PROJECT CRASHING IN CONSTRUCTION INDUSTRY: INVESTIGATION OF THE STRATEGIES, CHALLENGES AND IMPACTS

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SUPERVISOR'S DECLARATION

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

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STUDENT'S DECLARATION

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

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This study is dedicated to my beloved father, who taught me that the best kind of knowledge to have is to learn for its own sake. He is the one who has always support me to never give up and strive in completing this research. I also dedicated this study to my beloved mother who has never left my side and always reminds me that no matter how hard a task is, it could be done one step at a time.

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ABSTRACT

This survey is conducted to study the project crashing in the aspect of the strategies and challenges in construction industry. Besides, this study also identified the impacts on cost, time and quality once the strategies are being implemented. The objectives of this study were to identify the strategies that can crash a project successfully, to identify the challenges in project crashing and to examine the relationship between the strategies used in project crashing and the impacts in terms of cost, time and quality. The data are obtained mainly from the primary data which is the survey questionnaires. Total sample of 54 respondents were used in this study. The result of this study has identified the suitable strategies to crash a project, the challenges faced in project crashing and also see the impact of the strategies used in terms of cost, time and quality.

ABSTRAK

Kajian ini dijalankan untuk mengkaji ‘project crashing’ dari aspek strategi dan cabaran di dalam industri pembinaan. Selain itu, kajian ini juga turut mengenal pasti kesan perlaksanaan strategi ke atas kos, masa dan kualiti. Objektif kajian ini adalah untuk mengenalpasti strategi yang boleh menjayakan ‘project crashing’, mengenal pasti cabaran-cabaran di dalam ‘project crashing’ dan untuk mengkaji hubungan di antara strategi yang digunapakai di dalam ‘project crashing’ dan kesannya dari segi kos, masa dan kualiti. Data diperoleh berdasarkan data primer iaitu melalui boring kaji selidik. Sebanyak 54 sampel responden telah diselidik di dalam kajian ini. Hasil kajian ini telah mengenal pasti strategi yang sesuai untuk ‘project crashing’, cabaran yang dihadapi dalam melaksanakan ‘project crashing’ dan juga melihat kesan penggunaan strategi dari segi kos, masa dan kualiti.

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

The title of this research is project crashing in construction industry: investigation of the strategies, challenges and impacts. This chapter includes the problem background, problem statement, research objectives, research questions, scope of the study, hypothesis, significance study, operational definitions and expected results.

1.2 PROBLEM BACKGROUND

A project is a sequence of task and activities that is planned from the beginning until the end. The Project Management Institute (PMI) states that a project is an interim group works that is formed to produce a unique product or services. A project has a several characteristics for example temporary. The temporary of a project can be defined as something that has a beginning and end in time. When the goals or the objectives of the project are achieved, it indicates that the project has come to its end or in other word, success. Frimpong, Oluwoye and Crawford (2003) states that a project is consider success when the project has achieved its technical performance, maintained its schedule or behind schedule and managed to remain within budgetary costs. This situation proves that the project is something that is planned all along and the works or activities done in the project is by pursuing the objectives or goals.

The person responsible in managing the project is known as project manager. A project manager must know about the project management. This is because he is responsible for managing the project until they achieved their goals. Project

management is not the same as project. Project management is the ability to use the knowledge, skills and techniques to carry out the projects effectively and efficiently. A quality project management can be evaluate through the management tools and techniques used to manage the project (Frimpong *et al,* 2003). In addition, Oisen (1971) states that project management is the application of a set of tools and techniques to guide the use of diverse resources toward the achievements of a unique, complex, one-time task within the triple constrains that are time, cost and quality constraints.

In reality, the trend in construction industry nowadays is that many projects could not be finished on time. This situation is known as projects delayed. Project construction delays is viewed as one of the most common problems that may lead to a various of negative effects on the project and also the parties involved in it (El-Razek, Bassioni, and Mobarak , 2008). Project delayed can be defined as the failure to finish up the activities within the time given. The project delay can greatly affects the whole projects as well as affects the overall cost of the projects and also the companies' reputation. Ogunlana, Promkuntong and Jearkjirm (1996) states that delays in construction projects will usually affects the time and cost of the projects. The projects delay may occur due to the lack of resources, insufficient budgets, inexperience project managers, problems in resources shipment and many more.

