impact of the project change. The change management process can be used to reduce or minimize the impact of project change with four step identify change, evaluate and approve change, implementation change and analyze change.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 INTRODUCTION

This chapter covers research methodology which included research design, research method, population and sampling, data collection technique, design of questionnaire and statistical technique.

3.2 RESEARCH DESIGN

At the early stage, the research problem was identifying, where most of the researcher found that the project changes have brought various negative effects to construction industry. After that, the research title also was developing in this stage.

At the second stage, the research objective and research question was being identify and develop. The research objectives had developed after clarifying and identifying the problem. Objectives are precisely indicated what should be research. Research objective in this study are to determine the causes of project changes in construction industry and to find out the effect of project changes in construction industry. Besides that the research question are “What are the causes of project change in construction industry?” and “What are the effects of project change in construction industry?”

At the next stage, literature review was being constructed. What is project change, type of changes in contract, causes and effects of project change and change management modal had included in literature review. In literature part, citation will be

used to support some of the statement. Journal, Articles and other sources had been used to support literature review.

After literature review, the research design and planning sample have been carry out. Research design is a process of creating an empirical test to support or to refute a knowledge claim. The descriptive research will be using in this study which is survey method with questionnaire. The target population for this study are respondent from Kuantan, Pahang area and focus on construction industry which assesses the perception of developer, contractor and consultant. The number of sampling had determined using equation from Kish (1995), after determined the number of population. The questionnaire will be sending out to respondent through e-mail, posting and by personal. The questionnaire will be collecting after certain period.

After collecting data from respondent, the data will be analyzing through using Statistic Package for Social Sciences (SPSS). Such as, the reliability test, normality test, spearman's rank correlation coefficient, Pearson's correlation and ranking analyses will be carrying out. The data of causes and the effects of project change will be ranking base on their categorized in tablet .The final step is the conclusion and recommendation will be carrying out based on overall study. The following Figure 3.1 will be showing the research design process:

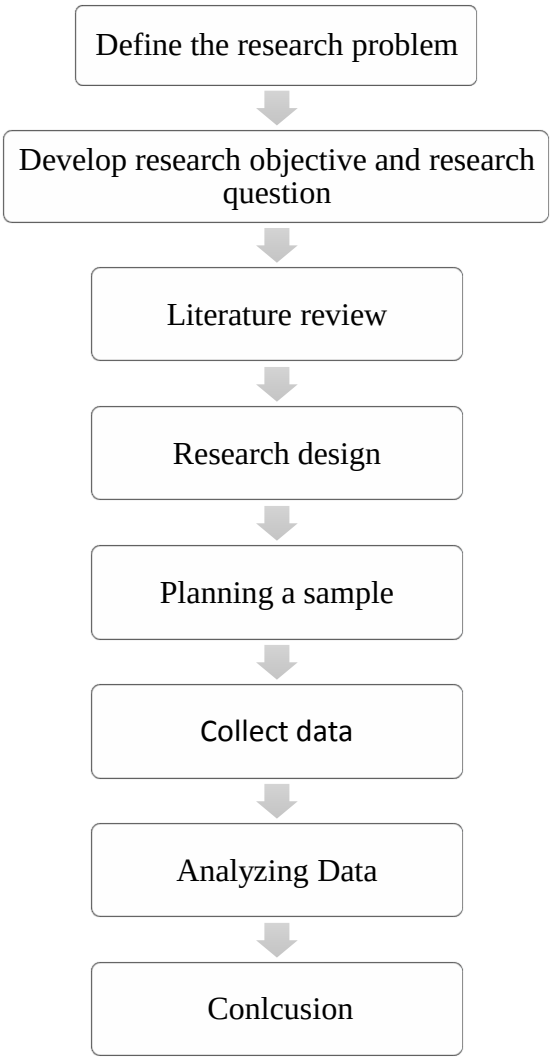

Figure 3.1: Research design process

3.3 RESEARCH METHOD

Descriptive method will be using in this research. There are three main types of descriptive methods which are observational methods, case-study methods and survey methods. In this research, survey method will be using, where respondent will answer those questions through questionnaire. In this study, the causes and effects of project change will be carrying out. According to Nworgu (2006), questionnaire is the most frequently used instrument in educational research, published studies and students projects in education.

3.4 POPULATION AND SAMPLING

According to Sekaran et al (2010), target population is the population of people which researchers are interested to investigate .The population of this research will target on those Construction Company within the state of Kuantan, Pahang which consist of consultant, contractor and developer.

The sampling method used in this study was judgment sample. This sampling method is come under the class of non probability sampling technique. Judgment sample is the data selected based on opinion of one or more expert person. For this research, 134 companies have been identified as population. , which are 45 developer companies, 78 of grade 7 contractor companies and 11 consultants have been identifying as population. The number of population was found from Real Estate and Housing Developer's Association (REDHA), CIDB and board of architecture and quantity surveyor .The size of the sample required from the targeted population was determined statically (Kish, 1995) as below:

$$n = \frac{N}{1 + N(e)^2}$$

Where:

n = size of sample
N = size of Population
e = level of precision

Assume that *N* is 134, while the desired confidence level is 95%, the sample size could be necessary is shown as below:

$$n = \frac{134}{1 + 135(0.05)^2}$$

= 100.

Therefore, there will be about 100 samplings from the population of 134 construction companies. That means 134 questionnaires will be sent out and at least 100 responds should received from the companies. The questionnaire will be answered by the consultant, contractor, developer or project manager in construction industry.

Table 3.1: Sample size for ±1%, ±5% and ±10% Precision Levels where confidence level is 95 % and P= 0.5.

	Error		
Population	**±1%**	**±5%**	**±10%**
100	100	80	50
250	244	154	72
500	477	223	84
1,000	910	286	91
5,000	3,334	371	99
10,000	5,000	385	100
25,000	7,143	394	100
50,000	8,334	397	100
75,000	8,824	398	100
100,000	9,091	399	100
150,000	9,375	399	100
200,000	9,524	400	100
250,000	9,616	400	100
500,000	9,804	400	100
750,000	9,869	400	100
1,000,000	9,901	400	100
5,000,000	9,981	400	100
10,000,000	9,991	400	100
25,000,000	9,997	400	100
50,000,000	9,999	400	100
75,000,000	9,999	400	100
100,000,000	10,000	400	100

3.5 TYPE OF MEASUREMENT SCALE

There are four basic types of measurement scale: ordinal, nominal, ratio and interval. By the way there are only 3 type of measurement scale will be used in this questionnaire.

1. Ordinal scale

- An ordinal scale of used to measure something that can be ranked and order. For example, the causes and effect of project change wan ranking from 1(not important) to 5(extremely important).

2. Nominal scale

- A nominal scale is a set of categories that have no set order, no ranking or hierarchy of values.
- For example gender (male and female)

3. Ratio scale

- The measurement of ratio scale is almost same to the interval scale because it also represents quantity and has equality of units. However, these scales no numbers have below zero which mean have a true zero.

- Measures will represent ratio data (for example, salary, age and weight).

Age: 21-30 years old
31-40 year old
41-50 years old

3.6 DATA COLLECTION TECHNIQUE

This section explains how the data will be collected and what are the methods or techniques are used to collect the data .The data collection used in this study was aim at investigating the causes and effects of project change in construction industry. There are two types of collection data which are primary and secondary data. By the way in our study will utilize primary data collection and survey method together. In this research, the data will be collected through questionnaire. The targeted population will be in kuantan, Pahang area .Questionnaire will be sent to respondent through personally,

mailing or posting. This method frequently used because questionnaire can be able to collect data in more short time with huge respondent. Other data collection technique might more expensive and timely compare with questionnaire for example interview and experimental study .Therefore questionnaire method has been selected used in this research because it's more save time and less cost consuming.

3.7 DEVELOPMENT OF MEASURES: DESIGN OF QUESTIONNAIRE

Data were gathering through questionnaire. This survey questions contain open ended and close ended question. Open ended which use Fill in relevant info and free response whereas close ended question which use scale and multiple choice to answer the questionnaire. This questionnaire was divided into 3 sections.

Section A: Demographic of respondent

Section B: The causes of project change in construction industry

Section C: The effect of project change in construction industry

Section A includes general questions, asking the personal information of respondents such as their name, position, experience, age, gender and type of organization they involve in construction industry. The multiple choice and fill in relevant info will be used to answer the section a question.

Section B includes the list of causes of project change in construction industry. In this section, the importance of those causes in project change will be determined. This section only include ranking question. These causes of project change are classified into 6 groups which are as follow:

1. Consultant/design related factor
2. Contractor related factor
3. Developer related factor,
4. Material and equipment related factor
5. Labor related factor

6. External related factor.

Section C will focus on the effects of the project change in construction industry. This part will determine the importance of those effects in project change. This section will contain open ended and close ended survey question. The five groups of effects of project change have been indentified which included:

1. Time related effect
2. Cost related effect
3. Cost and time related effect
4. Productivity and Quality related effect
5. Others related effect

Besides that, the respondents are request to give their suggestion how to reduce the impact of project change in construction industry through an open-ended question at the end of the section of the questionnaire. . Many researchers prefer to use a Likert-type scale because it's very easy to analyze statistically. (Jackson, 2009).A five point Likert scale will also use in this section B and C questionnaire which is ranging from the not important 1 to most important 5. This was adopted to capture the importance of the causes and effect of project change. The most important causes of project change will be ranked as 5 whereas the most not important causes of project change will ranked as 1.

1. Extremely not important
2. Not important
3. Neutral
4. Important
5. Extremely important

3.8 STATISTICAL TECHNIQUE

After the questionnaires have been collect, the data will analyze by using Statistic Package for Social Sciences (SPSS). SPSS is a computer program which is

wide using for statistical data analysis. Besides, the Microsoft excel will be also using if necessary.

The mean ranking analysis method will be used in this research to determine the importance of the causes and effect of project change. The higher the mean, the more important the causes and effects are. The causes and effect of project change will be rank. These ranking made it possible to cross compare the importance of the items from the perception of three group respondent which are consultant, contractor and developer.

Besides that, spearman's rank correlation coefficient will also carried out on this study. This used for test the strength of relationship (agreement) between the data from different parties which are consultant, contractor and developer. The result of the analysis will be between the value of +1 and -1. If the result is + 1 that mean indicates a positive correlation of ranks while -1 indicates a negative correlation of ranks. A correlation closes to 0 indicates there is no linear relationship between the ranks.

Furthermore, In order to test the relationship between causes and effects of conflict in construction industry, the Pearson Correlation Coefficient Analysis will be used in this research to test the empirical relationship between the categories of causes and effect of project change. There is strong positive correlation between two variables when the r is close to +1, while there is strong negative linear correlation when two variables are close to -1. There is no relationship between the variables when r is close to 0. A correlation less than 0.5 consider as weak and a correlation is described as strong when correlation is greater than 0.8.

Following by this, the normality test will be used to test whether the data is under normal distribution or not. Besides that, for this research, reliability analysis will also be carried out in order to determine the reliability of the questionnaire.

CHAPTER 4

DATA ANALYSIS

4.1 INTRODUCTION

This chapter shows the result of research data analysis by using Statistical Package for the Social Sciences (SPSS) and Microsoft Excel. Descriptive analysis, Reliability analysis, Normality, mean ranking, Pearson Correlation analysis and Spearman's rank correlation were carried out in this chapter. The result of data were presented in table and figure ways, so that more clearly and easy to understand.

In this research, 134 construction companies in Kuantan, Pahang were being identified. Therefore, 134 questionnaires were successfully distributed using email and posting and should be collected back 100 set of questionnaire. However, there are only 48 set of questionnaire were managed to collect back, meanwhile, 86 set of questionnaire did not get return from respondents. Besides that, among 48 respondents, there was 3 set of questionnaire is incomplete. Thus there only 45 set of questionnaire were used for data analysis. Overall, from 134 companies, the respond rate has achieved 33.58%. According to Chatman (2007), the results are adequate and confidence to use when achieves 30% or higher response. The minimum of 30 sample size is acceptable for statistical analysis (Sekaran, 2003). Among the 45 respondents, 16 respondents were from developer companies, 8 respondents were from consultant companies and following is 21 respondents form construction companies.

4.2 DEMOGRAPHIC ANALYSIS

In this study, demographic analysis is to determine the frequency, mean and mode of respondent's age, gender, working experience in construction area, position in company, type of organization and level education of respondent. Besides that, pie chart had been used for clearer reading.

Table 4.1 Demographic analysis of respondent

Items	**Frequency**	**Percentages (%)**
Age (years old)		
i. 21-30	11	24.44
ii. 31-40	15	33.33
iii. 41-50	12	26.67
iv. >51	7	15.56
Gender		
i. Female	16	35.56
ii. Male	29	64.44
Working Experience		
i. 1-5	7	15.6
ii. 6-10	10	22.22
iii. 11-15	13	28.89
iv. 16-20	4	8.89
v. >20	11	24.44

Position in Company		
i. Top Management	5	11.11
ii. Manager	3	6.67
iii. Project Manager	13	28.89
iv. Project Engineer	13	28.89
v. Project Coordinator	2	4.4
vi. Others (Quantity surveyor , Architecture, Executive)	9	20.00
Type of organization		
i. Developer	16	35.56
ii. Consultant	8	17.78
iii. Contractor	21	46.67
iv. Other	0	-
High level of Education		
i. SPM	1	2.22
ii. STPM	4	8.89
iii. Degree	31	68.89
iv. Master	2	4.44
v. PHD	0	-
vi. Others(diploma, advance diploma)	7	15.56

Table 4.2 Statistic Analysis of Demographic Data

Items	Mean	Median	Mode	Standard Deviation
Age	2.33	2.00	2	1.022
Working Experience	3.04	3.00	3	1.397
Position in Company	3.69	4.00	3	1.535
Type of organization	2.11	2.00	3	0.910
Highest level Education	3.22	3.00	3	0.902

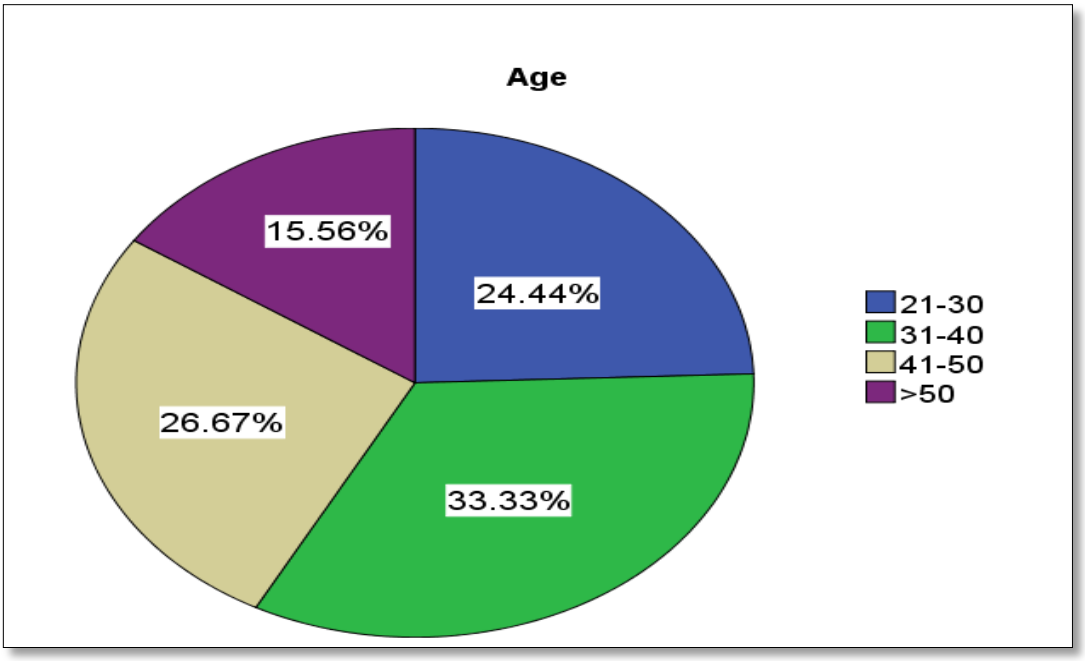

Figure 4.1 Age of respondents

Figure 4.1 shows the percentage of the respondent's age. There are five groups of age respondent which are 21-30, 31-40, 41-50 and more than 50 years old. The age

group of 31-40 years shows the higher percentages which is 33.33% (15 people) whereas group 41-50 years old shows the second higher percentages which is 26.67% (12 people) .Following by theses is group 21-30 years old which is 24.44 % (11 people) and the fourth highest age group is more than 50 years old which is 15.56 %(7 people.) Besides that, from table 4.2 shows the mean, median and mode of the responder's age which is 2.30, 2.00 and 2 respectively.

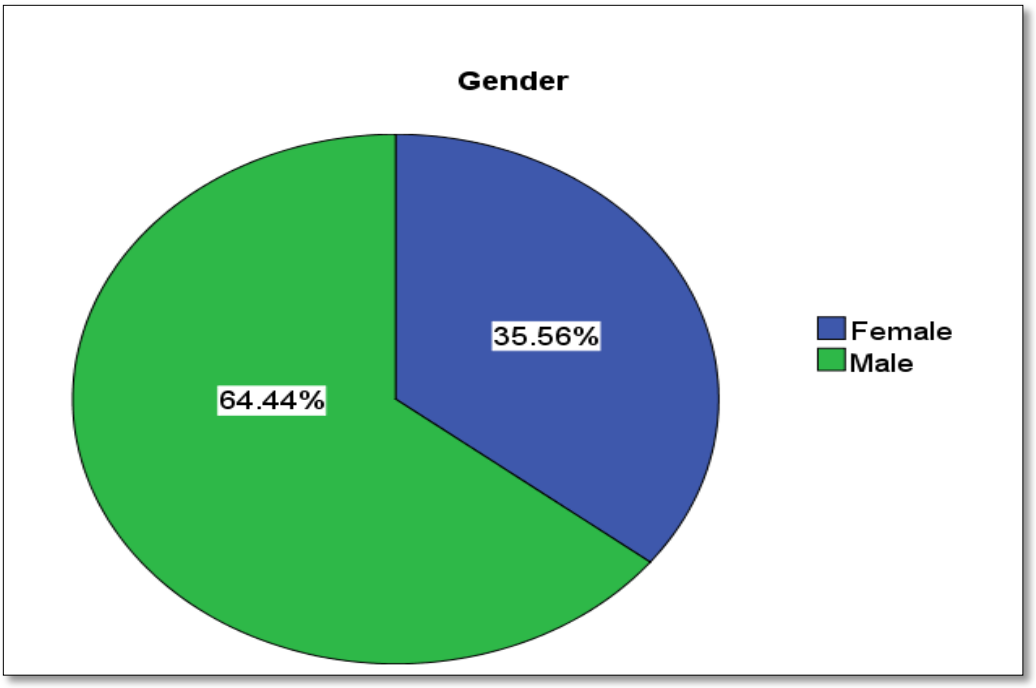

Figure 4.2 Gender of respondents

Figure 4.2 shows the gender's percentage of the 45 respondents who involve in this survey. From the total number, male respondent achieves higher percentage compare with female respondents, which is 64.44 %, (29 people) whereas female respondents were just achieved 35.56 % (16 people).

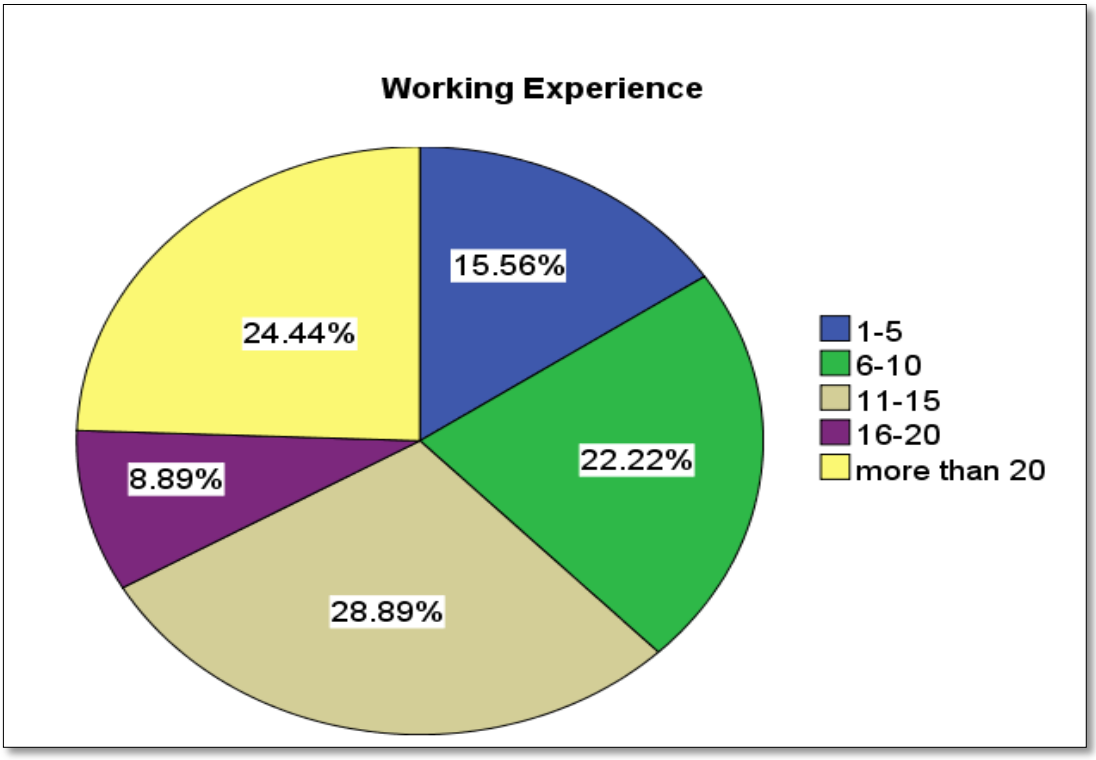

Figure 4.3 Working experience of respondents (years)

Figure 4.3 shows the working experience of the respondents in construction area. Majority of the respondents have 11-15years of experience in this field, which is 28.89%, 13 out of 45 respondents. Following is the second highest percentage is more than 20 years, 24.44%. (11 people) Besides that, the percentage of 6-10 years is 22.22 % (10 people) and 1-5 years is15.56 %(11 people). Working year range among 16-20 shows the lowest respondent which is only 8.89%, (4 people). Based on table 4.2, the mean, median and mode of working experience is 3.04, 3.00 and 3 respectively.