However, to counter this problem, a project manager has one escape route to deliver projects on time that is project crashing. A project crashing is a method where projects duration is shortening by reducing the time of the activities to less than its initial activity time at a certain amount of cost. The target of the project crashing was to minimize the required cost while meeting a specified deadline. For it to be effectives, a project crashing is only done on the critical activities in the project. Lima, Silva, and Vieira (2006) state that project crashing is basically an evaluation of the costs of reducing the duration of vital tasks that is located in the critical path.

This study is to highlight about the strategies of project crashing, challenges of the project crashing and the impacts of the strategies used in project crashing in terms of cost, time and quality constraints.

1.3 PROBLEM STATEMENT

In a construction industry, project managers are bound to the triple constraints that are schedule, cost and scope of the projects. These three criteria works in tandem with one another. Once a project manager fully understand about the triple constraint and knows how to handle with triple constraints, then only the project manager can achieve a successful and a quality projects. This is because the projects are being measured by these constraints and it is the key element towards a success projects, just like stated in the research by Schwalbe (2007) that in order to have a successful project, a project manager must put extra efforts in maintaining the scope, time and cost and maintained these three often-competing attributes. In the triple constraints, the element of schedule or commonly known as time is always a big threat to a project manager and it will always affects the cost element. This is because the longer the time of the project is, the higher the cost of the projects will be.

In construction industry, a project manager will face many unexpected problems that will force him to delay certain activities that will directly affect the projects duration. The project delay will be a serious problem for the project. Not only that, according to Al-Khalil and Al-Ghafly (1999), the projects delay will also cost not only the owner, but also the contractor where the owner will missing out on the possible incomes of cash flow from the use of the project and from the increased overhead cost for contract administration and supervision. Meanwhile, the contractor will loses due to increased costs in overhead and tied-up capital. Plus, it also includes the lost of opportunities for new projects due to the low financial capabilities.

In a situation where the manager cannot afford to encounter projects delay, the project manager will resort to every option that they have in hands. One of it is project crashing. A project crashing is a method of shortening the duration of the whole project by adding more resources to a certain activity. Although project crashing is one way to overcome projects delay, it is not a simple task and it is necessary to know how to handle and manage project crashing. This is because if the manager crash a non critical activity, it will be pointless as the project crashing is only effective on the critical activities. According to Kuhl and Tolentino (2008), the crashing method is focused on

minimizing the time of the activities on the critical path. A critical path is the one that can cause a delay of the project because there is no slack time on the critical path. A manager should know the strategies to successfully crashing a project.

Besides that, a manager should also know the challenges that they may face in order to implement the project crashing successfully. According to the triple constraints law, by shortening the duration of the project, the cost of the projects will be increased. This is because more resources are being assigned to the critical activities so that the activities will complete sooner than the initial assigned duration. The increased of one of the triple constraints will affect the other constraints. This will overall affect the project quality. Babu and Suresh (1996) believed that depending on the project crashing, the project quality may be affected.

As project crashing is a good factor for contractor and manager, it is viewed differently for other parties such as developer or consultant. Depending on the strategies used to implement the project crashing, it may results in either good impacts or bad impacts to the parties involved. A contractor may view the project crashing as a good factor if using the right strategies and methods as it helps the contractor to deliver the projects on time, but things are viewed differently for developer and consultant.

Furthermore, this research is conducted in order to exposed more about project crashing because there were less discussion about this topic and lack of exposure about the project crashing. The topic is quite general but then again, if asked about the project crashing, there are still a lot of people that does not know the term project crashing.

1.4 RESEARCH OBJECTIVES

1 To identify the strategies that can crash a project successfully

2. To identify the challenges in project crashing

3. To examine the relationship between the strategies used in project crashing and the impacts in terms of cost, time and quality.

1.5 RESEARCH QUESTIONS

1 What are the strategies that can crash a project successfully?

2. What are the challenges faced in project crashing?

3. Which constraints give more impacts on the strategies used in crashing a project?

1.6 SCOPE OF THE STUDY

The scope of this research is to find out the strategies, challenges and impacts of project crashing. So, this research will focuses on construction industry that includes contractors with G7 contracting license, developers and consultant in Kuantan area. The companies for contractors are picked from the registered companies under Construction Industry Development Board Malaysia (CIDB) while for the developers companies are selected from the companies that are registered under the Real Estate and Housing Developers' Association Malaysia (REHDA). The research is conducted in Kuantan area because Kuantan is the capital city of Pahang and it is the focus place of the public. Hence, it will be easier to approach the construction companies that hold a bigger status which usually place their office in the capital city. This targeted population is chosen because bigger company usually implement project crashing method.