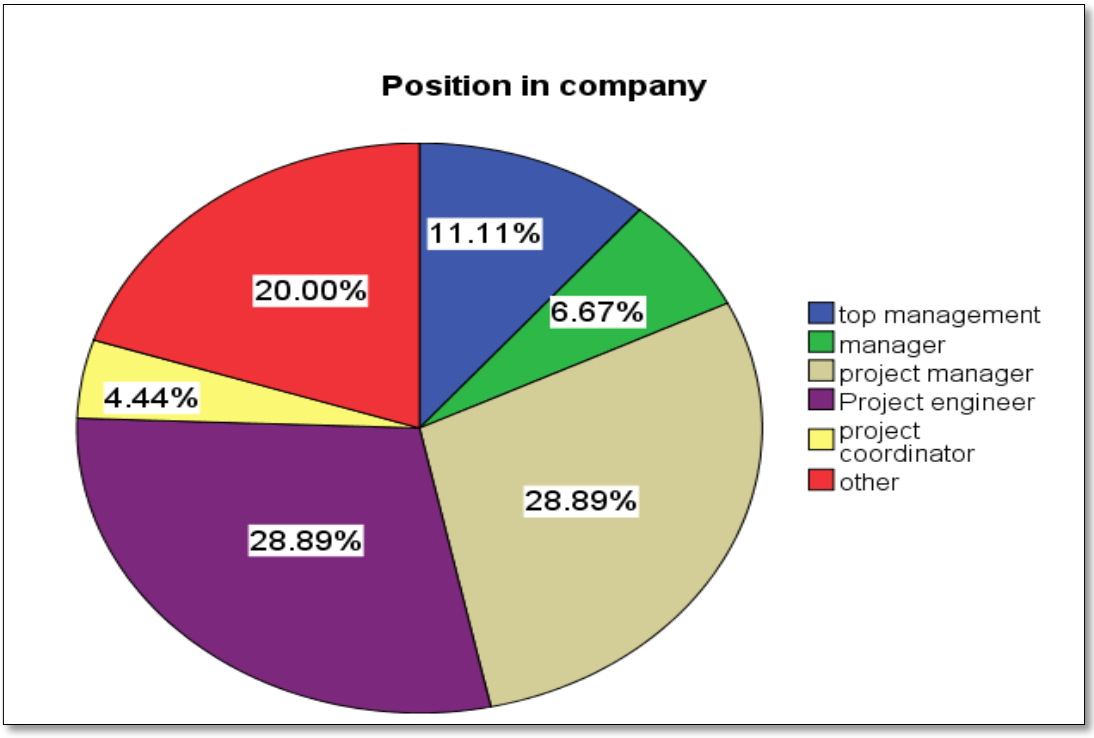

Figure 4.4 Respondent's position in company

Figure 4.4 shows the position of respondent in their companies. According to figure 4.4, the most position holding by respondents are project manager and project engineer. Both of this position has similar number of respondents and achieve highest percentages which are 28.89% (13 people). Following are the second highest percentage is other position such as architecture, quantity surveyor and executive position which contribute 20 %, (9 people). Besides that, the following are top management, manager and project coordinator position, which achieve 11.11% (5 people), 6.67% (3 people) and 4.44% (2 people) respectively. Meanwhile, the mean of respondent's position in company is 3.69 while median is 4.00 and mode is 3.

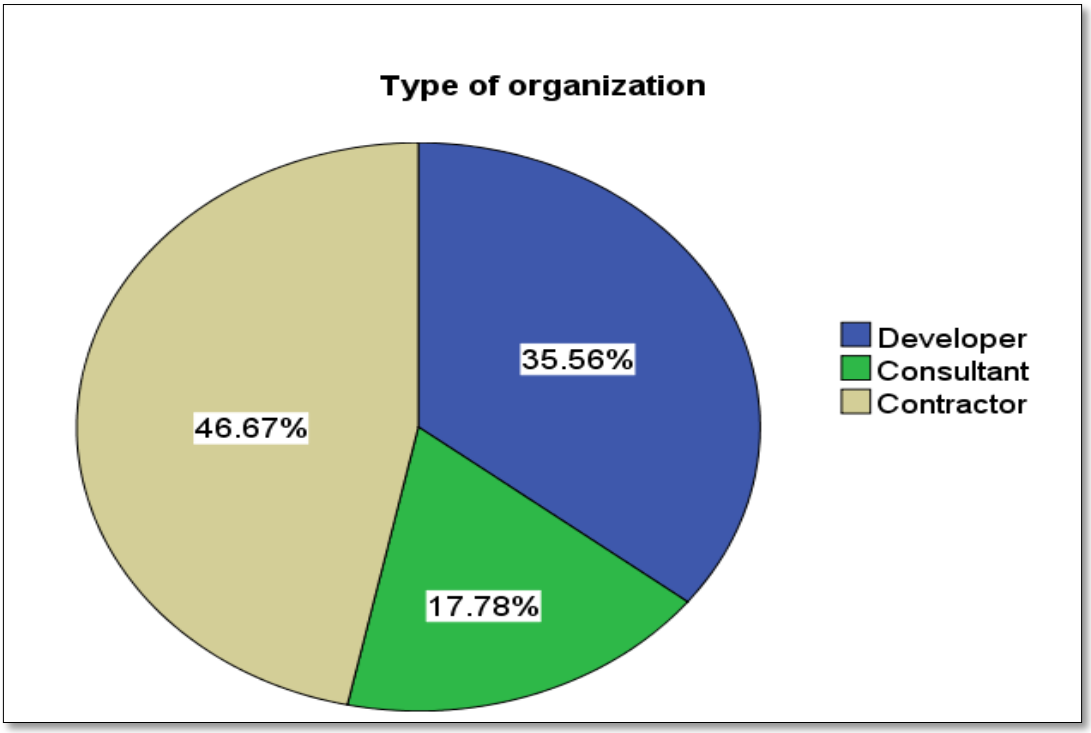

Figure 4.5 Type of organization

Figure 4.5 shows the type of organization those respondents from. There are 3 types of organization which are developer, consultant and contractor companies. According to figure, from the 45 respondents, 21 people from contractor companies which achieve highest percentage 46.67 %. Following is developer organization type, it shows 35.56%, which are 16 people from developer company. The consultant companies have achieved lowest percentage compare with other which is 17.78%, (8 people). Based on table 4.1, it achieves mean 2.11, median 2.00 and mode is 3.

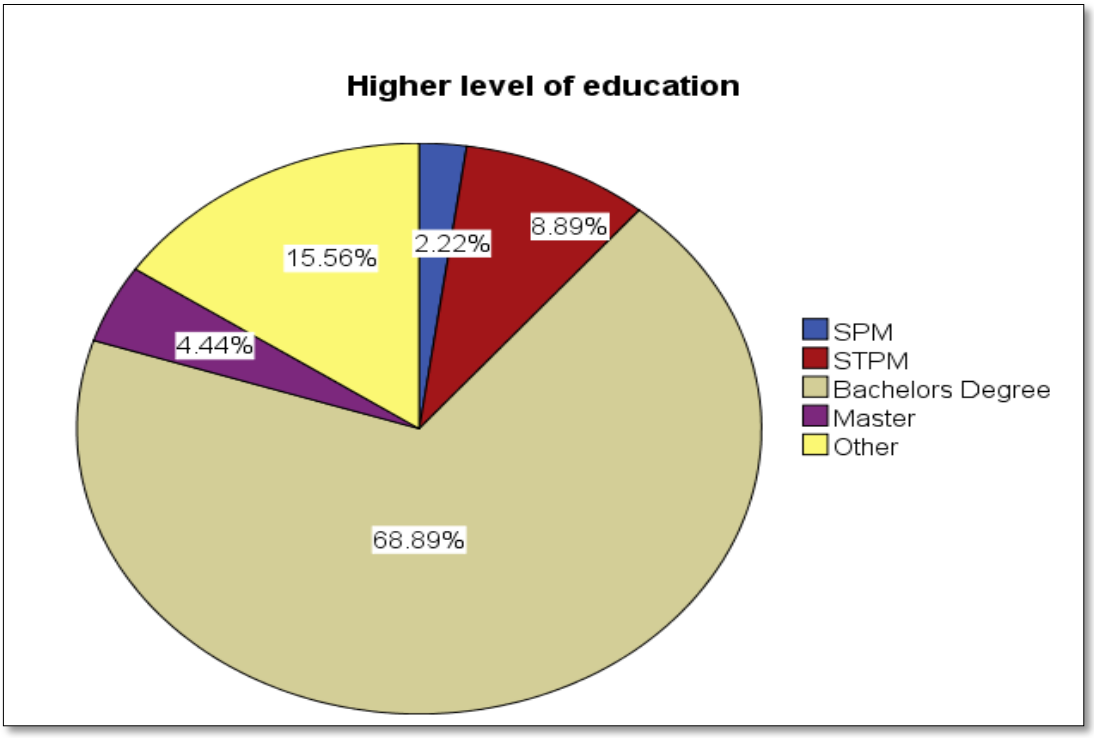

Figure 4.6 Highest education levels

Figure 4.6 shows the highest education level of respondents in the research. The degree education level achieves highest percentage which is 68.89%, 31 people out of 45. The second highest percentage is other education level such as diploma, advance diploma and LCCI which is 15.56% (7 people). The following are STPM which is 8.89% (4people), master is 4.44 %(2 people) and SPM level which is 2.22% (1 people). The mean of highest education levels is 3.22 while median and mode is 3 respectively.

4.3 RELIABILTY ANALYSIS

There are several methods can be used to measure the internal consistency. According to Craig and Janes (2003), Cronbach's alpha is the most commonly ways used to measure of reliability. Cronbach's alpha can be ranges from 0 to 1.00, the values close to 1.00 shows high consistency and more reliable, in contrast, the Cronbach's alpha is far from 1.00 indicate the data is not consistency and not reliable. If the alpha shows between 0.5 to 0.7 it consider as acceptable level, if the alpha more than 0.7 is consider in good level. According to Rahmi (2010), the data is reliable and acceptable if the Cronbach‟s Alpha values indicate 0.50 and above.

4.3.1 Reliability of causes of project change in construction industry (pilot test)

A pilot test is a method that is used to test the questionnaire before carrying out the research. It involves conduct an initial test of data collection instruments and progress to find and remove errors. In order to get more reliable and valid data, pilot test had been done before the real questionnaire distributed to respondents.

Table 4.3 Reliability of cause's variable

Variables	Cronbach's Alpha	Number of item (N)	Number of item deleted
1) Consultant and design related factor	0.727	6	-
2) Contractor related factor	0.844	7	-
3) Developer related factor	0.820	5	-
4) Material and equipment related factor	0.834	5	-
5) Labor related factor	0.940	2	-
6) External related factor	0.811	5	-

Table 4.3 shows the Conbach's alpha for the causes of project change in this research. 10 set of questionnaire have been used for test the reliability .In pilot test, all the values are more than 0.50 so it consider as acceptable. For the table above, labor related factor shows the highest value of Conbach's Alpha which is 0.940 whereas Consultant and design related effect shows the lowest value of Conbach's Alpha which is 0.727. The following are contractor related factor achieved second highest alpha, 0.844, material and equipment related factor achieved third highest alpha 0.834 and the developer and external related factor achieve the fourth and fifth highest which are 0.420 and 0.811 respectively. As all the values are more than 0.50, there have no number of items had deleted. In this section, there are 30 questions.

4.3.2 Reliability of effects of project change in Construction industry (Pilot Test)

Table 4.4 Reliability of effect's variable

Variables	**Cronbach's Alpha**	**Number of item (N)**	**Number of item deleted**
1) Time related effect	0.718	4	-
2) Cost related effect	0.794	4	-
3) Cost and time related effect	0.812	2	-
4) Productivity and quality related effect	0.870	2	-
5) Other related effect	0.711	4	-

Table 4.4 shows the Cronbach's alpha for effects of project change. 10 set of questionnaire have been used to test the reliability. Based from table, Productivity and quality related effect achieve highest Cronbach's alpha which is 0.870 whereas the second highest is cost and time related effect which is 0.812. The following are cost related effect, time related effect and other effect which are 0.794, 0.718 and 0.711

respectively. In this section have 16 questions and does not have any questions need to delete as achieve the acceptable level.

4.3.3 Reliability of causes of project change (Real test)

The reliability of real test shows as below:

Table 4.5 Reliability of cause's variable

Variables	Cronbach's Alpha	Number of item	Number of item deleted
1) Consultant and design related factor	0.688	6	-
2) Contractor related factor	0.695	7	-
3) Developer related factor	0.675	5	-
4) Material and equipment related factor	0.664	5	-
5) Labor related factor	0.449	2	-
6) External related factor	0.469	5	-

Table 4.5 shows the reliability of causes of project change. 45 set of questionnaire data had been use to test the reliability. Contractor related factor shows the highest cronbach's alpha compare with other which is 0.695, whereas labor and external related factor show the lowest cronbach's alpha which is 0.449 and 0.469 respectively. The cronbach's alpha less than 0.5 is consider as unacceptable. But the data still will be continue use in other analysis due to the limited time for this research, The consultant and design related factor have second highest alpha which is 0.688 and

the third highest is developer related factor(0.675) and fourth highest is material and equipment related factor(0.664).

4.3.4 Reliability of effects of project change in construction industry (Real test)

Table 4.6 Reliability of effect's variable

Variables	Cronbach's Alpha	Number of item	Number of item deleted
1) Time related effect	0.632	4	-
2) Cost related effect	0.504	4	-
3) Cost and time related effect	0.576	2	-
4) Productivity and quality related effect	0.612	2	-
5) Other related effect	0.613	4	-

Table 4.6 shows the cronbach's alpha for each effect variable. Time related effect have the highest cronbach's alpha which is 0.632, whereas the cost related effect shows the lowest cronbach's alpha which is 0.504. The second highest cronbach's alpha is other related effect (0.613) ,the third highest is productivity and quality related effect (0.612) and the fourth highest is cost and time related effect (0.504). In overall, all effects reached acceptable level as the cronbach's alpha more than 0.5.

4.4 NORMALITY ANALYSIS

Normality analysis is use to test the set of data is normal distribute or not .There are several methods can be used to test the data. In this study, normality analysis was carried out by using Shapiro-Wilk (SW) test. According to SPSS 14(2007), the sig value is greater than 0.05 is indicating normal distribution.

4.4.1 Normality test for causes of project change

Table 4.7 Normality test for causes project change

Tests of Normality

Causes Variables	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
A)Consultant and design related factor	.164	45	.004	.943	45	.027
B)Contractor related factor	.120	45	.108	.950	45	.050
C)Developer related factor	.093	45	.200*	.960	45	.126
D)Material and equipment related factor	.123	45	.084	.915	45	.003
E)labor related factor	.246	45	.000	.899	45	.001
F)External related factor	.165	45	.003	.930	45	.010

Table 4.7 shows the normality test of causes of project change with using SPSS. In this part, 45 set of questionnaire had been used to test normality. From the table ,Shapiro-Wilk have shown the significant value of each category of causes, there is only one variable show sig. value more than 0.05 which is Developer related factor (0.126) .This shows developer related factor is normally distributed. In contrast, other variable significance values are not greater than 0.05 which mean they are not normal distributed. Consultant design related factor shows 0.027 sig value, whereas contractor related factor, material and equipment, labor and external related factor shows 0.05,0.003,0.001 and 0.010 respectively. Overall data of this research are not normally distributed.

4.4.2 Normality test for effects of project change

Table 4.8 Normality test for effect of project change

Tests of Normality

Effects	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
Variable	**Statistic**	**df**	**Sig.**	**Statistic**	**df**	**Sig.**
A)Time related effect	.135	45	.038	.956	45	.086
B)Cost related effect	.163	45	.004	.941	45	.023
C)Cost and time related effect	.197	45	.000	.931	45	.010
D)Productivity and quality related effect	.255	45	.000	.907	45	.002
E)Other related effect	.104	45	.200*	.968	45	.244

Table 4.8 show the normality test of effect of project change. In this part, 45 set of questionnaire had been used to test normality. Other related effect shows the sig value more than 0.05 which 0.244. That means this effect achieved normal distributed. On the other hand, cost related, cost time related and product and quality related effect show sig. value less than 0.05 which are 0.023,0.010,and 0.002 respectively The overall of this data shows not normal distributed as all the sig. value does not achieve 0.05.

4.5 MEAN AND RANKING CAUSES OF PROJECT CHANGE IN CONSTRUCTION INDUSTRY

In this part, 30 causes had been classify into six groups which are consultant and design related factor, contractor related factor, developer related factor, material and equipment related factor, labor related factor and external related factor. Mean and ranking for each causes will be determined.

4.5.1 Consultant and design related factor

Table 4.9 Ranking of consultant and design related factor

Sub Causes	N	Mean	Rank
A1-Error and omission in design	45	3.98	2
A2-Consultant poor in material and equipment knowledge	45	3.96	3
A3-Design complexity	45	3.82	4
A4-Consultant lack of coordination with other parties	45	4.04	1
A5-Lack of require data to design	45	3.58	6
A6- Change in design by consultant	45	3.76	5

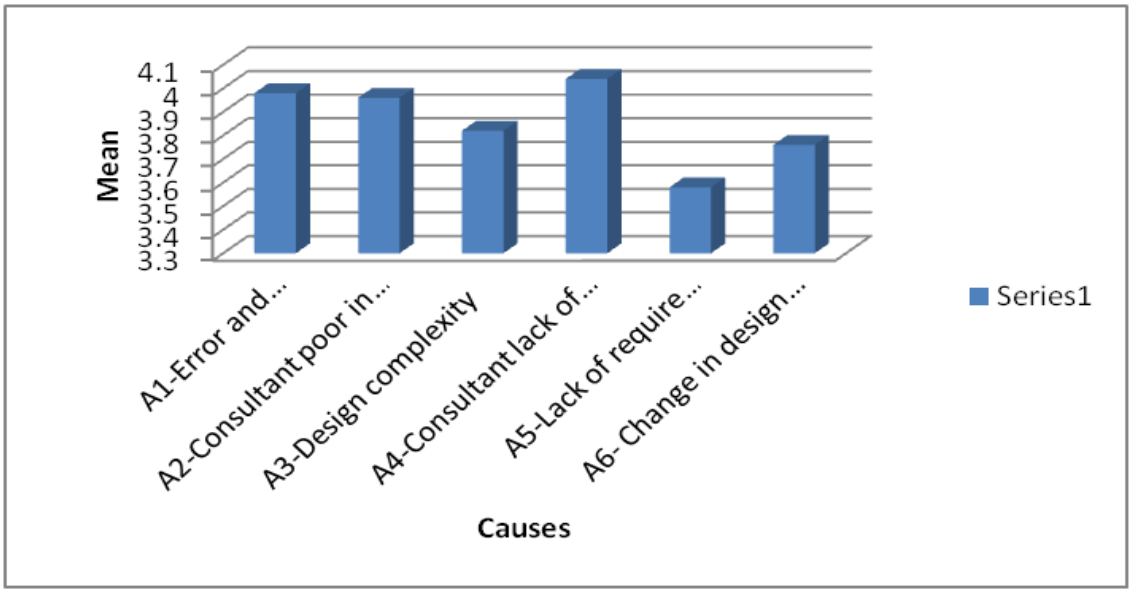

Figure 4.7 Histogram of consultant and design related factor

Table 4.9 and Figure 4.7 shows the mean and rank of consultant and design related factor based on 45 respondent. From table, the highest mean and rank is goes to A4 (4.04) and the second highest mean and rank is goes to A1 (3.98), the following are

third highest A2 (3.96), the fourth highest is goes to A3 (3.82) and the fifth goes to A6 (3.76). Whereas the lowest mean ranking is achieve by A5 which is 3.58.

4.5.2 Contractor related factor

Table 4.10 Ranking of contractor related factor

Sub causes	N	Mean	Rank
B1-Contractor's financial difficulties	45	4.09	1
B2-Contractor desired profitability	45	3.76	6
B3-Differing in site condition	45	3.87	4
B4-Lack of involvement in design	45	3.51	7
B5-Contractor poor in site management	45	3.78	5
B6-Contractor poor in judgment and lack of experience	45	4.02	2
B7-Lack of communication with other parties	45	3.98	3

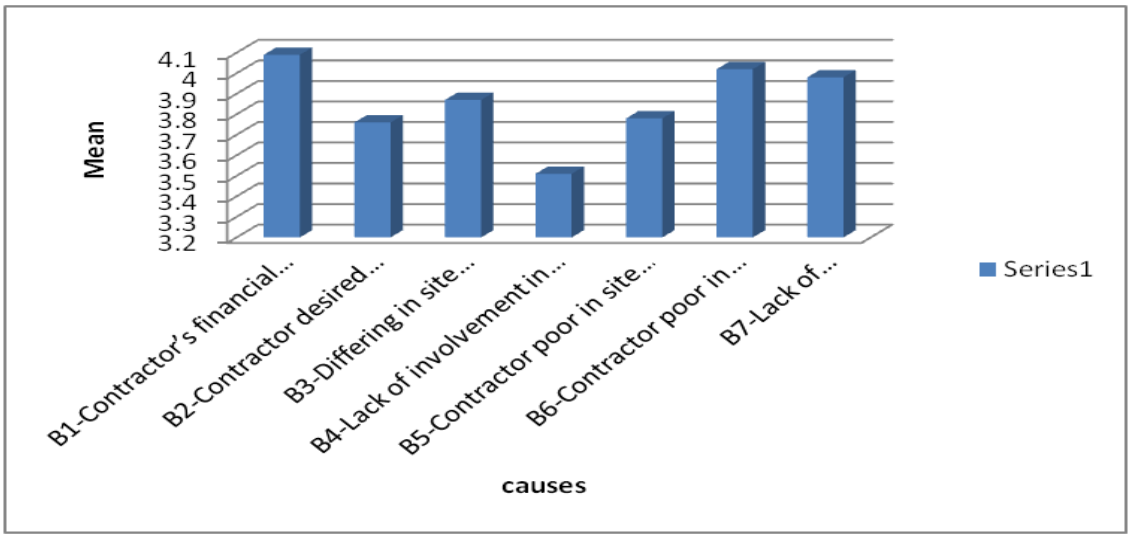

Figure 4.8 Histogram of contractor related factor

Table 4.10 and Figure 4.8 shows the mean and ranking of contractor related factor based on 45 respondents. From the table, the highest mean is goes to B1 (4.09) whereas the lowest mean is goes to B4 (3.51). The following are second highest mean is B6 (4.02), third highest is B7 (3.98), fourth highest is B3 (3.87), the fifth highest is B5 (3.78), and the sixth highest is B2 (3.76).

4.5.3 Developer related factor

Table 4.11 Ranking of developer related factor

Sub Causes	N	Mean	Rank
C1-Slow decision making by developer	45	4.27	1
C2-Developer's financial problem	45	4.00	2
C3-Change in specification by developer	45	4.00	2
C4-Change in scope or plan of work by developer	45	3.82	4
C5-Change in schedule	45	3.91	3

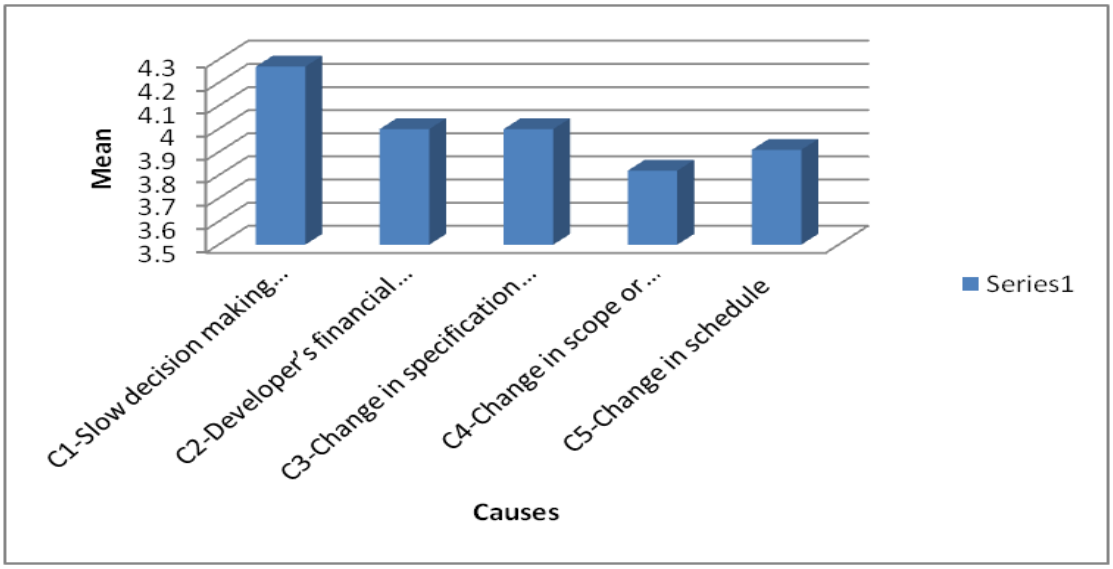

Figure 4.9 Histogram of developer related factor

Table 4.11 and figure 4.9 shows the mean and rank of developer related factor. From table, the highest mean is goes to C1 (4.27) the following is C2 and C3 both have same mean and rank which is 4.00. The third highest is goes to C5 (3.91) and the fourth highest is C4 (3.82).

4.5.4 Material and equipment related factor

Table 4.12 Ranking of material and equipment related factor

Sub Causes	N	Mean	Rank
D1-Material shortage in market	45	3.56	5
D2-Equipment shortage	45	4.00	2
D3-Equipment breakdowns	45	3.76	3
D4-Change in material type	45	3.73	4
D5-Delay in material delivery	45	4.16	1

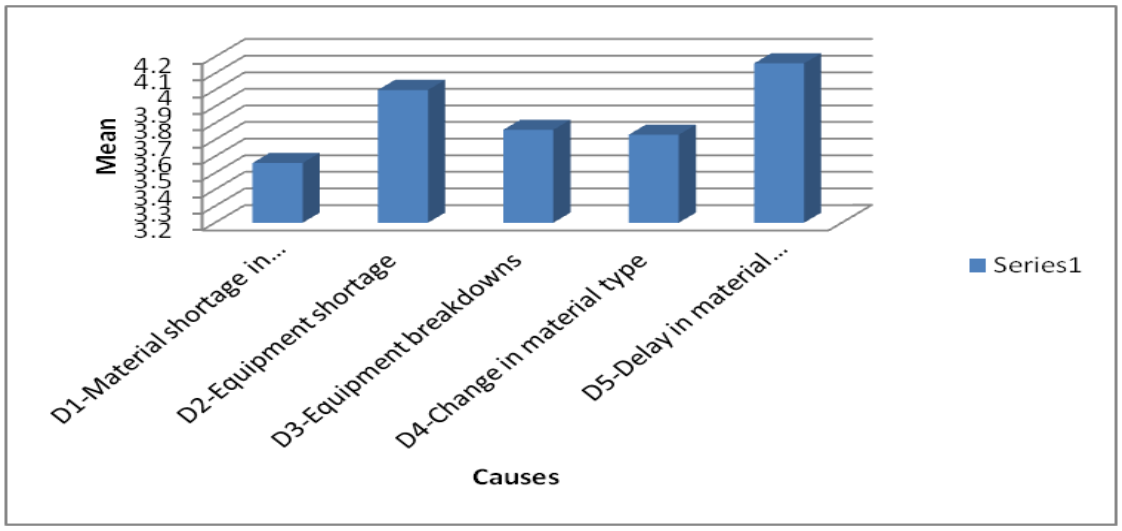

Figure 4.10 Histogram of material and equipment related factor

From table 4.12 and figure 4.10 shows the mean and rank of material and equipment related factor. According to table, the highest mean is located at causes D5 (4.16) and the second highest is goes on D2 (4.00) .Besides that, the third highest is

goes to D3 (3.76), fourth highest is goes to D4 (3.73) and the lowest mean is goes to D1 (3.56).

4.5.5 Labor related factor

Table 4.13 Ranking of labor related factor

Sub Causes	N	Mean	Rank
E1-Defective workmanship	45	4.07	2
E2- Shortage in workers	45	4.20	1

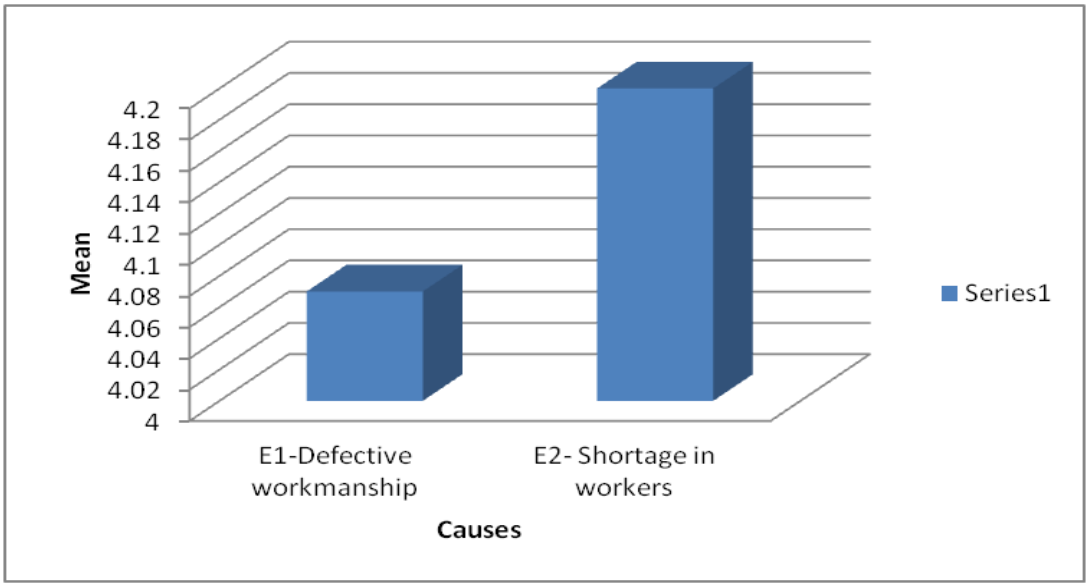

Figure 4.11 Histogram of labor related factor

Table 4.13 and figure 4.11 show the mean and rank of the labor related factor. There are two factor under labor categorized which are E1 defective workmanship and E2 shortage in worker. From table, E2 has the highest mean which is 4.20 whereas E1 has the lowest mean and rank which is only 4.07.

4.5.6 External related factor

Table 4.14 Ranking of external related factor

Sub Causes	N	Mean	Rank
F1-Weather condition	45	3.82	3
F2-Natural disaster	45	3.20	5
F3-Change in government rule and regulation	45	3.78	4
F4-Change in economic condition	45	4.00	1
F5-Technology change	45	3.87	2

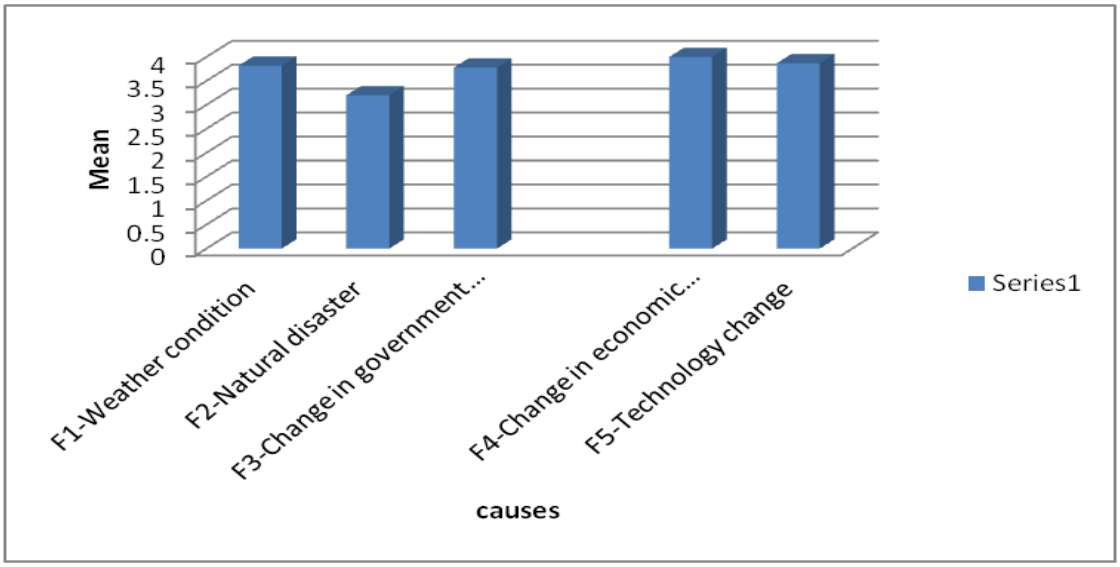

Figure 4.12 Histogram of external related factor

Table 4.14 and figure 4.12 shows the mean and rank of external factor. According to table, the highest mean and rank is goes to F4 (4.00), the second highest mean is belong to F5 (3.87), the third highest is goes to F1 (3.82), the fourth highest is achieved by F3 (3.78) and the lowest mean ranking is goes to F2 (3.20).

4.5.7 Overall ranking for main causes

Table 4.15 Overall mean ranking for causes

Main Causes	Mean	Rank
A) Consultant and design related factor	3.86	3
B) Contractor related factor	3.86	3
C) Developer related factor	4.00	2
D) Material and equipment related factor	3.84	4
E) Labor related factor	4.14	1
F) External related factor	3.73	5

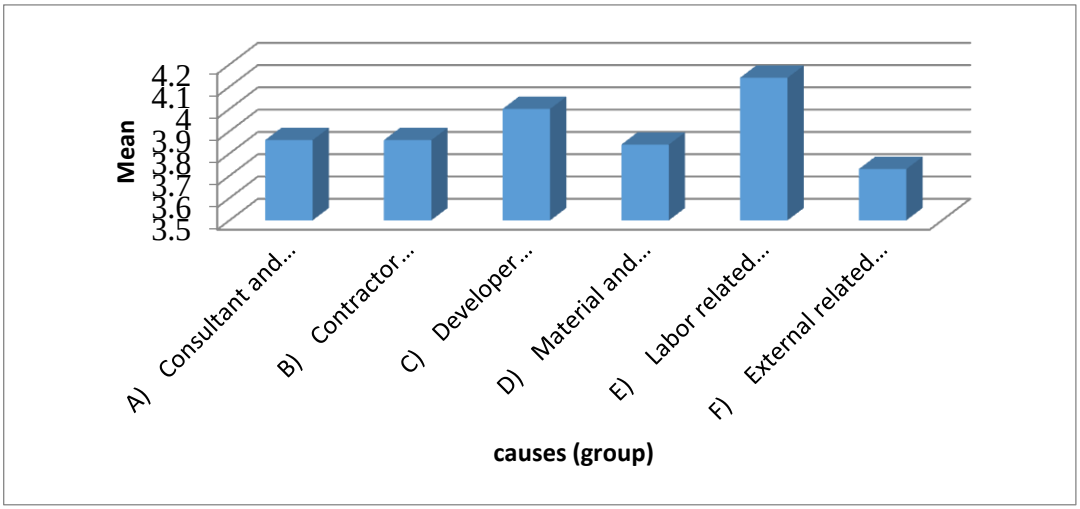

Figure 4.13 Histogram of overall main causes

There are 45 respondents in this research. In table 4.15 and figure 4.13, show the overall mean and rank of each category of main causes. The highest mean is goes to E labor related factor (4.14), then the second highest mean is goes to C developer related

factor(4.00) , and the third highest mean is B contractor related factor and A consultant and design related factor, which both have same mean (3.86). Following is the fourth highest which D material is and equipment related factor (3.84) and the lowest mean is goes on F external related factor categories which is 3.73 only.

4.6 EFFECTS OF PROJECT CHANGE IN CONSTRUCTION INDUSTRY

In this part, 16 effects had been classify into five groups which are time related effect, cost related effect, cost and time related effect, productivity and quality effect and the last is other related effect. Mean and ranking for each causes will be determined.

4.6.1 Time related effect

Table 4.16 Ranking of time related effect

Sub Effects	N	Mean	Rank
A1-Delay in completion schedule	45	4.36	1
A2-Delay in payment	45	4.18	2
A3-Delay in procurement process	45	3.93	4
A4-Interruption of continue works	45	4.07	3

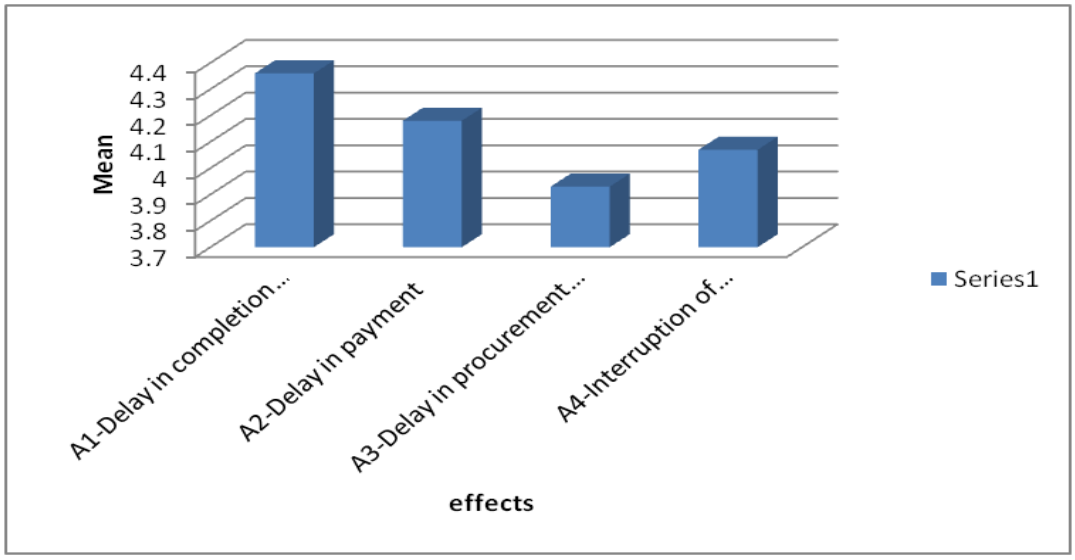

Figure 4.14 Histogram of time related effect

Table 4.16 and figure 4.14 shows the mean and rank of time related effect. There are four effects under time related which are A1 delay in completion schedule, A2 delay in payment, A3 delay in procurement process and A4 interruption of continue works. According to table, A1 has the highest mean ranking which are 4.36 whereas the lowest mean and rank belong to A3 (3.93). Then, the second highest is goes to A2 (4.18) and the third is A4 (4.07)

4.6.2 Cost related effects

Table 4.17 Ranking of cost related effects

Sub Effects	N	Mean	Rank
B1-Increase project cost	45	4.36	1
B2-Increase in overhead expenses	45	4.29	2
B3-Material waste	45	3.89	4
B4-Addition payment for contractor	45	3.93	3

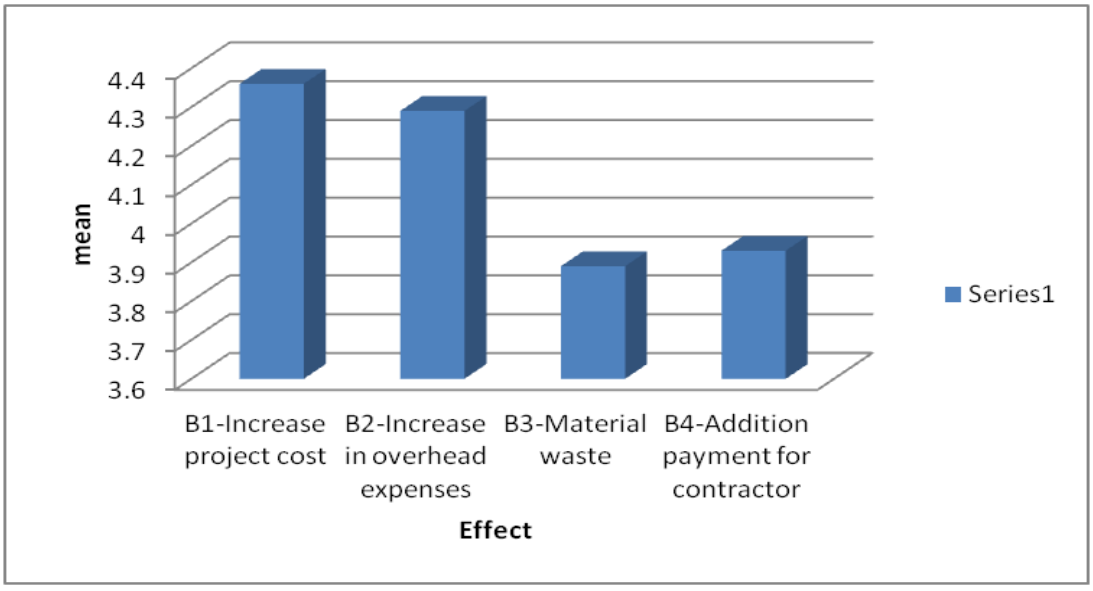

Figure 4.15 Histogram of cost related effect

From table 4.17 and figure 4.15, there are four effects under cost related group which are B1- increase project cost, B2 increase in overhead expenses, B3 Material waste and B4 addition payment for contractor. According to table, the highest mean and rank is goes to B1 which is 4.36, the following are, second highest B2 (4.29), the third highest B4 (3.93) and the lowest mean is goes to B3 (3.89).