1.7 HYPOTHESIS

H1: There is relationship between the strategies used and impacts of project crashing in terms of cost, time and quality.

1.8 SIGNIFICANCE OF THE STUDY

This research will enlighten people about the strategies that can successfully implement the project crashing. A successful project crashing can ensure that the projects to be finished within due date. Plus, a neat and careful planning might actually finished up the projects with lower costs. This research also identifies the challenges of project crashing in construction industry. By studying the challenges, people involved

such as contractor, developer, general worker and consultant will be more prepared and ready to implement the project crashing. Plus, this research will enlighten people about the impacts of project crashing towards the strategies used in terms of cost, time and quality. The impacts will be differently for each of the strategies used in implementing project crashing. As this research is being carried out, the opinion of the parties involved can be seen and evaluate. In a nutshell, this research is carried out to give more exposure on the project crashing.

1.9 OPERATIONAL DEFINITION

In this research, the formula of obtaining the sample size is referred to the Israel's journal which is:

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

n = Sample Size
N = Population Size
e = The Level of Precision (Sampling Error)

Figure 1.1: Formula for Sample Size

1.10 EXPECTED RESULT

The final results of this research will expose and highlight more about the project crashing in construction industry. By knowing the right strategy to implement the project crashing, the problem such as project delay or could not finished the project on time can be overcome. Furthermore, if the right strategy is known, the contractor might do the right call to spur his worker's spirit and motivation. Plus, the respondents might actually suggest a new idea or opinion regarding this research that will be very valuable and helpful. Their experience in the real situation is considered to be very important for this research. Besides that, by knowing the challenges of the project crashing, people will be mentally and physically more prepared to carry out the project crashing. This is because they may have an idea of what to be faced in implementing the

project crashing. Furthermore, the relationship between the strategies used and the impacts in terms of cost, time and quality may also be identified. This will enable the researcher to see what is the impacts if when using the strategies to crash a project. Not only that, it will also provide the situation where three different points of view are being reviewed regarding the same topic that is the project crashing. By studying the impacts that it could bring, the contractor, developer or consultant might as well takes a precautionary step to avoid any ugly circumstances when implementing the project crashing. The final results of this research will also be a source and material for future researcher regarding the project crashing.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter will covers about the research objectives. The detailed explanation are being discussed on the project crashing that includes the strategies that can crash a project successfully, the challenges in implementing the project crashing, the impacts of the strategies used in implementing project crashing and also the theoretical framework indicating the relationship between independent variable and dependent variable. For the purpose of acquiring more knowledge, the importance of time, triple constraint and project delay are also discussed in this chapter.

2.2 IMPORTANCE OF TIME IN CONSTRUCTION

Time is very essential especially in construction industry. This is because time can indicate the start or end of a project. It can also lead to several situation such as project delay, project success or even deciding whether to use the project crashing method or not. For that, time is something that the project manager, contractor, developer, consultant and also the clients need to be wary of. For the clients and developer, they would prefer shorter time in a project compared to project manager and contractor. Sometimes, the project may be a bit difficult for them to manage that they required more spaces and time to deliver the projects.

Apart from that, the time management can be the key in determining the reputation of a company. If a company is always deliver the project within time, the reputation of the companies will be good in the eyes of a client compared to the

company that does not handle their time management so well. Given the situation where the client had to choose between the company that manage to run their past projects well and within time with another company that failed to run their past projects within time, the client would certainly choose the company that have a good reputation that is the one that manage to run their projects well and within the time given.

Time management can be defined as to make use the time available to its best or early preparation and planning for facing a certain situation. Failed in time management can lead to a situation that will cost the person or groups. Ordonez and Benson (1997) states that time constraint exists whenever there is a duration given until deadline, even if it means that the person is able to complete the task in less time. Among the failed situation is bankrupt, project termination, projects delay or to pay penalties for failing to deliver the projects on time or known as Liquidated Ascertain Damages (LAD). The importance of time has made it as one of the triple constraints along with cost and scope. This just shows how important time is in a project.

2.3 CONSTRUCTION INDUSTRY

Construction industry is a work field that involves all the works that relate to the constructing such as designing, negotiating, maintenance and many more. It purposes is to make a better life for people and also to create a place where normal people can live their daily life perfectly. Yang (2007) states that a construction project is a set of individual activities and they have their inter-precedence constraints.