4.6.3 Cost and time related effects

Table 4.18 Ranking of cost and time related effects

Sub Effects	N	Mean	Rank
C1-Hiring new professional	45	3.49	2
C2-Rework and demolition	45	4.09	1

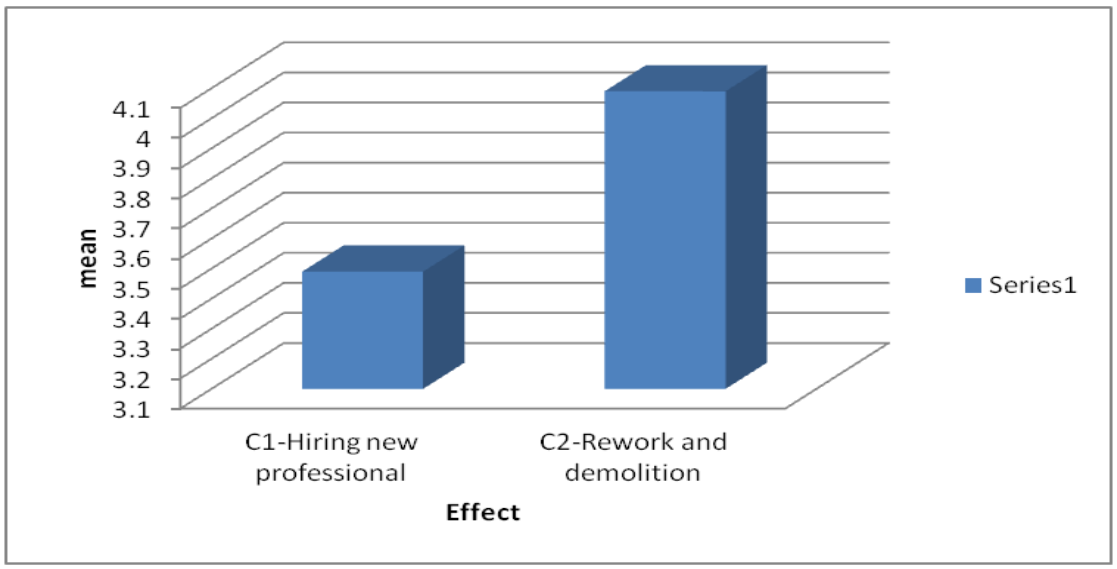

Figure 4.16 Histogram of cost and time related effect

Table 4.18 and figure 4.16 show the mean and ranking of cost and time related effect. There are two effects under this group which are C1 hiring new professional and C2 Rework and demolition .From the table, C2 has the highest mean and ranking which is 4.09 whereas the C1 has the lowest mean and rank which is only 3.49.

4.6.4 Productivity and quality related effect

Table 4.19 Ranking of productivity and quality related effect

Sub Effects	N	Mean	Rank
D1-Productivity degradation	45	3.91	1
D2-Quality degradation	45	3.80	2

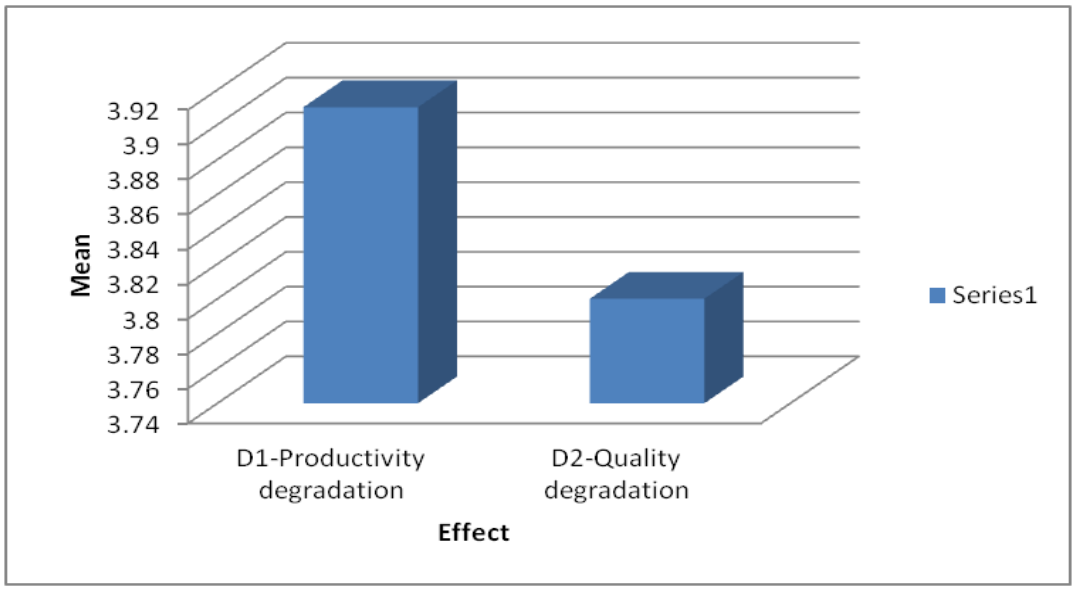

Figure 4.17 Histogram of productivity and quality related effect

Table 4.19 and figure 4.17 shows the mean and rank of productivity and quality related effects. There are two effects under productivity and quality group which are D1 productivity degradation and D2 Quality degradation. From table, D1 has the highest mean and rank which is 3.91 and the D2 has the lowest mean which is 3.80 only.

4.6.5 Other related effects

Table 4.20 Ranking of other related effect

Sub Effects	N	Mean	Rank
E1-Damage to firm's reputation	45	3.87	2
E2-Low morale of labor	45	3.42	4
E3-Poor safety condition	45	3.69	3
E4-Contract claim and dispute among professional	45	3.89	1

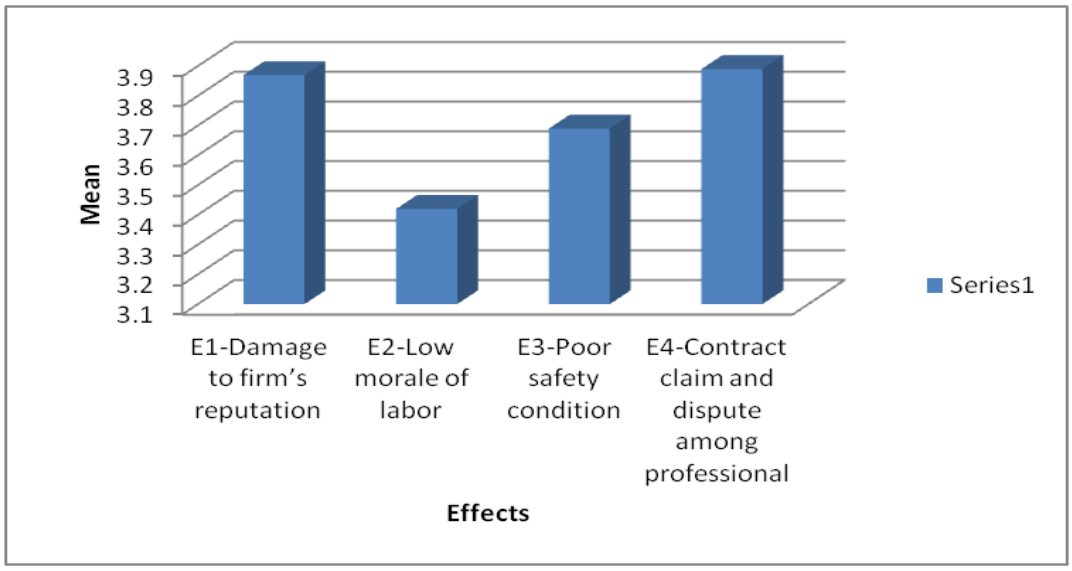

Figure 4.18 Histogram of other related effect

Table 4.20 and figure 4.18 represents the mean and rank of other related effects. There are four effects under this group which are E1 damage to firm's reputation. E2 low morale of labor, E3 poor safety condition and the last is E4 contract claim and dispute among professional. Based on table, the highest mean is goes to E4 (3.89), the

second highest is goes to E1 (3.87), then the third highest is goes to E3 (3.96) and the last is the lowest mean is goes to E2 (3.42).

Main effects	Mean	Rank
A) Time related effect	4.14	1
B) Cost related effect	4.12	2
C) Cost and time related effect	3.79	4
D) Productivity and quality related effect	3.86	3
E) External related effect	3.72	5

4.6.6 Overall ranking for main effects

Table 4.21 Overall mean ranking of effects

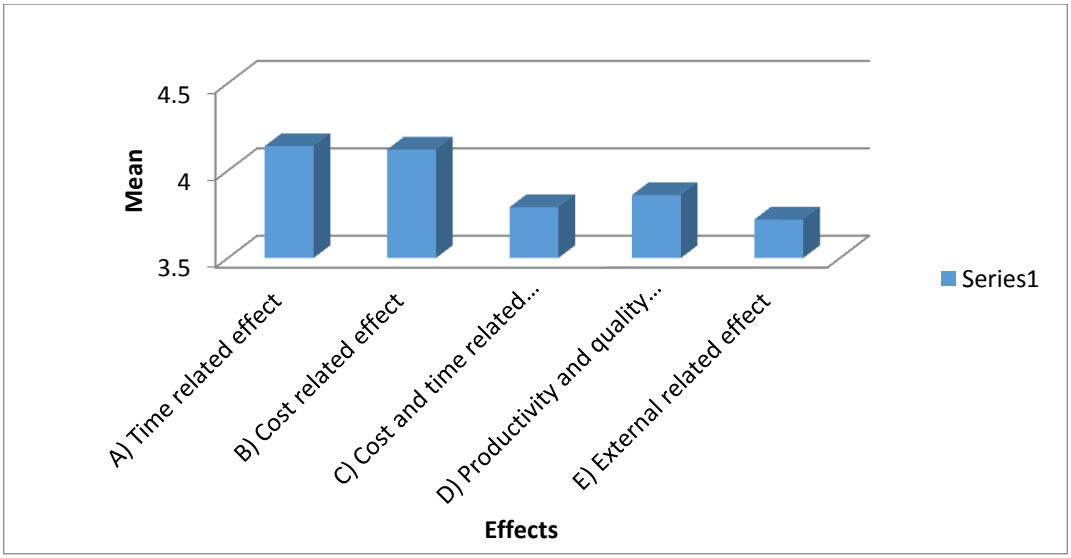

Figure 4.19 Histogram of overall effects

Table 4.21 and figure 4.19 shows the overall mean and rank of main effect of project change. There are 5 categories which are A time related factor, B cost related

effect, C cost and time related effect, D productivity and quality related effect and E external related effect. From table, the highest mean is goes to time related effect (4.14), the second highest is goes on cost related effect(4.12), third is goes to productivity and quality related effect (3.86) , the fourth is goes to cost and time related effect (3.79) and the last is external related effect (3.72).

4.7 CORRELATION BETWEEN CAUSES AND EFFECTS OF PROJECT CHANGE IN CONSTRUCTION INDUSTRY (PEARSON CORRELATION)

According to Soon and Sambasivan (2007), correlation analysis is one of the efficient methods can been used to study the relationship between variables. The regression analysis method had not been used in this research data analysis, since it is used to identify the relationship between one dependent variable with one or more independent variables; and it is possible to predict the value of dependent variable from the values of independent variables (Greasley, 2008). However, Correlation Analysis had been used in this research since it is aim to examine the direction and strength of relationship between both variables of causes and effects, to determine whether or not it is statistically significant; which is unlikely to have occurred by chance. In this research, Pearson correlation will be used to study the empirical relationship between the categories causes and effects of project change. Below shows the Pearson correlation coefficient:

Table 4.22 Pearson correlation coefficient

Coefficient range	**Strength**
±0.91 to ±1.0	Very Strong
±0.71 to ±0.90	Strong
±0.41 to ±0.70	Moderate strong
±0.21 to ±0.40	Weak but definite Relationship
0 to ±0.20	Slight, almost negligible

4.7.1 Relationship between consultant and design related factor and all group of effects of project change

4.7.1.1 Correlation between Consultant and design related factor and time related effects

Table 4.23 correlation between consultant and design related factor and time related effect

Correlations

		Consultant and design related factor	Time related effect
Consultant and design related factor	Pearson Correlation	1	.327*
	Sig. (2-tailed)		.028
	N	45	45
Time related effect	Pearson Correlation	.327*	1
	Sig. (2-tailed)	.028	
	N	45	45

*. Correlation is significant at the 0.05 level (2-tailed).

Table 4.23 shows the relationship between consultant and design related factor and time related effect. The Pearson correlation, r is 0.327 between this variable. Therefore, there is weak positive relationship between consultant and design related factor and time related effect. Besides that, the correlation is significant between this two variable as the sig. value is lower than 0.05.

4.7.1.2 Correlation between Consultant and design related and cost related effects

Table 4.24 correlation between consultant and design related factor and cost related effect

Correlations

		Consultant and design related factor	Cost related effect
Consultant and design related factor	Pearson Correlation	1	.321*
	Sig. (2-tailed)		.031
	N	45	45
Cost and related effect	Pearson Correlation	.321*	1
	Sig. (2-tailed)	.031	
	N	45	45

*. Correlation is significant at the 0.05 level (2-tailed).

Table 4.24 shows the correlation between consultant and design related factor and cost related effect. There is weak positive relationship between two variables because Pearson correlation r is 0.321 and correlation is significant between these two variables. This is because the sig value is 0.031 less than 0.05.

4.7.1.3 Correlation between Consultant and design related and cost and time related effect

Table 4.25 Correlation between consultant and design related factor and cost and time related effect

Correlations

		Consultant and design related factor	Cost and time related effect
Consultant and design related factor	Pearson Correlation	1	.272
	Sig. (2-tailed)		.071
	N	45	45
Cost and time related effect	Pearson Correlation	.272	1
	Sig. (2-tailed)	.071	
	N	45	45

Table 4.25 shows the correlation between consultant and design related factor and cost and time related effect. There is weak relationship between these two variables as the Pearson correlation r is 0.272. However there are no significant relationship between consultant and design related factor and cost and time related effect as the sig value is 0.71 which more than 0.05.

4.7.1.4 Correlation between Consultant and design related and productivity and quality related effect

Table 4.26 correlation between consultant and design related factor and productivity and quality related effect

Correlations

		Consultant and design related factor	Productivity and quality related effect
Consultant and design related factor	Pearson Correlation	1	.203
	Sig. (2-tailed)		.182
	N	45	45

Productivity and quality related effect	Pearson Correlation	.203	1
	Sig. (2-tailed)	.182	
	N	45	45

Table 4.26 shows the correlation between 2 variables. From the table, Pearson correlation, r is 0.203. Thus, there is weak relationship between variables. However there is no significant relationship between consultant and design related factor and productivity and quality related effect due to the sig value is 0.182 more than 0.05.

4.7.1.5 Correlation between Consultant and design related and other related effect

Table 4.27 correlation between consultant and design related factor and other related effect

Correlations

		Consultant and design related factor	Other related effect
Consultant and design related factor	Pearson Correlation	1	-.025
	Sig. (2-tailed)		.869
	N	45	45
Other related effect	Pearson Correlation	-.025	1
	Sig. (2-tailed)	.869	
	N	45	45

Table 4.27 shows the correlation between consultant and design related factor and other related effect. There is weak negative relationship between two variables because the Pearson correlation r, is -0.25. Besides that, there is no significant relationship between each other as the sig value is more than 0.05.

4.7.2 Relationship between contractors related factor and all the categories effect of project change

4.7.2.1 Correlation between contractors' related factor and time related effect

Table 4.28 correlation between contractor related factor and time related effect

Correlations

		Contractor related factor	Time related effect
Contractor related factor	Pearson Correlation	1	.015
	Sig. (2-tailed)		.924
	N	45	45
Time related effect	Pearson Correlation	.015	1
	Sig. (2-tailed)	.924	
	N	45	45

Table 4.28 shows the correlation between contractor related factor and time related effect. Based on table, Pearson correlation r is 0.15 which mean there is negligible relationship between two variables. The sig value is indicating 0.924, thus there is no significant relationship between contractor related factor and time related effect as the sig value more than 0.05.

4.7.2.2 Correlation between contractor related factor and cost related effect

Table 4.29 correlation between contractor related factor and cost related effect

Correlations

	Contractor related factor	Cost related effect

Contractor related factor	Pearson Correlation	1	.385**
	Sig. (2-tailed)		.009
	N	45	45
Cost related effect	Pearson Correlation	.385**	1
	Sig. (2-tailed)	.009	
	N	45	45

**. Correlation is significant at the 0.01 level (2-tailed).

Table 4.29 shows the correlation between two variables. There are weak positive relationship between contractor related factor and cost related effect as Pearson correlation r, is 0.385. Besides that, there is significant relationship between variables as the sig value is 0.009 less than 0.01.

4.7.2.3 Correlation between contractor related factor and cost and time related effect

Table 4.30 correlation between contractor related factor and cost and time related effect.

Correlations

		Contractor related factor	Cost and time related effect
Contractor related factor	Pearson Correlation	1	.390**
	Sig. (2-tailed)		.008
	N	45	45
Cost and time related effect	Pearson Correlation	.390**	1
	Sig. (2-tailed)	.008	
	N	45	45

**. Correlation is significant at the 0.01 level (2-tailed).

Table 4.30 shows there is weak positive relationship between contractor related factor and cost and time related effect. There is also has significant relationship between these two variable at the level 0.01 due to sig value is 0.008.

4.7.2.4 Correlation between contractor related factor and productivity and quality related effect

Table 4.31 correlation between contractor related factor and productivity and quality related effect

Correlations

		Contractor related factor	Productivity and quality related effect
Contractor related factor	Pearson Correlation	1	.200
	Sig. (2-tailed)		.187
	N	45	45
Productivity and quality related effect	Pearson Correlation	.200	1
	Sig. (2-tailed)	.187	
	N	45	45

From table 4.31, Pearson correlation r, between two variables is 0.200, thus there is weak relationship between them. Besides that, there is no significant relationship as the sig value is more than 0.05 levels.

4.7.2.5 Correlation between contractor's related factor and other related effect

Table 4.32 correlation between contractors related factor and other related effect

Correlations

		Contractor related factor	Other related effect
Contractor related factor	Pearson Correlation	1	.239
	Sig. (2-tailed)		.113
	N	45	45
Other related effect	Pearson Correlation	.239	1
	Sig. (2-tailed)	.113	
	N	45	45

Table 4.32 shows the correlation between contractors' related factor and other related effect. There is weak relationship between the variable as Pearson correlation r is 0.239. Besides that, there is no significant relationship between contractor related factor and other related factor.

4.7.3 Relationship between developers' related factor and all categories effects of project change

4.7.3.1 Correlation between developer related factor and time related effect

Table 4.33 correlation between developer related factor and time related effect

Correlations

	Developer related factor	Time related effect

Developer related factor	Pearson Correlation	1	.078
	Sig. (2-tailed)		.611
	N	45	45
Time related effect	Pearson Correlation	.078	1
	Sig. (2-tailed)	.611	
	N	45	45

Table 4.33 shows the correlation between developer related factor and time related effect. Pearson correlation r, is 0.078 which mean there is negligible relationship between variables. Besides that, there is no significant relationship between two variables as the sig value is more than 0, 05.

4.7.3.2 Correlation between developer related factor and cost related effect

Table 4.34 correlation between developer related factor and cost related effect

Correlations

		Developer related factor	Cost related effect
Developer related factor	Pearson Correlation	1	.318*
	Sig. (2-tailed)		.033
	N	45	45
Cost related effect	Pearson Correlation	.318*	1
	Sig. (2-tailed)	.033	
	N	45	45

*. Correlation is significant at the 0.05 level (2-tailed).

Table 4.34 shows the correlation between two variables. There is weak positive relationship between developer related factor and cost related effect as the Pearson

correlation r is 0.318. Besides that, there is significant relationship between two variables because the sig value is less than 0.05.

4.7.3.3 Correlation analysis between developer related factor and cost and time related effect

Table 4.35 correlation between developer related factor and cost and time related effect

Correlations

		Developer related factor	Cost and time related effect
Developer related factor	Pearson Correlation	1	.008
	Sig. (2-tailed)		.956
	N	45	45
Cost and time related effect	Pearson Correlation	.008	1
	Sig. (2-tailed)	.956	
	N	45	45

From the table 4.35, Pearson correlation r is 0.008, which mean there is negligible relationship between developer related factor and cost and time related effect. There is no significant relationship between two variables as sig value is 0.956 more than 0.05.

4.7.3.4 Correlation between developer related factor and productivity and quality related effect

Table 4.36 correlation between developer related factor and productivity and quality related effect

Correlations

		Developer related factor	Productivity and quality related effect
Developer related factor	Pearson Correlation	1	-.142
	Sig. (2-tailed)		.351
	N	45	45
Productivity and quality related effect	Pearson Correlation	-.142	1
	Sig. (2-tailed)	.351	
	N	45	45

Table 4.36 shows the correlation between two variables. There is negative negligible relationship between two variables as the Pearson correlation r is -1.42. In addition, there is no significant relationship between them because the sig value is more than 0.05.

4.7.3.5 Correlation between developers' related factor and other related effect

Table 4.37 correlation between developers related factor and other related effect

Correlations

		Developer related factor	Other related effect
Developer related factor	Pearson Correlation	1	.186
	Sig. (2-tailed)		.221
	N	45	45
Other related effect	Pearson Correlation	.186	1
	Sig. (2-tailed)	.221	
	N	45	45

From table 4.37, there is negligible relationship between developer's related factor and other related effect. Pearson correlation r is 0.186 and there is no significant relationship between them a sig value is 0.221 at 0.05 levels.