2.3.1 Contribution of construction industry globally

Nowadays, almost all area in the world has their construction industry taking place. Construction involves from the manual constructing such as the simple housing constructed by using fronds and tree branches, to the complex constructing that is the using of machinery and equipment. Construction industry plays a major role in determining a countries reputation and standard. It is one of the criteria that will determine the countries development. For instance, the first world country such as America has a quite a lot of spectacular building and landscape. It is part of the

construction that makes the countries seen as a remarkable place. Not to mention, the infrastructure also have a role in determining the development of a country.

2.3.2 Contribution of construction industry towards Malaysia

In Malaysia, the same thing happened. Construction industry has successfully upheld the national's reputation and name. This can be seen through the construction in several national's landmark such as Petronas twin towers or KLCC, KL tower, Penang Bridge, Putrajaya and many more. The construction of these landmarks indicates that the developments in construction industry in Malaysia can be on par as the construction industries on other develop countries.

The Petronas twin towers or Kuala Lumpur Conventional Centre (KLCC) is one of the tallest buildings in the world. From 1998 until 2004, it holds the status of the world's tallest building. On the other hand, the Penang Bridge is the Asia's world largest bridge that is 14 km. The bridge that connects to the Penang Island also became the national's proud achievement.

In the construction of these magnificent buildings and bridge, there are also several issues that occurred. Same situation with other project that is being run, the construction of these landmarks also faces the difficulties and issues that give headache and problems to the parties that involved in the construction. Among them is the project delay.

2.4 PROJECT DELAY

In managing a project, the risk of getting the project delay is very high. Project delay can be defined as the late finished of a certain projects. Projects delay is a situation where the project cannot be completed under the planned time (Azlan Shah Ali *et al*, 2010). There are many causes of project delay. One of them is the failure to manage the triple constraint. The triple constraint consists of time, cost and scope. Other causes of project delay includes the changes of scope, changes in contracts, stakeholder's involvement, weather and many more.

2.4.1 Scenario of project delay in Malaysia

In Malaysia, many companies face project delay in their project. The delay may occur due to the inexperience manager. An experience manager may run the projects smoothly and efficiently. On the other hand, an inexperience manager may get hasty and cannot properly decide what good decisions for the project's benefit are. This may be because the manager does not know the impacts it will bring of taking a certain decision.

Another cause that can lead to project delay is the failure of managing the triple constraint. The triple constraint is very important because not only it can lead to project delay, it can also lead to the failure of a projects. The first trait of the triple constraint is the time. Time is important in determining the beginning of a project or activities and the end of a project. It can also determine the beginning time for a successor activities. Worst case scenario, the failure of managing time in projects would lead to the failure of the projects and it will hence affect the company's reputation and name.

The second trait is the cost. Managing the project with extra cost would be good in speeding up the projects. But if the cost is wasted by allocating unnecessary resources would affect the project's quality. Cost is one of the critical criteria that one has to consider if they are managing a project (Syed Burhanuddin Hilmi Syed Mohamad, Mohamad Hilmi Adenan, and Ismail Abdul Rahman, 2012). Cost trait may lead to the project delay through the purchasing activities. This can be seen in two situations. The first situation is when the time taken for purchasing the product is longer. This is because they want to wait either for the price to drop or the negotiations for the resource is taking longer time. Another situation is when the resource is already bought but the shipment of the resources is delayed. This will lead to the delay of the activities that are in need of the resources. Besides that, Clough and Sears (1994) and O'Brien (1998) both share the same opinion that is the project progression and quality may be affected by the owner's budgetary and financial issues.

The third trait of triple constraint is the scope. A scope is a section of works that need to be done under a contract or subcontract in the completion of a project that can

be divided into specific project goals, deliverables, task, costs and deadlines. Changes in scope may lead to the project delay. This is because the changes in scope will mean that the list of works to be done may need to be changed. This will take time as the changes in scope may require all parties involved in the project to discuss about the change in scope. The time taken for the meeting to be conducted and the relayed information about the changes in scope will take quite some time and it will still affect the duration of the project. Arain, Assaf, and Low (2004) state that the changes of scope of the project is usually the result of unprofessional planning at the planning stage or rather because of lack of participation from the owner in the design phase.