4.7.4 Relationship between material and equipment related factor and all effect categories of project change

4.7.4.1 Correlation between material and equipment related factor and time related effect

Table 4.38 correlation between material and equipment related factor and time related effect

Correlations

		Material and equipment related factor	Time related effect
Material and equipment related factor	Pearson Correlation	1	.085
	Sig. (2-tailed)		.580
	N	45	45
Time related effect	Pearson Correlation	.085	1
	Sig. (2-tailed)	.580	
	N	45	45

Table 4.38 shows the correlation between material and equipment related factor and time related effect. From table, Pearson correlation r is 0.85, which mean there is negligible relationship between two variables. Besides that, there is no significant relationship between them as sig value is 0.580 more than 0.05 levels.

4.7.4.2 Correlation between material and equipment related factor and time related effect

Table 4.39 correlation between material and equipment related factor and cost related effect

Correlations

		Material and equipment related factor	Cost related effect
Material and equipment related factor	Pearson Correlation	1	.415**
	Sig. (2-tailed)		.005
	N	45	45
Cost related effect	Pearson Correlation	.415**	1
	Sig. (2-tailed)	.005	
	N	45	45

**. Correlation is significant at the 0.01 level (2-tailed).

Table 4.39 shows the Pearson correlation r, between two variables is 0.415.Thus, there is moderate positive relationship between material and equipment related factor and cost related effect. Besides that, there is significant relationship between them as the sig vale is 0.005 less than 0.01 levels.

4.7.4.3 Correlation between material and equipment related factor and cost and time related effect

Table 4.40 correlation between material and equipment related factor and cost and time related effect

Correlations

		Material and equipment related factor	Cost and time related effect
Material and equipment related factor	Pearson Correlation	1	.362*
	Sig. (2-tailed)		.015
	N	45	45
Cost and time related effect	Pearson Correlation	.362*	1
	Sig. (2-tailed)	.015	
	N	45	45

*. Correlation is significant at the 0.05 level (2-tailed)

Based on table 4.40, Pearson correlation shows 0.362 between two variables. There is weak positive relationship between material and equipment related factor and cost and time related effect. Besides that, there is significant relationship between them as the sig value is less than 0.05.

4.7.4.4 Correlation between material and equipment related factor and productivity and quality related effect

Table 4.41 correlation between material and equipment related factor and productivity and quality related effect

Correlations

		Material and equipment related factor	Productivity and quality related effect
Material and equipment related factor	Pearson Correlation	1	.208
	Sig. (2-tailed)		.171
	N	45	45

Productivity and quality related effect	Pearson Correlation	.208	1
	Sig. (2-tailed)	.171	
	N	45	45

Table 4.41 shows the correlation between material and equipment related factor and productivity and quality related effect. Pearson correlation r is 0.208 which mean there is weak positive relationship between them. In addition, there is no significant relationship as the sig value is 0.171 more than 0.05.

4.7.4.5 Correlation between material and equipment related factor and other related effect

Table 4.42 correlation between material and equipment related factor and other related effect

Correlations

		Material and equipment related factor	Other related effect
Material and equipment related factor	Pearson Correlation	1	.113
	Sig. (2-tailed)		.460
	N	45	45
Other related effect	Pearson Correlation	.113	1
	Sig. (2-tailed)	.460	
	N	45	45

Table 4.42 shows the correlation between material and equipment related factor and other related effect. There is negligible positive relationship between two variables as the Pearson correlation r is 0.113 and there is no significant relationship between them.

4.7.5 Relationship between labors related factor and all categories effects of project change

4.7.5.1 Correlation between labor related factor and time related effect

Table 4.43 correlation between labor related factor and time related effect

Correlations

		Labor related factor	Time related effect
Labor related factor	Pearson Correlation	1	.208
	Sig. (2-tailed)		.171
	N	45	45
Labor related factor	Pearson Correlation	.208	1
	Sig. (2-tailed)	.171	
	N	45	45

Table 4.43 shows the correlation between labor related factor and time related effect. Pearson correlation r is 0.208 thus there is weak relationship between variable. There is no significant relationship as the sig value more than 0.05.

4.7.5.2 Correlation between labor related factor and cost related effect

Table 4.44 correlation between labor related factor and cost related effect

Correlations

		Labor related factor	Cost related effect
Labor related factor	Pearson Correlation	1	.309*
	Sig. (2-tailed)		.039
	N	45	45
Cost related effect	Pearson Correlation	.309*	1
	Sig. (2-tailed)	.039	
	N	45	45

Table 4.44 shows the correlation between two variables. There is weak positive relationship between labor related factor and cost related effect. Pearson correlation r is 0.309. There is significant relationship between variables at 0.05 levels.

4.7.5.3 Correlation between labor related factor and cost and time related effect

Table 4.45 correlation between labor related factor and cost and time related effect

Correlations

		Labor related factor	Cost and time related effect
Labor related factor	Pearson Correlation	1	.227
	Sig. (2-tailed)		.134
	N	45	45
Cost and time related effect	Pearson Correlation	.227	1
	Sig. (2-tailed)	.134	
	N	45	45

From table 4.45, there is weak relationship between labor related factor and cost and time related effect as Pearson correlation r is 0.227. Besides that, the sig value is 0.134 thus there is no significant relationship between variables.

4.7.5.4 Correlation between labor related factor and productivity and quality related effect

Table 4.46 correlation between labor related factor and productivity and quality related effect

Correlations

	Labor related factor	Productivity and quality related effect

Labor related factor	Pearson Correlation	1	.114
	Sig. (2-tailed)		.454
	N	45	45
Productivity and quality related effec	Pearson Correlation	.114	1
	Sig. (2-tailed)	.454	
	N	45	45

According to table 4.46, Pearson correlation r is 0.114, which mean there is negligible relationship between labor related factor and productivity and quality related effect In addition due to sig value is 0.454 more than 0.05; there is no significant relationship between two variables.

4.7.5.5 Correlation between labors related factor and other related effect

Table 4.47 correlation between labors related factor and other related effect

Correlations

		Labor related factor	Other related effect
Labor related factor	Pearson Correlation	1	.115
	Sig. (2-tailed)		.452
	N	45	45
Other elated effect	Pearson Correlation	.115	1
	Sig. (2-tailed)	.452	
	N	45	45

Table 4.47 shows the correlation between two variables. There is negligible relationship between labors related factor and other related effect because the Pearson correlation is 0.115. Furthermore, there is no significant relationship as the sig value is 0.452.

4.7.6 Relationship between external related factor and all categories effect of project change

4.7.6.1 Correlation between external related factor and time related effect

Table 4.48 correlation between external related factor and time related effect

Correlations

		External related factor	Time related effect
External related factor	Pearson Correlation	1	.147
	Sig. (2-tailed)		.335
	N	45	45
Time related effect	Pearson Correlation	.147	1
	Sig. (2-tailed)	.335	
	N	45	45

Table 4.48 shows that Pearson correlation r is 0.147 and there is negligible relationship between external related factor and time related effect. Besides that, there is no significant relationship between variables as the sig value is 0.335.

4.7.6.2 Correlation between external related factor and cost related effect

Table 4.49 correlation between external related factor and cost related effect

Correlations

		External related factor	Cost related effect
External related factor	Pearson Correlation	1	.381**
	Sig. (2-tailed)		.010

	N	45	45
Cost related effect	Pearson Correlation	.381**	1
	Sig. (2-tailed)	.010	
	N	45	45

**. Correlation is significant at the 0.01 level (2-tailed).

Table 4.49 shows that Pearson correlation r is 0.381 which mean there is weak correlation between external related factor and cost related effect. In addition, there is significant relationship between two variables at 0.01 significant levels.

4.7.6.3 Correlation between external related factor and cost and tome related effect

Table 4.50 correlations between external related factor and cost and time related effect

Correlations

		External related factor	Cost and time related effect
External related factor	Pearson Correlation	1	.223
	Sig. (2-tailed)		.140
	N	45	45
Cost and time related effect	Pearson Correlation	.223	1
	Sig. (2-tailed)	.140	
	N	45	45

Table 4.50 shows the correlation between two variables. Pearson correlation r is 0.223 which mean there is weak relationship between external related factor and cost and time related effect. Besides that, there is no significant relationship as sig value is 0.140.

4.7.6.4 Correlation between External related factor and Productivity and quality related effect

Table 4.51 correlation between external related factor and productivity and quality related effect

Correlations

		External related factor	Productivity and quality related effect
External related factor	Pearson Correlation	1	.154
	Sig. (2-tailed)		.312
	N	45	45
Productivity and quality related effect	Pearson Correlation	.154	1
	Sig. (2-tailed)	.312	
	N	45	45

Table 4.49 shows the Pearson correlation is 0.154 which mean there is negligible relationship between external related factor and productivity and quality related effect. Besides that there is no significant relationship as sig value is 0.312.

4.7.6.5 Correlation between external related factor and other related effect

Table 4.52 correlation between external related factor and other related effect

Correlations

		External related factor	other related effect
External related factor	Pearson Correlation	1	.256
	Sig. (2-tailed)		.089
	N	45	45

other related effect	Pearson Correlation	.256	1
	Sig. (2-tailed)	.089	
	N	45	45

Table 4.52 shows that Pearson correlation r is 0.256 which mean there is weak relationship between external related factor and other related effect. Again, there is also no significant relationship as sig value is 0.089.

4.7.7 Summary of correlation between several causes and effects

Table 4.53 Summary of Pearson correlation between the categories of causes and effects of project change

Effects	**Causes**					
	Consultant and design	Contractor	Developer	Material and equipment	Labor	External
Time related effects	**0.327***	0.015	0.078	0.085	0.208	0.147
Cost related effect	**0.321***	**0.385****	**0.318***	**0.415****	**0.309***	**0.381***
Cost and time related effect	0.272	**0.390****	0.08	**0.362***	0.227	0.223
Productivity and quality related effect	0.203	0.200	-0.142	0.208	0.114	0.154
Other related effect	-0.025	0.239	0.186	0.113	0.115	0.256

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Based on table 4.53, there are just several causes and effect have significant relationship. In this study, cost related and other all related causes have significant relationship. Besides that, between time related effect and consultant and design related factor also have significant relationship. In addition, contractor related factor and cost and time related effect also have significant relationship. In last, material and equipment related factor and cost and time related effect also have significant relationship. Compare with other, relationship between of material and equipment related factor and cost and time related effect was the most high which is 0.45 at 0.01 levels.

4.8 MEAN AND RANKING CAUSES OF PROJECT CHANGE BY GROUPS (DEVELOPER, CONSULTANT AND CONTRATCOR)

In this part, respondents were being categorized into 3 groups, which are Developer, Consultant and Contractor. The analysis were carried out by using mean and ranking to identify which causes occur most and most important based on the perception from three parties. Table below shows the overview mean ranking of each sub causes according to 3 categories of respondents:

4.8.1 Ranking of causes based on three parties

Table 4.54 Mean ranking of the sub causes

	Developer		**Consultant**		**Contractor**		**Overall**	
Sub Causes of Project change	**Mean**	**Rank**	**Mean**	**Rank**	**Mean**	**Rank**	**Mean**	**Rank**
A) Consultant and design related factor								
A1-Error and omission in design	4.07	**3**	3.5	**7**	4.1	**5**	3.81	**19**

A2-Consultant poor in material and equipment knowledge	3.56	**10**	3.75	**6**	3.52	**15**	3.61	**23**
A3-Design complexity	3.75	**8**	3.88	**5**	4.14	**4**	3.93	**13**
A4-Consultant lack of coordination with other parties	3.88	**6**	4.12	**3**	3.67	**13**	3.89	**15**
A5-Lack of require data to design	3.75	**8**	4.12	**3**	4.24	**3**	4.03	**6**
A6- Change in design by consultant	3.81	**7**	3.75	**6**	3.71	**12**	3.76	**21**
B) Contractor related factor								
B1-Contractor's financial difficulties	4.06	**4**	4	**4**	4.14	**4**	4.07	**4**
B2-Contractor desired profitability	3.56	**10**	4.13	**2**	3.76	**12**	3.82	**18**
B3-Differing in site condition	3.88	**6**	4	**4**	3.81	**11**	3.9	**14**
B4-Lack of involvement in design	3.5	**11**	3.75	**6**	3.43	**16**	3.56	**24**
B5-Contractor poor in site management	3.88	**6**	3.25	**9**	3.9	**8**	3.68	**22**
B6-Contractor poor in judgment and lack of experience	4.06	**4**	3.88	**5**	4.05	**6**	4	**9**
B7-Lack of communication	4	**5**	4.13	**2**	3.9	**8**	4.01	**8**

with other parties								
C) Developer related factor								
C1-Slow decision making by developer	4.06	**4**	3.88	**5**	4	**7**	3.98	**10**
C2- Developer's financial problem	4.25	**1**	4.13	**2**	4.44	**1**	4.27	**1**
C3-Change in specification by developer	3.88	**6**	4.13	**2**	4.05	**6**	4.02	**7**
C4-Change in scope or plan of work by developer	3.69	**9**	3.88	**5**	3.9	**8**	3.82	**18**
C5-Change in schedule	4.06	**4**	4	**4**	3.76	**12**	3.94	**12**
D) Material and Equipment related factor								
D1-Material shortage in market	3.5	**11**	3.25	**9**	3.71	**13**	3.49	**25**
D2-Equipment shortage	4.06	**4**	4	**4**	3.85	**10**	3.97	**12**
D3-Equipment breakdowns	3.75	**8**	4.13	**2**	3.62	**14**	3.83	**17**
D4-Change in material type	3.69	**9**	3.88	**5**	3.76	**12**	3.78	**20**
D5-Delay in material delivery	4.06	**4**	3.88	**5**	4.33	**2**	4.09	**3**
E) Labor related factor								
E1-Defective workmanship	4.06	**4**	4	**4**	4.1	**5**	4	**9**
E2- Shortage in workers	4.13	**2**	4.25	**1**	4.24	**3**	4.21	**2**

F) External related factor								
F1-Weather condition	4	**5**	3.25	**9**	3.9	**8**	3.72	**22**
F2-Natural disaster	3.13	**12**	3.38	**8**	3.19	**17**	3.23	**24**
F3-Change in government rule and regulation	3.75	**8**	4	**4**	3.71	**13**	3.82	**19**
F4-Change in economic condition	4.13	**2**	4.13	**2**	3.86	**9**	4.04	**5**
F5-Technology change	3.88	**6**	3.88	**5**	3.86	**9**	3.87	**16**

Based on the ranking, the five most important causes of project change as perceive by developer are: (1) C2 (developer's financial problem) which is 4.25, (2), E2 (shortage in workers) and F4(change in economic condition) which all are 4.13, (3) A1 (error and omission in design) which is 4.07, (4) B1 (contractor's financial difficulties) , B6 (contractor poor in judgment and lack of experience) ,C1 (slow decision making by developer) , C5 (change in schedule) , D2 (equipment shortage) ,D5 (delay in material deliver) ,and E1 (defective workmanship) and F1 (weather condition)all which are 4.06 and (5) B7 (lack of communication with other parties) which is 4.0.

On the other hand, the five most important causes of project change as perceived by consultant are: E2 (shortage in worker) which is 4.25, (2) B2(contractor desired profitability) , B7 (lack of communication with other parties) , C2 (developer's financial problem), C3 (change in specification by developer) , D3 (equipment breakdown) and F4 (change in economic condition) , all of this have same ranking number which is 4.13, (3) A4 (consultant lack of coordination with other parties) , A5 (lack of required data) both are 4.12, (4) B1(error and omission in design) ,B3(differing site condition), C5(change in schedule) ,D2(equipment shortage), E1 (defective workmanship), F3(change in government rule and regulation) which are 4.0, (5) A3 (design complexity), B6(contractor poor in judgment and lack of experience), C1 (slow decision making by developer) ,C4 (change in scope or plan of

work by developer), D4 (change in material type) ,D5(delay in material deliver), and F5(technology change) which all are 3.88.

Besides that, the five most important causes of project change as perceive by contractor are: (1) C2 (developer's financial problem) which is 4,44, (2) D5(delay in material deliver) which is 4.33, (3) A5(lack of require data related to design) and E2(shortage in workers) both which are 4.24 , (4)A3 (design complexity) and B1 (contractor's financial difficulties) which are 4.14 ,and (5) A1 (error and omission in design) and E1 (defective workmanship) which are 4.1.

Overall, the five most important causes of project change based on three parties are: （1） C2 (developer's financial problem) which is 4.27, (2) E2 (shortage in workers) which is 4.21, (3) D5 (delay in material deliver) which is 4.09 (4) B1 (contractor's financial difficulties) which is 4.07 and (5) F4 (change in economic condition) which is 4.04.

4.8.2 Overall Ranking of main causes based on three parties

Table 4.55 Overall Ranking of main causes of project change

Category	**Developer**		**Consultant**		**Contractor**		**Overall**	
Main causes	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank
A) Consultant and design related factor	3.8	5	3.85	4	3.9	3	3.85	4
B) Contractor related factor	3.85	3	3.88	3	3.86	4	3.86	3
C) Developer related factor	3.99	2	4	2	4.03	2	4.01	2
D) Material and equipment	3.81	4	3.83	5	3.85	5	3.83	5

related factor								
E) Labor related factor	4.1	1	4.13	1	4.17	1	4.13	1
F) External related factor	3.78	6	3.73	6	3.7	6	3.74	6

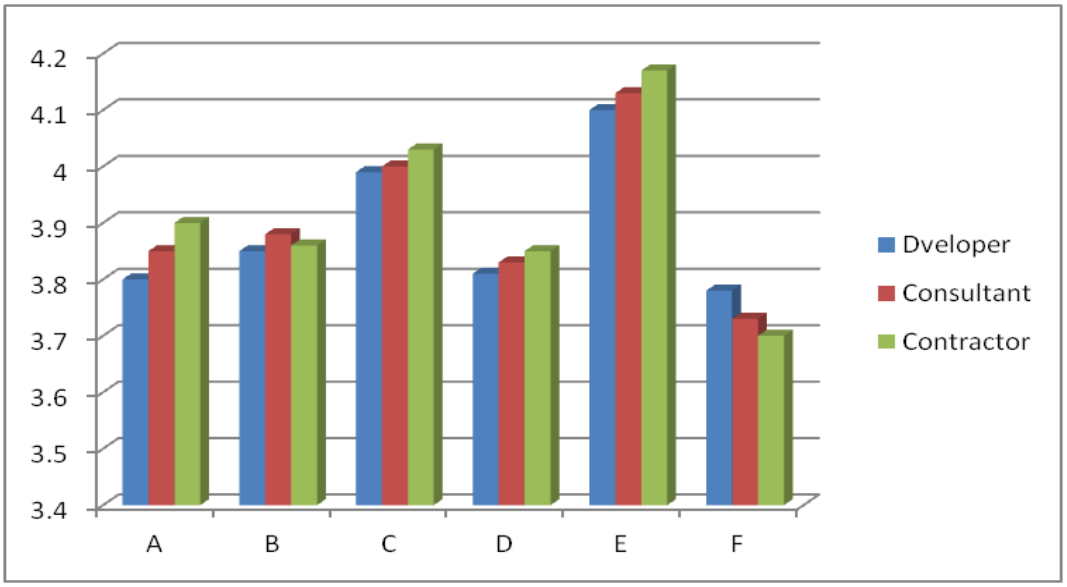

Figure 4.20 Histogram of overall ranking of main causes of project change based on three groups (developer, consultant and contractor)

Based on table 4.55 and figure 4.20 there are six group of causes of project change which are A) consultant and design related factor, B) Contractor related factor, C) Developer related factor, D) Material and equipment related factor, E) labor related factor and F) external related factor.

From graph, developers agree that (E) labor related factor are the main causes lead project change which is 4.1. Besides that, developers also agree that the (F) external related factor have the lowest mean ranking toward project change which is only 3.78. By the ways, the second highest ranking goes to C) developer related factor which is 3.99, B) contractor related factor the third which is 3.85,D) material and equipment related factor the fourth which is 3.81, and the A) consultant and design related factor the fifth which is 3.8.

Furthermore, according to consultant, they agreed that the main causes lead project change is E) labor related factor and the second highest is goes to C) developer related factor which is 4.00, the third is B) contractor related factor which is 3.88, the fourth is A) consultant and design related factor which is 3.85, the fifth is goes to D) material and equipment related factor which is 3.83 and the last is goes to F) external related factor which is 3.73.

Besides that, based on contractor, the main causes is goes to E) labor related factor (4.17), the second causes is C) developer related factor (4.03), the third causes is A) consultant and design related factor (3.9), the fourth causes is B) contractor related factor (3.86), the fifth causes is E) labor related factor (3.85) and the last is F) external related factor (3.7).

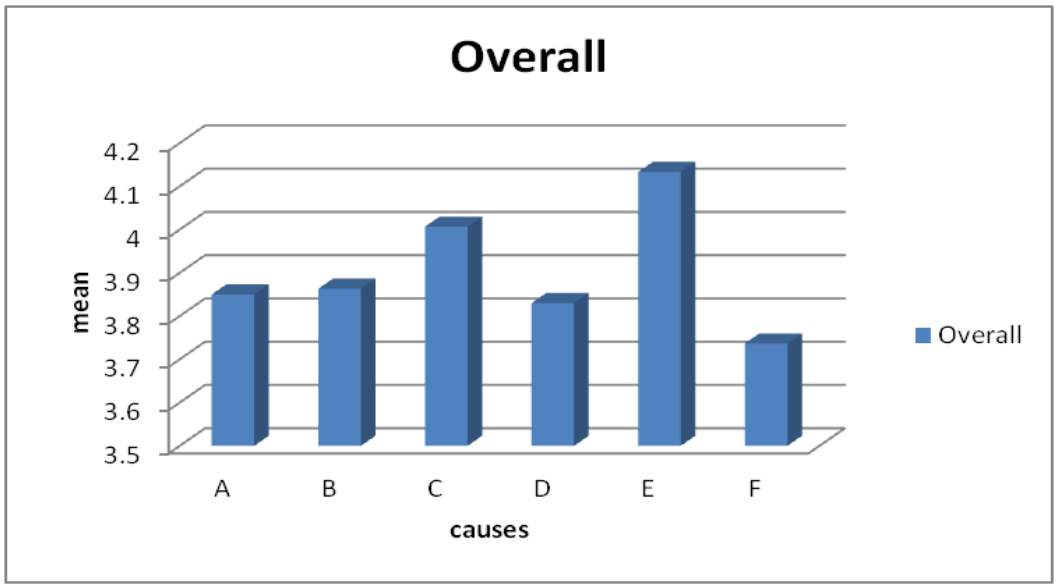

Figure 4.21 Histogram of main causes of project change (overall ranking)

Overall, based on figure 4.21 ,the most important causes of project change is goes to E) labor related factor (4.13), the second highest causes is C) developer related factor (4.01), the third highest is B) contractor related factor (3.86), the fourth highest is goes to A) consultant and design related factor(3.85) ,the fifth highest goes to D) material and equipment related factor (3.83) and the last is F) external related factor (3.74).

4.9 MEAN AND RANKING EFFECTS OF PROJECT CHANGE BY GROUPS (DEVELOPER, CONSULTANT AND CONTRATCOR)

In this part, respondents were being categorized into 3 groups, which are Developer, Consultant and Contractor. The analysis were carried out by using mean and ranking to identify which effects is most important based on the perception from three parties. Table below shows the overview mean ranking of sub effects according to 3 categories of respondents:

4.9.1 Ranking of effect based on three parties

Table 4.56 Mean ranking of the sub effects

	Developer		**Consultant**		**Contractor**		**Overall**	
	Mean	**Rank**	**Mean**	**Rank**	**Mean**	**Rank**	**Mean**	**Rank**
A) Time related effect								
A1-Delay in completion schedule	4.31	**2**	4.38	**2**	4.38	**3**	4.36	**2**
A2-Delay in payment	3.94	**6**	4	**4**	4.43	**2**	4.12	**4**
A3-Delay in procurement process	3.81	**8**	4.38	**2**	3.86	**9**	4.02	**7**
A4-Interruption of continue works	4.06	**5**	4	**4**	4.1	**6**	4.05	**6**
B) Cost related effect								
B1-Increase project cost	4.38	**1**	4.5	**1**	4.29	**4**	4.39	**1**
B2-Increase in overhead expenses	4.13	**4**	4.13	**3**	4.48	**1**	4.25	**3**

B3-Material waste	3.81	**8**	3.88	**5**	3.95	**8**	3.88	**11**
B4-Addition payment for contractor	3.88	**7**	4	**4**	3.95	**8**	3.94	**8**
C) Cost and Time related effect								
C1-Hiring new professional	3.56	**10**	3.63	**7**	3.38	**13**	3.52	**13**
C2-Rework and demolition	3.94	**6**	4.13	**3**	4.19	**5**	4.09	**5**
D) Quality and Productivity effect								
D1-Productivity degradation	3.94	**6**	4	**4**	3.86	**9**	3.93	**9**
D2-Quality degradation	3.81	**8**	3.75	**6**	3.86	**9**	3.81	**10**
E) Other related effect								
E1-Damage to firm's reputation	4.19	**3**	3.88	**5**	3.62	**11**	3.9	**10**
E2-Low morale of labor	3.31	**11**	3.5	**8**	3.48	**12**	3.43	**14**
E3-Poor safety condition	3.69	**9**	3.63	**7**	3.71	**10**	3.68	**12**
E4-Contract claim and dispute among professional	3.69	**9**	4	**4**	4	**7**	3.9	**10**

Table 4.56 shows the overview mean ranking of effects of project change .From table 4.20, the most five highest mean ranking effects based on developer perception are: (1) B1 (increase project cost) which is 4.38, (2) A1 (delay in completion schedule) which is 4.31, (3), E1 (damage to firm's reputation) which is 4.19, (4) B2 increase in overhead expenses which is 4.13(5) A4 (interruption of continue works) which is 4.06.

According to consultant, the most five highest mean ranking effects are: (1) B1 (increase project cost) which is 4.5, (2) A1 delay in completion schedule and A3 delay in procurement process which both is 4.38, (3) B2 (increase in overhead expenses) and C6 (rework and demolition) which both are 4.13, (4) A2(delay in payment) , A4 (interruption of continue work), B4 (addition payment for contractor) ,D1 (productivity degradation) and E4 (contract claim and dispute among professional) which all are 4.0, (5) B3 (material waste) and E1 (damage to firm's reputation) both which are 3.88.

Based on contractor, the five highest mean ranking of effects of project change are: (1) B2 (increase in overhead expenses) which are 4, 48, (2) A2 (delay in payment) which is 4.43, (3) A1 (delay in completion schedule) which is 4.38, (4) B1 (increase project cost) which is 4.39 and (5) C2 (Rework and demolition) which is 4.19.

Based on overall, the five highest mean ranking of effects are: (1) B1 (increases project cost) which is 4.39, (2) A1 (delay in completion schedule) which is 4.36, (3) B2 (increase in overhead expenses) which is 4.25, (4) A2 (delay in payment) which is 4.12 and (5) C2 (rework and demolition) which is 4.09.

4.9.2 Overall Ranking of main effects based on three parties

Table 4.57 Overall Ranking of main effect of project change

Category	**Developer**		**Consultant**		**Contractor**		**Overall**	
Main effects	**Mean**	**Rank**	**Mean**	**Rank**	**Mean**	**Rank**	**Mean**	**Rank**
A) Time related effect	4.03	**2**	4.19	**1**	4.2	**1**	4.14	**1**
B) Cost related	4.05	**1**	4.13	**2**	4.17	**2**	4.12	**2**

effect								
C) Cost and time related effect	3.75	**4**	3.88	**3**	3.79	**4**	3.81	**4**
D) Productivity and quality effect	3.88	**3**	3.88	**3**	3.86	**3**	3.87	**3**
E) Other related effect	3.72	**5**	3.75	**4**	3.7	**5**	3.72	**5**

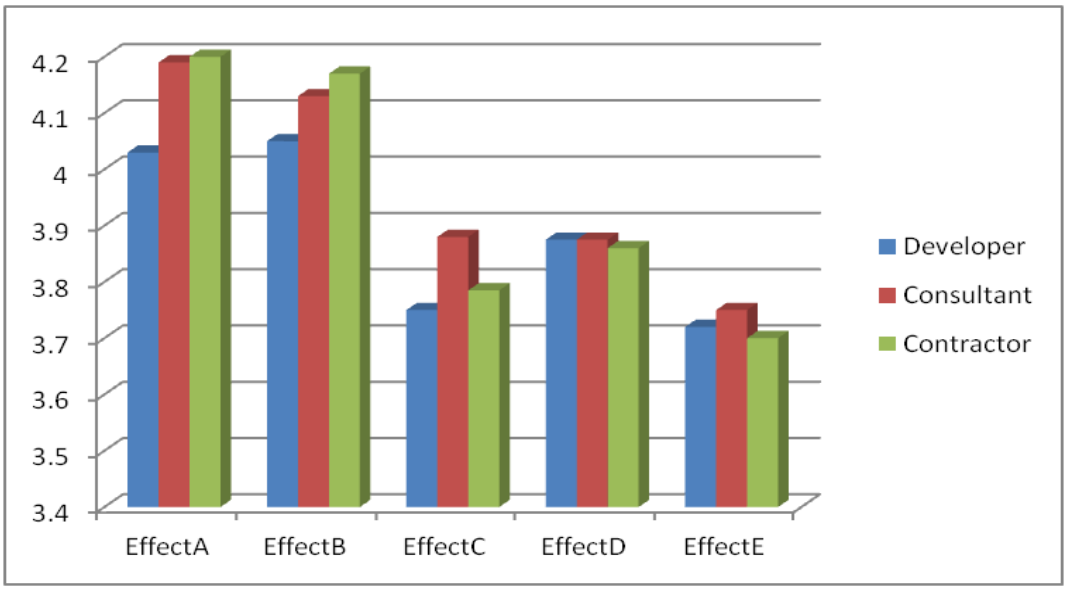

Figure 4.22 Histogram of overall ranking of main effect of project change based on three groups (developer, consultant and contractor)

Table 4.57 and figure 4.22 shows the overall mean ranking of main effects of project change based on three parties' view. There are 5 categories of effects of project change which are time related effect, cost related effect, cost and time related effect, productivity and quality effect and the last is other related effect. According to developer, effect B cost related effect has achieve highest mean ranking which is 4.05, then the second highest is goes to A time related effect (4.03), the third is goes to D productivity and quality effect (3.88), the next is fourth highest which is C cost and time

related effect (3.75), and the last and lowest ranking is goes to E other related effect (3.72).

Besides that, according to consultant , the highest mean ranking is achieve by A time related effect (4.19) whereas the lowest mean ranking is goes on E other related effect (3.75). Following is the second highest mean ranking is B cost related effect (4.13) C cost and time and D productivity and quality effect both are same achieve third highest ranking3.88

Furthermore, based on contractor, A time related effect has the highest ranking which is 4.2, after that the second highest ranking is belong to B cost related effect (4.17), then the third highest is goes on D productivity and quality effect (3.86) and the fourth highest is goes to C cost related effect (3.78). In addition, the lowest mean ranking is goes to E other related effect which is 3.7 only.

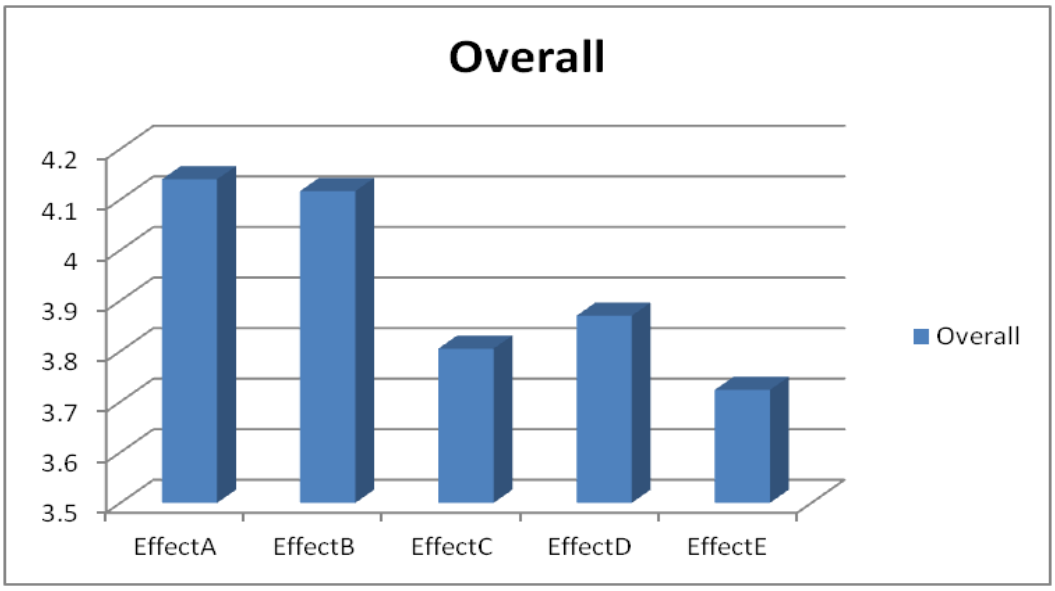

Figure 4.23 Histogram of main effects of project change (overall ranking)

Figure 4.23 shows the overall mean ranking of main effects of project change. A time related effect has the highest mean ranking which is 4.14 whereas E other related effect has the lowest mean ranking which are 3.72. After that, the second highest is goes

on B cost related effect (4.12), the third highest goes to D productivity and quality effect (3.87) and the fourth highest is achieve by C cost and time related effect (3.81).

4.10 CORRELATION ANALYSIS (SPEARMAN'S RANK CORRELATION)

According to Assaf and Al-Heijji(2006), spearman's rank correlation which is a non parametric test. In this research, spearman's rank correlation has been carried out to test the degree agreement between different parties. There are three groups of parties in this research who are consultant, contractor and developer. The correlation coefficient take value between +1 and -1, where +1 mean strong positive relationship (agreement) and -1 indicating strong negative relationship (disagreement). Meanwhile, the higher correlation coefficient, the stronger relationship (agreement) between respondents would be.

4.10.1 Correlation analysis for causes of project change

4.10.1.1 Correlations between developer and consultant

Table 4.58 Spearman's rank correlation between developer and consultant

Correlations

			Developer	Consultant
Spearman's rho	Developer	Correlation Coefficient	1.000	.943**
		Sig. (2-tailed)	.	.005
		N	6	6
	Consultant	Correlation Coefficient	.943**	1.000
		Sig. (2-tailed)	.005	.
		N	6	6

**. Correlation is significant at the 0.01 level (2-tailed).

Table 4.58 shows the Spearman's rank correlation between 2 categories of respondent which are Developer and Consultant. From the table, N shows the number of causes by categories. That mean there are 6 groups in causes which are consultant and design related factor, contractor related factor, developer related factor, material and equipment related factor, labor factor and external factor. From table, developer and consultant achieve the Correlation coefficient value of 0.943 and the Sig. value of 0.005. If significance probability is lesser than the level of significance, correlate is significant. The higher correlation indicates that there is a high degree agreement between developer and consultant. Therefore there is significant relationship between Developer and Consultant in the rankings as the Sig. value is less than 0.01.It is also strong positive relationship as the correlation coefficient is 0.943 which nearest to +1.

4.10.1.2 Correlations between developer and contractor

Table 4.59 Spearman's rank correlation between developer and consultant

Correlations

			Developer	Contractor
Spearman's rho	Developer	Correlation Coefficient	1.000	.829*
		Sig. (2-tailed)	.	.042
		N	6	6
	Contractor	Correlation Coefficient	.829*	1.000
		Sig. (2-tailed)	.042	.
		N	6	6

*. Correlation is significant at the 0.05 level (2-tailed).

Table 4.59 shows the spearman's rank correlation between developer and consultant. From table, developer and consultant achieve the correlation coefficient value of 0.829 and the sig. value of 0.042. Therefore there is a significant relationship between developer and consultant as the sig value is less than 0.05. It also shows strong positive relationship because the correlation coefficient is 0.829 which nearest to +1.

4.10.1.3 Correlation between contractor and consultant

Table 4.60 Spearman's rank correlation between contractor and consultant

Correlations

			Consultant	Contractor
Spearman's rho	Consultant	Correlation Coefficient	1.000	.943**
		Sig. (2-tailed)	.	.005
		N	6	6
	Contractor	Correlation Coefficient	.943**	1.000
		Sig. (2-tailed)	.005	.
		N	6	6

**. Correlation is significant at the 0.01 level (2-tailed).

Table 4.60 shows the spearman's rank correlation between contractor and consultant. From table, there is strong positive relationship between contractor and consultant as the correlation coefficient between two group respondents is 0.943. Besides that, the Sig. value is 0.005 which is lower than 0.01. That means there have significant relationship among them.

**Correlation is significant at the 0.01 level (2-tailed).

		Developer	**Consultant**	**Contractor**
Spearman's rho Developer	Correlation Coefficient	1.000	0.943**	0.829*
	Sig(2 -tailed)	-	0.005	0.042
	N (number of causes based on group)	6	6	6
Spearman's rho Consultant	Correlation Coefficient	0.943**	1.000	0.943**
	Sig(2 -tailed)	0.005	-	0.005
	N	6	6	6
Spearman's rho Contractor	Correlation Coefficient	0.829*	0.943**	1.000
	Sig(2 -tailed)	0.042	0.005	-
	N	6	6	6

*. Correlation is significant at the 0.05 level (2-tailed).

Table 4.61 shows the summary of Spearman's correlation between developers, consultant and contractor for causes of project change in construction industry. In nutshell, there is strong agreement between consultant and developer. Besides that there is a strong agreement between contractor and consultant.

4.10.2 Correlation analysis for effects of project change

4.10.2.1 Correlation between developer and consultant

Table 4.62 Spearman's rank correlation between developer and consultant

Correlations

			Developer	Consultant
Spearman's rho	Developer	Correlation Coefficient	1.000	.800
		Sig. (2-tailed)	.	.104

		N	5	5
	Consultant	Correlation Coefficient	.800	1.000
		Sig. (2-tailed)	.104	.
		N	5	5

Table 4.62 shows the spearman's rank correlation between developer and consultant. There are 5 groups of effects of project change which are time related effect, cost related effect, and cost and time related effect, productivity and quality effect and other related effect. From the table, there is no significant relationship between two parties' respondent as their Sig value is more than 0.05 and their correlation coefficient is 0.800. That mean the correlation is not significant.

4.10.2.2 Correlation between developer and contractor

Table 4.63 Spearman's rank correlation between developer and contractor

Correlations

			Developer	Contractor
Spearman's rho	Developer	Correlation Coefficient	1.000	.900*
		Sig. (2-tailed)	.	.037
		N	5	5
	Contractor	Correlation Coefficient	.900*	1.000
		Sig. (2-tailed)	.037	.
		N	5	5

Table 4.63 shows the rank correlation between two parties' respondent developer and contractor. From table, they achieve correlation coefficient value of 0.900

and the sig. value is 0.037. Mean, there is strong positive relationship between these two parties as their high correlation coefficient near to +1 and the sig value is less than 0.05 that means the there is significant relationship.

4.10.2.3 Correlation between contractor and consultant

Table 4.64 Spearman's rank correlation between contractor and consultant

			Contractor	Consultant
Spearman's rho	Contractor	Correlation Coefficient	1.000	.900*
		Sig. (2-tailed)	.	.037
		N	5	5
	Consultant	Correlation Coefficient	.900*	1.000
		Sig. (2-tailed)	.037	.
		N	5	5

*. Correlation is significant at the 0.05 level (2-tailed)

Table 4.64 shows the spearman's rank correlation between two parties who are contractor and consultant. Bases on table, both of them achieve correlation coefficient value of 0.900 and the sig. value is 0.037. There have significant relationship. Again, there is strong positive relationship between these two parties as their high correlation coefficient near to +1 and the sig value is less than 0.05.

Table 4.65 Summary of Spearman's rank correlation coefficient of the Developers, Consultants and Contractors for effects of project change

Table 4.65 shows the summary of Spearman's rank correlation of the developers, consultant and contractor for effects of project change in construction industry. In

		Developer	**Consultant**	**Contractor**
Spearman's rho Developer	Correlation Coefficient Sig(2 -tailed) N (number of causes based on group)	1.000 - 5	0.800 0.104 5	0.900* 0.037 5
Spearman's rho Consultant	Correlation Coefficient Sig(2 -tailed) N	0.800 0.104 5	1.000 - 5	0.900* 0.037 5
Spearman's rho Contractor	Correlation Coefficient Sig(2 -tailed) N	0.900* 0.037 5	0.900* 0.037 5	1.000 - 5

nutshell, there is strong agreement between contractor and developer, and also consultant and contractor.

Overall the results are shown by:

Table 4.66 Overall of spearman's rank correlation of developers, consultant, and contractor for causes and effect of project change

Causes	**Relationship**
Developer- Consultant	Strong Positive Agreement
Developer- Contractor	Strong Positive Agreement
Consultant- Contractor	Strong Positive Agreement

Effects	**Relationship**
Developer- Consultant	No Agreement
Developer- Contractor	Strong positive Agreement
Consultant- Contractor	Strong Positive Agreement

4.11 SUMMARY OF FINDINGS

In demographic analysis result, most of the respondents are among group age 41-50 (26.7 %) and majority are male (64.4%). Besides that, the working experience group between 11-15 years has the highest percentage (28.9%) compare with other group. Among respondents, most of them come from contractor company (46.7%) compare with other type. Majority of the respondents are taking project manager and project engineer position (28.9%) and most of respondents hold degree highest level of education (68.9 %).

Besides that this research has three objectives:

i. To identify the causes of project change in construction industry.
ii. To find out the effects of project change in construction industry.
iii. To examine the relationship between the causes and effects of the project change.

4.11.1 Summary finding of causes of project change in construction industry

The researcher would like to identify causes of project change in this research. After went through the analysis, data analysis had been done. The result as below:

Table 4.67 Overview causes of project change (based on 45 respondents)

Causes of project change	Sub element		Main element	
	Mean	**Rank**	**Mean**	**Rank**
A) Consultant and design related factor			**3.86**	3
1) Error and omission in design	3.98	**9**		
2) Consultant poor in material and equipment knowledge	3.96	**10**		
3) Design complexity	3.82	**13**		
4) Consultant lack of coordination with other parties	4.04	**6**		
5) Lack of require data related to design	3.58	**17**		
6) Change in design by consultant	3.75	**16**		
B) Contractor related factor			**3.86**	3
1) Contractor's financial difficulties	4.09	**4**		
2) Contractor desired profitability	3.76	**15**		
3) Differing site condition	3.87	**12**		
4) Lack of involvement in design	3.51	**19**		
5) Contractor poor in site management	3.78	**14**		
6) Contractor poor in judgment and lack of experience	4.02	**7**		
7) Lack of communication with other parties	3.98	**9**		
C) Developer related factor			**4.00**	2
1) Slow decision making by developer	4.27	**1**		
2) Developer's financial problem	4.00	**8**		
3) Change in specification by developer	4.00	**8**		
4) Change in scope or plan of work by developer	3.82	**13**		
5) Change in schedule	3.91	**11**		

D) Material and equipment related factor	3.56	**18**	**3.84**	4
1) Construction Material Shortage in market	4.00	**8**		
2) Equipment shortage	3.76	**15**		
3) Equipment breakdowns	3.73	**16**		
4) Change in material type	4.16	**3**		
5) Delay in material delivery				
E) Labor related factor			**4.14**	1
1) Defective workmanship	4.07	**5**		
2) Shortage in workers	4.20	**2**		
F) External related factor			**3.73**	5
1) Weather condition	3.82	**13**		
2) Natural disaster	3.20	**20**		
3) Change in government rule and regulation	3.78	**14**		
4) Change in economic condition	4.00	**8**		
5) Technology change	3.87	**12**		

There are 45 respondents in this research. From the overall of main element, the highest mean is goes to E- labor related factor (4.14), then the second highest mean is goes to C -developer related factor (4.00), and the third highest mean is B -contractor related factor and A- consultant and design related factor, which both have same mean (3.86). Following is the fourth highest which D material is and equipment related factor (3.84) and the lowest mean is goes on F- external related factor categories which is 3.73 only. Most of the respondent agreed that the labor related factor is important main group factor will impact on project change. Whereas, the less important main causes is goes on external related factor. Therefore, the solution should be found out the solution in order to avoid those causes affect project change.

4.11.2 Summary finding of effect of project change in construction industry

To identify the second research objective which is to identify the effects of project change in construction industry, the researcher had achieved a result from the data analysis. The result is show as below:

Table 4.68 Overview of effect of project change (based on 45 respondents)

Effects of project change	**Sub element**		**Main element**	
	Mean	**Rank**	**Mean**	**Rank**
A) Time related effect			**4.14**	1
1) Delay in completion schedule	4.36	1		
2) Delay in payment	4.18	3		
3) Delay in procurement process	3.93	6		
4) Interruption of continue works	4.07	5		
B) Cost related effect			**4.12**	2
1) Increase project cost	4.36	1		
2) Increase in overhead expenses	4.29	2		
3) Material waste	3.89	8		
4) Addition payment for contractor	3.93	6		
C) Cost and time related effect			**3.79**	4
1) Hiring new professional	3.49	12		
2) Rework and demolition	4.09	4		
D) Productivity and quality effect			**3.86**	3
1) Productivity degradation	3.91	7		
2) Quality degradation	3.80	10		
E) Other related effect			**3.72**	5
1) Damage to firm's reputation	3.87	9		
2) Low morale of labor	3.42	13		

3) Poor safety condition 4) Contract claim and dispute among professional	3.69 3.89	11 8		

From the sub element, delay in completion schedule had the highest mean and rank whereas low morale labor shows the lowest mean .Besides that, Table 4.68 also shows the overall main element mean and rank of effect. There are 5 categories which are A) time related factor, B) cost related effect, C) cost and time related effect, D) productivity and quality related effect and E) external related effect. From table, the highest mean is goes to time related effect (4.14), the second highest is goes on cost related effect(4.12), third is goes to productivity and quality related effect (3.86) , the fourth is goes to cost and time related effect (3.79) and the last is external related effect (3.72). In a nutshell, most of the respondent agreed that time related effect is most important main effect group. Whereas, they also agreed that the external related effect is not much important effect and it might not frequent occur on project change.

4.12 FISHBONE DIAGRAM

Fishbone diagram can also be called as Ishikawa diagram or causes and effect diagram. It used to examine and identify all the causes (or inputs) that result in a single effect (or output). Causes are arranged according to their level of importance or detail (SkyMat, 2013). This can help you find for root causes, identify areas where there may be problems, and compare the relative importance of different causes.

Below shows the Fishbone diagram between various causes to one effect. The causes of project change had been arranged according to their correlation between effects. That means, if the causes are important to the effect, the causes will vary on the place near to effect. There are five diagram at below, the first if various causes and time related effect, the second is the various causes and cost related effect, the third is various causes and cost and time related effect then the fourth is various causes and productivity and quality related effect and the last is various causes and other related effect.

4.12.1 Fishbone diagrams of causes and time related effect

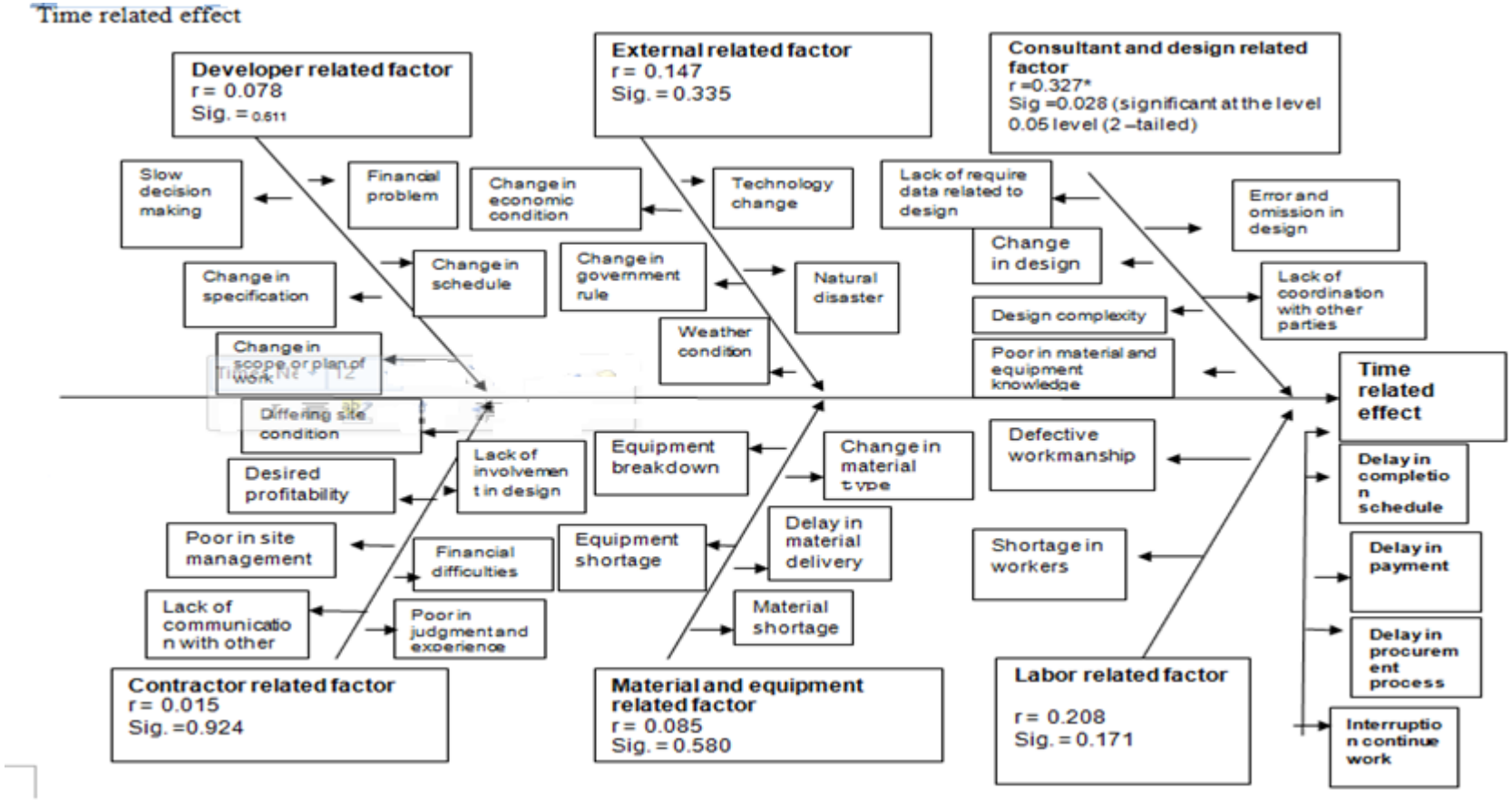

Figure 4.24 Fishbone diagrams of causes and time related effect

4.12.2 Fishbone diagrams between causes and cost related effect

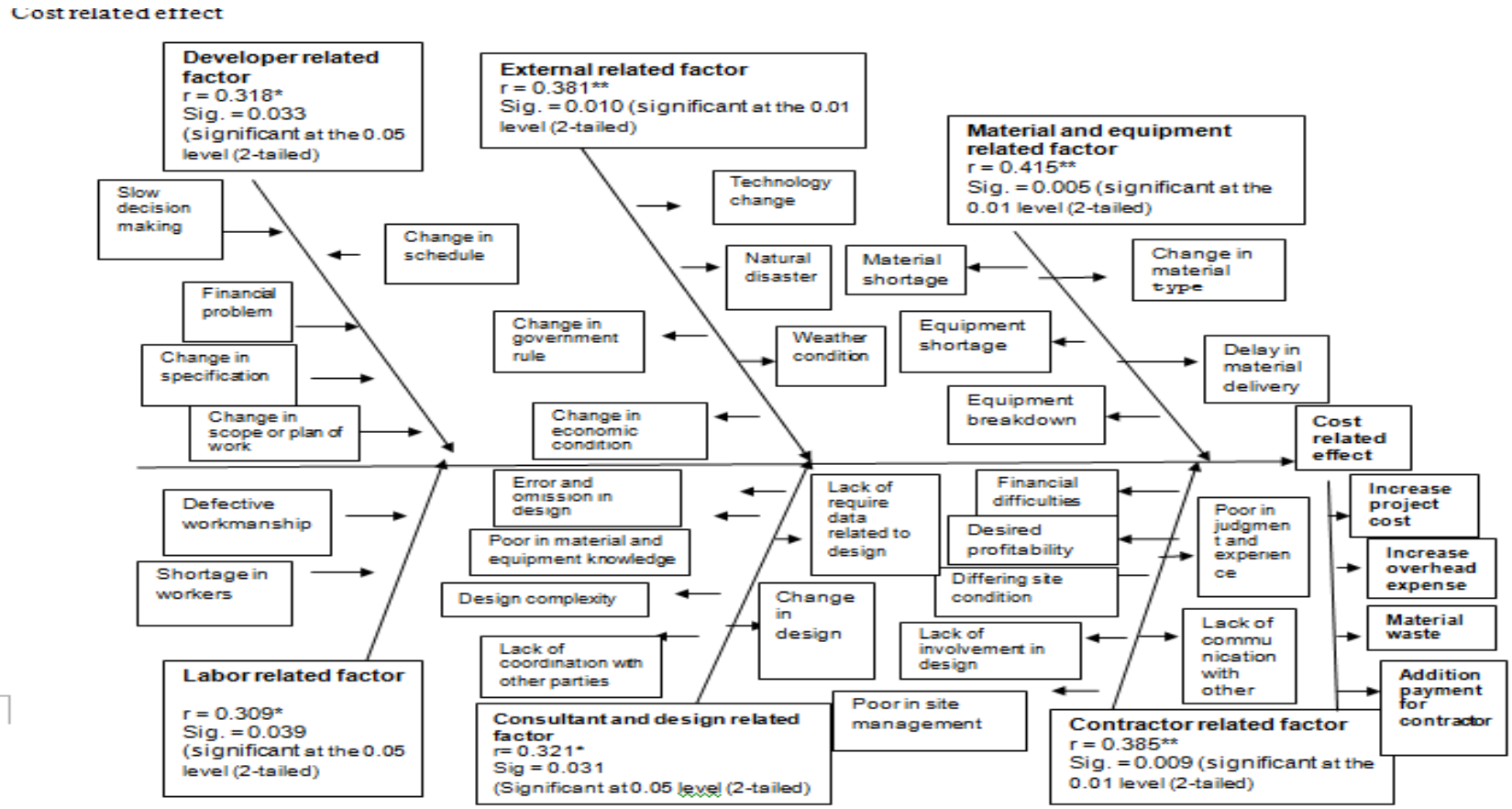

Figure 4.25 Fishbone diagrams between causes and cost related effect

4.12.3 Fishbone diagram between causes and cost and time related effect

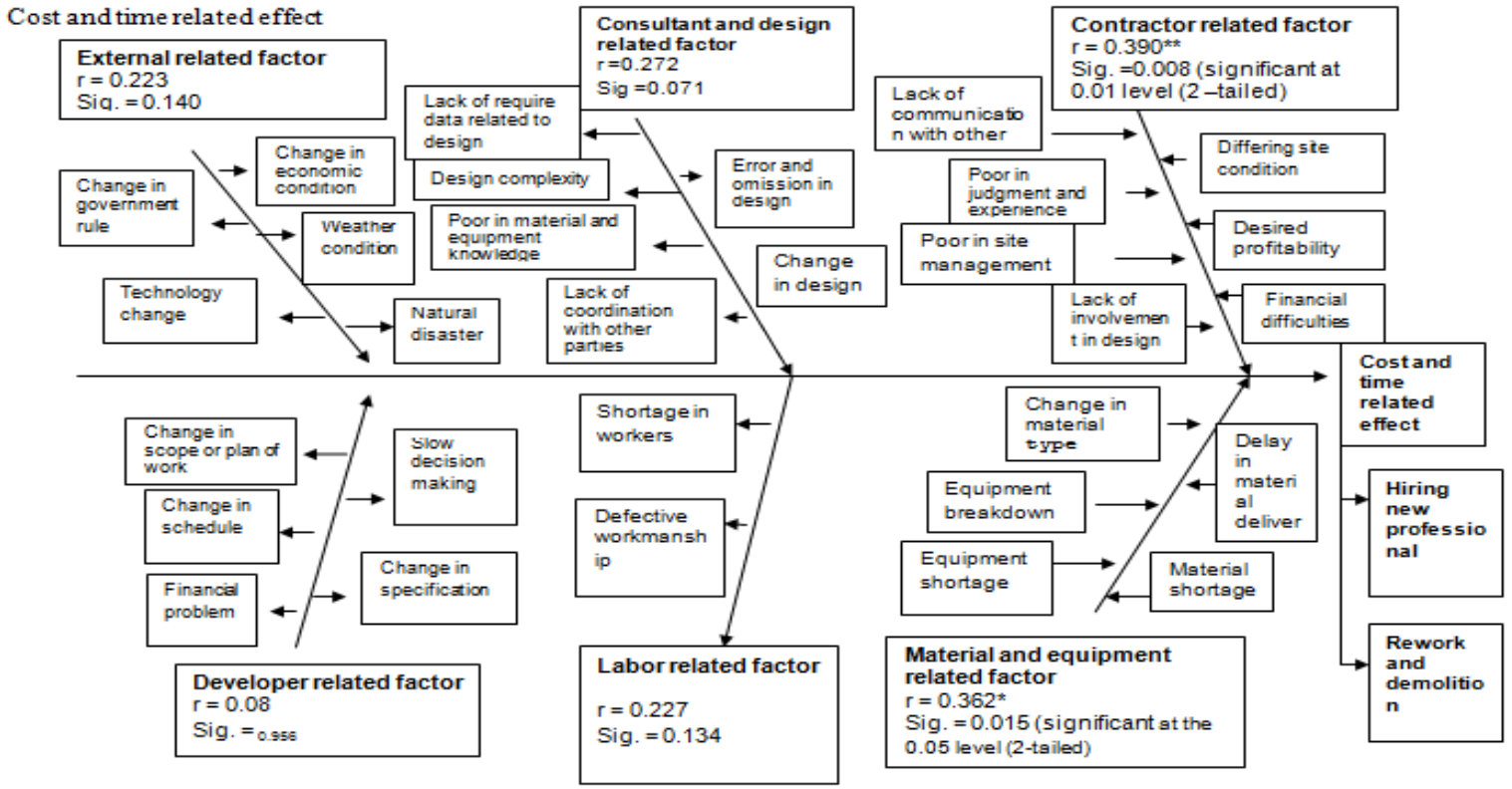

Figure 4.26 Fishbone diagram between causes and cost and time related effect

4.12.4 Fishbone diagram between causes and productivity and quality related effect

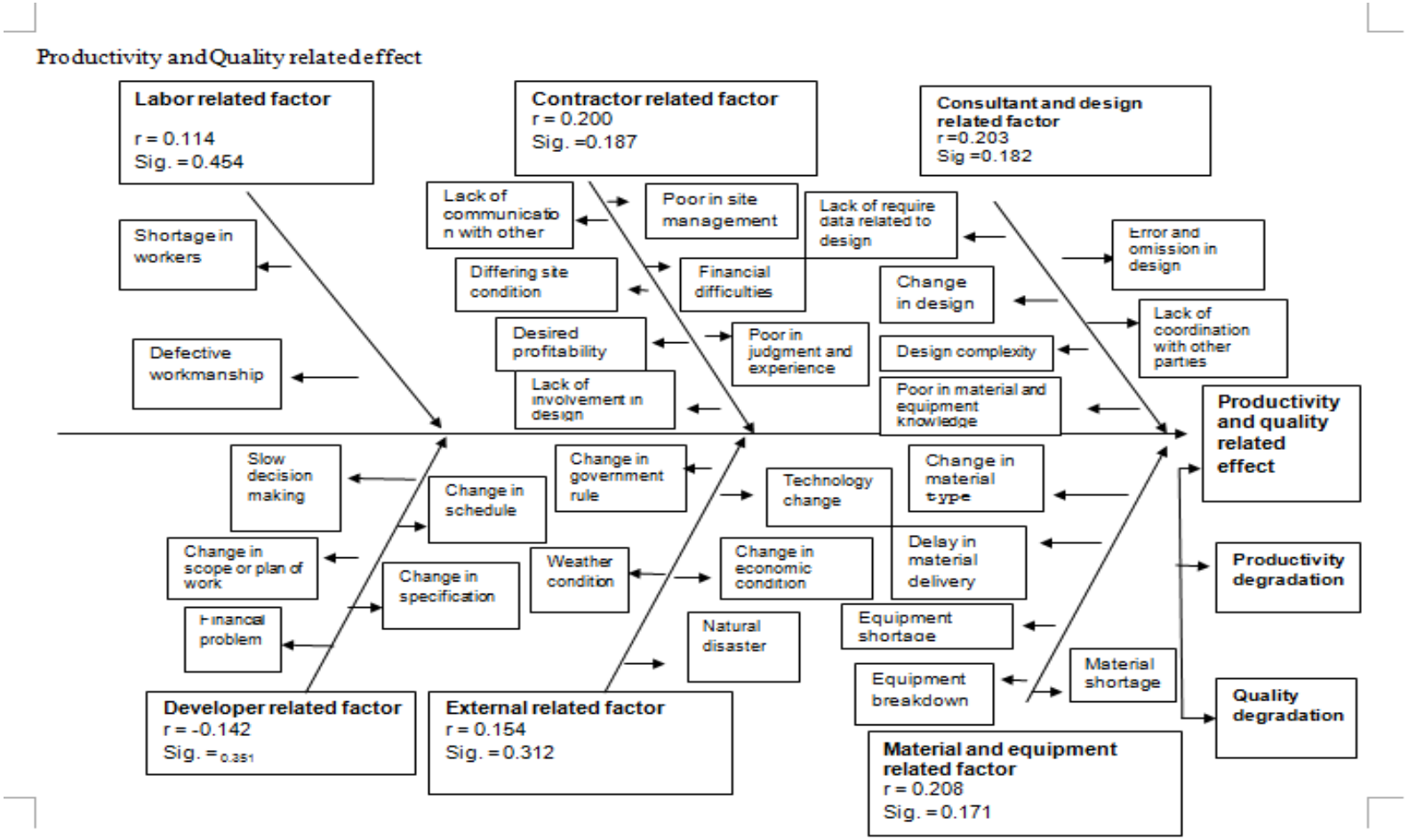

Figure 4.27 Fishbone diagram between causes and productivity and quality

4.12.5 Fishbone diagrams between causes and other related effect

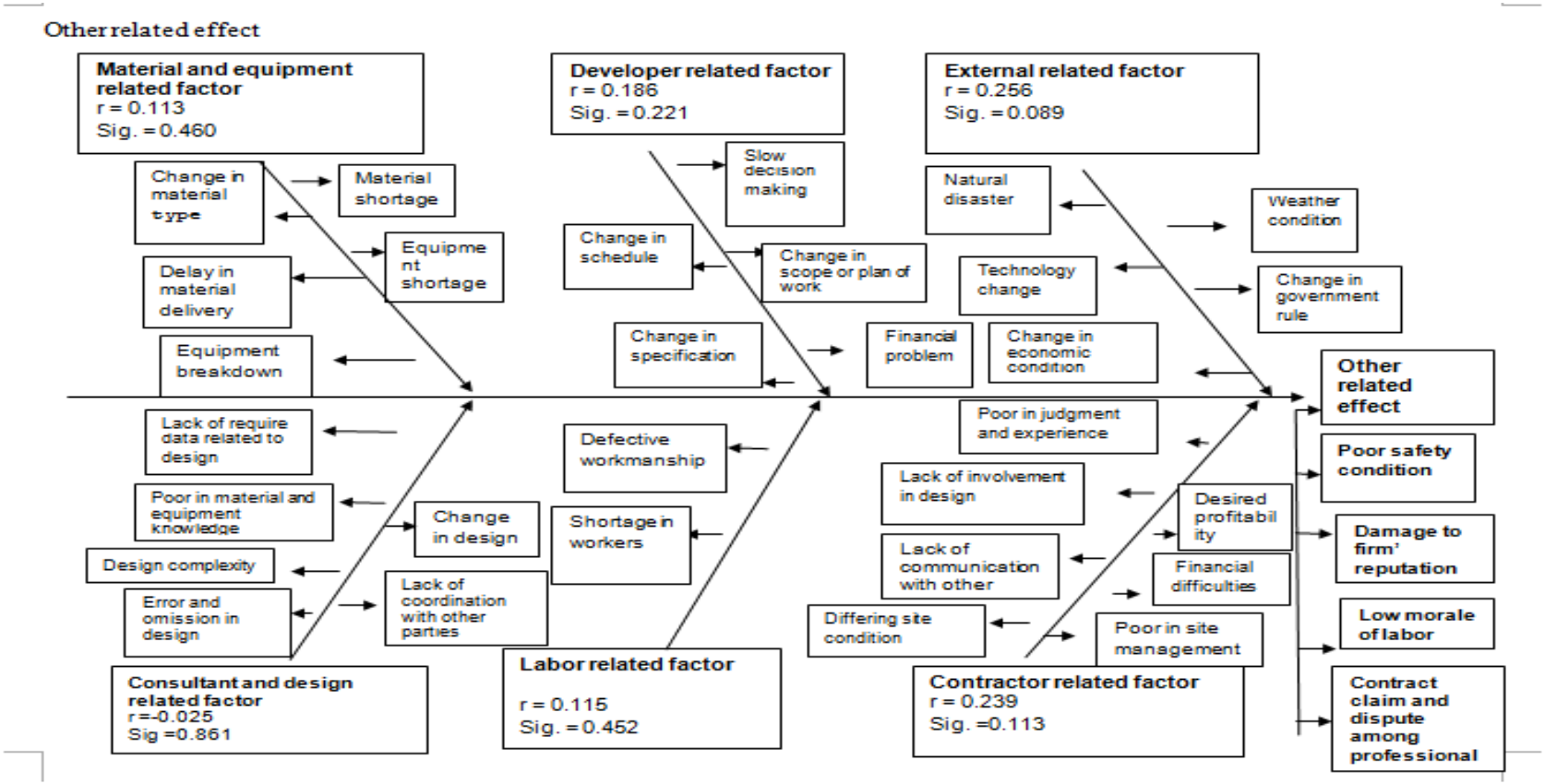

Table 4.28 Fishbone diagrams between causes and other related effect

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 INTRODUCTION

In this chapter, discussions of result, limitation and recommendation of future research and the conclusion had been carried out. This research mainly is to study the causes and effect of project change.

5.2 DISCUSSION

There are three objectives in this research .Firstly is to identify the causes of project change in construction industry. The second objective is to find out the effects of project change in construction industry. The third objective is to examine the relationship between causes and effect of project change. All of three research objectives (RO) are successfully achieved.

RO1: Identify the causes of project change in Construction Industry

Firstly, we discuss the result obtained by analyzing the causes of project change. In this research, there are 30 causes of project change and had been classify into 6 groups which included consultant and design related factor, contractor related factor, developer related factor, material and equipment related factor, labor related factor and the last is external related factor.

From previous chapter, based on 45 respondents, the five most important causes that will lead to project change were: (1) slow decision making by developer (mean

=4.27), (2) shortage in workers (mean =4.20), (3) delay in material delivery (mean=4.16), (4) Contractor financial difficulties (mean = 4.09), and (5) defective workmanship (mean = 4.07).

Major of the respondent agreed that slow decision making by developer which is the most important factor that impact on project change. There are many reason of the slow decision making by developer. Due to not enough experience, developer late in review and approvals projects and directly impact on project change. Besides that, respondents also agreed that the shortage in workers is the second important causes that impact on project change. Construction project is complex and difficult, thus need a lot of labor to complete it. Shortages in workers will cause the insufficient labor to finish the progress of the work and will directly impact on project delay.

Apart from that, respondents also agreed that, the delay in material delivery is the third important causes that impact on project change. The ineffective communication with supplier will cause the delay in material and directly impact on project schedule change. Contractor financial difficulties are the fourth important causes that will impact on project change. Contractor don't have enough money to paid workers, material and equipment fees and will directly impact on project change. In addition, defective workmanship is the fifth highest important causes that will impact on the project change. In a project team, there is important to have skills and knowledgeable workers to undertaken project. The poor workmanship can cause error and impacts on change occur in project. Moreover, natural disaster has the lowest mean and rank among those causes which is just only 3.20. There is only less respondent agreed that natural disaster is important causes in impact project change.

Overall, 45 respondents agreed that labor related factor group (mean =4.14) is the most important factor that cause the project change, whereas, they also agreed that external related factor group (mean=3.73) is the less important factor that will cause project change.

Mean and ranking of causes of project change also had been carried out in chapter 4 based on the different viewpoints of three parties (developer, consultant and

contractor). According to developer views, the three most important causes were: (1) developer's financial problem (mean=4.25), (2) shortage in workers and change in economic condition (mean=4.13), (3) error and omission in design (mean= 4.07). From developer views, they agreed that the developer's financial problem is the most important causes impact on project change whereas they also agreed that the less important of causes that will impact on project change is goes to natural disaster (mean= 3.13).The frequency of the natural disaster happen is low, so it not very important causes impact on project change.

Besides that, according to consultant's view, the three most important causes were: (1) shortage in worker (mean=4.25), (2) contractor desired profitability, lack of communication with other parties, developer's financial problem, change in specification by developer, equipment breakdown and change in economic condition have same mean and rank (mean=4.13) (3) consultant lack of coordination with other parties and lack of required data (mean= 4.12). In contrast, from consultant view , they agree that weather condition, material shortage and contractor poor in site management is less important causes will impact on project change which the mean is only 3.25 respectively.

From contractor view, the three most important causes were: (1) developer's financial problem (mean=4.44), (2) delay in material delivery (mean= 4.33), (3) lack of require data related to design and shortage in workers (mean =4.24). From contractor view they also agreed that natural disaster (mean =3.19) is less important causes in affect project change.

Last but not least, organization should focus on those causes that are important and so that can minimize the project change occur with right place and direction. From the result, they should focus on labor related factor because the group of factors has the higher potential impact on project change.

RO 2: Find out the effects of project change in Construction Industry

Secondly, we discuss the effect of project change in construction industry. There are 16 effects of project change and had been categories into 5 groups which are time related effect, cost related effect, cost and time related effect, productivity and quality related effect, and the last is other related effect.

From 45 respondents, the five most important effects of project change were: (1) increase project cost (mean =4.36), (2) increase overhead in expenses (mean =4.29), (3) delay in payment (mean =4.18), (4) rework and demolition (mean=4.09), and (5) interruption of continue works (mean= 4.07).

Majority of the respondents agree that increase project cost is the most important effect on project change. According to Arain and Low (2005), increase project cost is most frequent effect that occurs in project change. The alteration, change in work, design and schedule of the project will impact on the total cost project increase. This is because more resources need to be allocated in order to complete the project. Besides that, respondents also agreed that the second important effect is increase project overhead expenses. Project change need to require processing procedures, proper documentation, paperwork and review before they implementation it. Thus it will increase the overhead expenses if project changes occur. From respondents, they also agreed that delay in payment is the third important effect in project change. Delay in payment will occur when the extra work and total cost of project increase. Contractor and developer might face financial difficulties due to extra work. The rework and demolition is the fourth important effect of project change. Any alteration and addition in design will impact rework and demolition problem. Besides that, rework and demolition will lengthen the project time and cost. Respondents also agree that interruption of continue works is fifth important effect to project change. The project's work will be temporary stop or postpone due to the changes occur in project. Consequently, this has lengthened the completion time of project. Based on respondents, low morale of labor is not frequent occur and not important effects in project change as the mean is low which is only 3.42.

Overall, 45 respondents agree that time related effect group which is important and frequent occurred effects in project change whereas the other related effect groups is less important effect in project change. Organization should focus on those effect that are important and occur frequently so that can minimize the project change occur.

The most three important effects based on developer perception are: (1) increase project cost which is 4.38, (2) delay in completion schedule which is 4.31 and (3), damage to firm's reputation which is 4.19.

According to consultant, the most three important effects are: (1) increase project cost which is 4.2, (2) delay in completion schedule and delay in procurement process which both is 4.38 and (3) increase in overhead expenses and rework and demolition which both are 4.13 .Based on contractor, the most three important effects of project change are: (1) increase in overhead expenses which are 4. 48, (2) delay in payment which is 4.43 and (3) delay in completion schedule which is 4.38. These three parties agreed that project change will not impact much on morale of labor. Low morale labor has the lowest mean and rank in effects.

RO3: Examine the relationship between the causes and effect of project change

Thirdly, we discuss the result of the relationship between various causes and effect of project change by categories. According to pervious chapter, there is a moderate strong positive relationship between material and equipment related factor and cost related effect. Besides that, there is also has significant relationship between this two variables. This mean material and equipment related causes will impact on the cost of project. The relationship between these two variables is the strongest compare with other. The fish bond diagram had been used in this research in order to let readers more clearly and easy understand the relationship between different causes and effects of project change.

Besides that, there are also several significant relationships between different groups of causes and different groups of effects of project change. In this correlation test, there are two level of significant correlation which is 0.01 and 0.05. Consultant and

design related factor has impact on the time related and cost related effect at level of significance 0.05. Besides that, contractor related factor has the significant relationship between cost related effects and also cost and time related effect at significance level of 0.01. Other than that, the labor related factor and external related factor also have significant relationship with cost related effect at significance level of 0.05. Furthermore, material and equipment related factor also has significant relationship with cost and time related effect at level of significance 0.05. The companies should focus on these causes and effects of project change in construction industry which have significant relationships. So that, the issue project change in construction industry can be reduced to a minimum level or even none. Finally, other causes and effects of project change do not show significant relationship.

In addition, spearman's rank also has been carried out in this study to test the agreement between contractor consultant and developer. In overall, there is significant strong positive relationship (agreement) between contractor – consultant, developer-consultant and developer- contractor in the causes of project change. That mean they all have strong agreement on the importance of each causes. Whereas in the effect of project change, there is no significant relationship between developer- consultant but there is significant positive relationship between developer-contractor and contractor-consultant. In short, developer and consultant don't have same perception and agreement on effect of project change.

By the ways, there are several suggestions from respondents in order to reduce and minimize the impact of project change in construction industry. Firstly, the consultant or those involved in design and supervision must be professional and knowledgeable. Secondly, effective management in project planning and time can reduce the impact of project change. Thirdly, there should be proper planning and discussion between developers, Contractor and, consultant. There should be a clear communication between each party in order to minimize the conflict in change. Fourthly, avoid and reduce the owner interruption in design related matters during constructions. This is because alter design might cause extra work and impact on progress and cost of project Thus the design and method of construction must be firmed in planning stage. Fifthly, there should be a financial control and management in order

to reduce financial difficulties during construction time. Sixthly, in order to reduce impact from economic change problem, it is important to gain more information from newspaper to know the economic change of a region.

5.3 LIMITATION AND RECOMMENDATION

There are various limitations in this research. One of the limitations is time and cost consuming. Researcher is given limited time to complete the research. However, a research is complicated and need a long time to complete it. Besides that, researcher need to send many questionnaire to targeted person, mostly the respondent are more than 100 people, it is quite expensive if using posting method to distribute questionnaire. Moreover, envelop and stamps fees are costly for a researcher. Thus in the future research, researcher can try other method or ways to distribute questionnaire, not just only rely on one method. Besides that, in future research, researcher should be given sufficient time in order to complete the research.

Furthermore, the population of this research is targeted on construction companies in Kuantan, Pahang only. Thus, data just collected from one area only, this impact the results from research may not very accurate and significant due to the limited respondent. Therefore, in the future research, researcher can expand their population to other states in order to increase respondent rates and get more data from respondents.

Other than that, difficulties in collect back data also one of the limited of this research. In this research, 134 questionnaires had sent out, but in the end just collected back 45 set of questionnaire. There are some of the respondent refuse to give full cooperative in answering the questionnaire. Not only that, some of the company's email address is invalid and unable to send to them. The insufficient resources and information are another limitation of the study. There is not much of journal, article and online data about the project change in construction industry. It is difficult to find statement to support our thesis due to limited information. In the future research, researcher can more focus on the relationship between the causes and effect of project change and discuss how to reduce the effect of project change.

5.4 CONCLUSION

As conclusion, we investigate the causes and effects of project change in construction industry. Through the questionnaire survey, the most important causes and effects of project change were identified. There are six groups of causes of project change in this research which are consultant and design related factor, contractor related factor, developer related factor, material and equipment related factor, labor related factor and external related factor. Overall, respondents agreed that labor related factor is the most important factor will affect project change. In addition, there are five groups of effects of project change which are time related effect, cost related effect, cost and time related effect, productivity and quality effect and the last is other related effect. In overall, respondent agree that time related effect is the most important and frequent occur in project change. Based on this research, we can examine which factor and effect are important, so that we can find out a best solution to reduce problem. Besides that, through the ranking, we know which most important, and which causes should priories and should be first focus in order to avoid negative impact of project change. Change management solution can be developing based on the result.

Besides that, the respondents also have been categories into three groups (contractor, consultant and developer) in order to test the agreement between these three parties. In overall, both contractor and consultant respondents agreed that time related effect is the most important effect of project change whereas developer indicated that cost related effect is most important effect of project change. In addition, three parties' who are contractor, consultant and developer also agree that labor related factor is the most important causes affect project change. T

As an important contribution, we also study the Pearson's correlation analysis between the causes and effects of project change in construction industry. This result of this study can be useful to the practitioners who are contractor, developer and consultant and also for academicians. There can better understand the relationship between the causes and effect so that can find a solution to reduce the negative impacts to project.

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APPENDIX A

GANTT CHART

		Week													
No	**Research activities**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
1	FYP 1 Briefing														
2	Meeting with SV , discuss the research title and objective														
3	Find journal and information														
4	Deciding the project title and objective														
5	Approval project title														
6	Preparing chapter 1,2,3														
7	Submit draft chapter 1,2,3														
8	Adjustment and editing the draft														
9	Prepare questionnaire , cover page content and reference list														
10	Submitting full fyp proposal														
11	Preparing slide of presentation														
12	Presentation														

APPENDIX B

GANTT CHART FYP2

		Week											
No	Task	1	2	3	4	5	6	7	8	9	10	11	12
1	Finalize questionnaire												
2	Distribute Questionnaires												
3	Collect questionnaire data												
4	Analyze data												
5	Report												
6	Submission and Finalize everything												
7	Submission FYP 2 and presentation												

APPENDIX C

QUESTIONNAIRE

Questionnaire

A Study of Causes and Effects of

Project Change in Construction Industry

This is an academic study to fulfill one of the requirements of Final Year Project under Bachelor Degree of Project Management course in University Malaysia Pahang. The study is to identify the causes and effects of project change in construction industry. Your response to the survey is important in order to succeed the research. Please answer the questionnaire honestly and based on your experiences. Your answer and identity will be confidential and will be used only for the purpose of the academic research. Your cooperation in answering this questionnaire will be much appreciated.

Section A- Personal Information

1. Name: (Optional) _____

2. Age: _____

2. Gender: Female/ Male

3. Working Experience in Construction: _____year(s

4. Position in Company: _____

5. What type of organization is your company?

A. Developer

B. Consultant (Please choose type of consultant: Quantity Surveyor / Architect / Civil Engineering / Others: _____

C. Contractor (Please choose your grade: 1 / 2 / 3 / 4 / 5 / 6 / 7)

D. Others: (Please state) _____

6. Higher level of Education (please choose): SPM / STPM / Bachelors Degree / Masters Degree / PHD / Others :(Please state) _____

Section B -The causes of project change in construction industry

Using the following scale, please answer each of the following questions by circle in the appropriate box. **What are the causes of project change? How important of those causes lead in project change?**

1- Extremely Not important causes	2- Not important causes	3- Neutral	4-Important causes	5-Extremly important causes

A) Consultant/design related factor					
1. Error and omission in design	1	2	3	4	5

2. Consultant poor in material and equipment knowledge	1	2	3	4	5
3. Design complexity	1	2	3	4	5
4. Consultant lack of coordination with other parties	1	2	3	4	5
5. Lack of require data related to design (drawing detail)	1	2	3	4	5
6. Change in design by consultant (improvement design)	1	2	3	4	5

B) Contractor related factor					
7. Contractor's financial difficulties	1	2	3	4	5
8. Contractor desired profitability	1	2	3	4	5
9. Differing site condition	1	2	3	4	5
10. Lack of involvement in design	1	2	3	4	5
11. Contractor poor in site management	1	2	3	4	5
12. Contractor poor in judgment and lack of experience	1	2	3	4	5
13. Lack of communication with other parties	1	2	3	4	5

C) Developer related factor					
14. Slow decision making by developer	1	2	3	4	5
15. Developer's financial problem	1	2	3	4	5
16. Change in specification by developer	1	2	3	4	5
17. Change in scope or plan of work by developer (additional or reduce the requirement)	1	2	3	4	5
18. Change in schedule (accelerate the project)	1	2	3	4	5

D) Material and equipment related factor					
19. Construction Material shortage in market	1	2	3	4	5
20. Equipment shortage	1	2	3	4	5
21. Equipment breakdowns	1	2	3	4	5
22. Changes in material type	1	2	3	4	5
23. Delay in material delivery	1	2	3	4	5

E) Labor related factor					
24. Defective workmanship	1	2	3	4	5
25. Shortage in workers	1	2	3	4	5

F) External related factor					
26. Weather condition	1	2	3	4	5
27. Natural disaster	1	2	3	4	5
28. Change in government rule and regulation (ex :permit)	1	2	3	4	5
29. Change in economic condition (ex: inflation, market decline)	1	2	3	4	5
30. Technology change	1	2	3	4	5

Other causes of project change (if have please state): _____

Section C – Effect of project change in construction industry

Using the following scale, please answer each of the following statement by Circle in the appropriate box. **What are the effects of project change? How important of those effects occur in project change?**

1- Extremely Not important effect	2- Not important effect	3- Neutral	4-Important effect	5-Extremly important effect

A) Time related effect					
1. Delay in completion schedule	1	2	3	4	5
2. Delay in payment	1	2	3	4	5
3. Delay in procurement process	1	2	3	4	5
4. Interruption of continue works	1	2	3	4	5

B) Cost related effect					
5. Increase project cost	1	2	3	4	5
6. Increase in overhead expenses	1	2	3	4	5
7. Material waste	1	2	3	4	5
8. Addition payment for contractor	1	2	3	4	5

C) Cost and Time related effect					
9. Hiring new professional	1	2	3	4	5
10. Rework and demolition	1	2	3	4	5

D) Productivity related effect					
11. Productivity degradation	1	2	3	4	5

E) Quality related effect					
12. Quality degradation	1	2	3	4	5

F) Other related effect					
13. Damage to firm's reputation	1	2	3	4	5
14. Low morale of labor	1	2	3	4	5
15. Poor safety condition	1	2	3	4	5
16. Contract claim and dispute among	1	2	3	4	5

professional					

Other effect of project change (if have please state): _____

How to reduce or minimize the impact of project change in construction industry?

_____

_____

Please attach your signature, name and phone number here (with company chop if possible) to validate the participation in answering the questionnaire.

_____

Name:

Phone Number:

Thank you very much for spending your time to complete this questionnaire. Your cooperation is much appreciated.

APPENDIX D

Demographic data

Age

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	21-30	11	24.4	24.4	24.4
	31-40	15	33.3	33.3	57.8
	41-50	12	26.7	26.7	84.4
	>50	7	15.6	15.6	100.0
	Total	45	100.0	100.0	

Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Female	16	35.6	35.6	35.6
	Male	29	64.4	64.4	100.0
	Total	45	100.0	100.0	

Higher level of education

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SPM	1	2.2	2.2	2.2
	STPM	4	8.9	8.9	11.1
	Bachelors Degree	31	68.9	68.9	80.0
	Master	2	4.4	4.4	84.4
	Other	7	15.6	15.6	100.0
	Total	45	100.0	100.0	

Type of organization

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Developer	16	35.6	35.6	35.6
	Consultant	8	17.8	17.8	53.3

	Contractor	21	46.7	46.7	100.0
	Total	45	100.0	100.0	

Working Experience

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1-5	7	15.6	15.6	15.6
	6-10	10	22.2	22.2	37.8
	11-15	13	28.9	28.9	66.7
	16-20	4	8.9	8.9	75.6
	more than 20	11	24.4	24.4	100.0
	Total	45	100.0	100.0	

Position in company

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	top management	5	11.1	11.1	11.1
	manager	3	6.7	6.7	17.8
	project manager	13	28.9	28.9	46.7
	Project engineer	13	28.9	28.9	75.6
	project coordinator	2	4.4	4.4	80.0
	other	9	20.0	20.0	100.0
	Total	45	100.0	100.0	