Together, these three traits or the triple constraint will determine the projects quality. The quality of a project will reflect the ability of the companies that manage the project. This will hence affect the company's reputation and name.

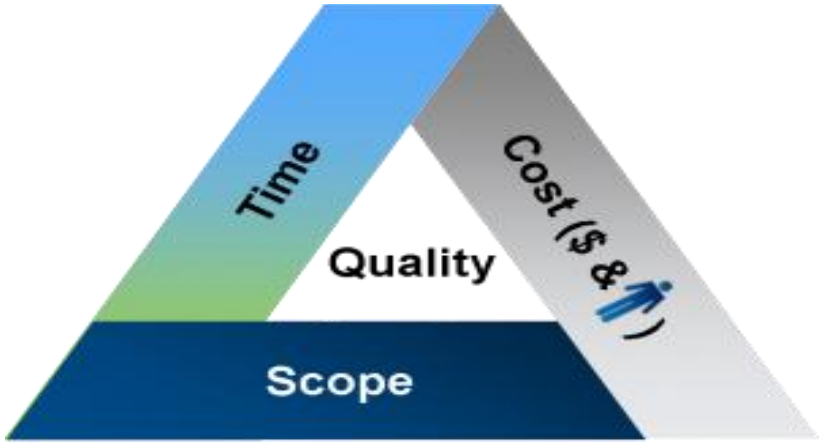


Figure 2.1: Triple Constraint

The shortage of skilled worker may also lead to the projects delay. This is because an unskilled worker may work inefficiently and ineffectively. Unskilled worker tends to do his job based on his perspective and act with what they are being told to do. They are unable to make a critical decision on their own. This will make the progression of the project slow. Having a few of skilled worker or expertise will lead to variations and delay (Keane, Sertyesilisik, and Ross, 2010).

2.5 PROJECT CRASHING

A project crashing is a term used to describe the method used in order to shorten the duration of a project or activities that will enable the projects to be delivered within time. Syed Burhanuddin Hilmi Syed Mohamad *et al,* (2012) states that a project crashing is a process of doing the activity in a fast pace or even multiple activities in order to shorten the overall durations of a project. If a project need be speed up in order to meet a deadline, crashing the project may be the solution. One of the ways to reduce the total time of the project is by allocating more resources to their completion (Tibben-Lembke, and Mitchell, 2007). There are many types and strategies for project crashing. Depending on a situation, how the company manage to cut the longer duration into a shorter duration is known as project crashing.

2.5.1 Importance of project crashing

A project crashing is very important in ensuring that the project does not face the project delay or rather, deliver the projects within time. This is because the method itself is to shorten the duration of the project by any means as long as it is legal. Syed Burhanuddin Hilmi Syed Mohamad *et al,* (2012) states that project crashing is a method used to fasten the project in order to achieve the main target of the project. Furthermore, a project crashing analysis is a method to lower the cost used while meeting a specified deadline (Yang, 2007). Project crashing can also helps to decide the company's reputation and name. A company that success in implementing the project crashing will have a bright and stable future ahead of them because if they had succeed in implementing the project crashing, it means that they had success in delivering their projects within the time given. So, the chances of the companies selected for getting the next tender is high.

Besides that, project crashing method will enable the project to finish earlier than anticipated. This situation will lead to the contractor starting his new project earlier. Sometimes, especially when the economy is doing well, the ability to finish up the project early enables the contractor to start another job earlier and, thus, making more incomes (Syed Burhanuddin Hilmi Syed Mohamad *et al*, 2012).

2.5.2 Conflict of project crashing

Although project crashing may seems like a benefit for the company, it also has a thorn on its side. The project crashing has the ability to create a conflict internally or externally. The conflict may occur when two parties could not reach mutual agreement. For instance, the contractor may want the project crashing to be implementing in order to finish all the works and activities within time, while the developer may want the project to be finished late because he wants the contractor to breach their agreement so that the contractor will pay penalties to the developer.

Another situation would be a conflict in determining the material that is needed for an activity. The contractor may choose the material based on price, but the client may want the material based on his choice and opinion. Although the final words is on the client, but the situation will create a disapproving contractor on the projects. This may be because when they need to purchase a material according to the client's choice, they have to wait for a certain amount of time in order to acquire the material. This situation may lead to projects delay even after implementing the project crashing method.

Apart from that, the conflict can also rises among contracts document. Keane *et al*, (2012) states that, if there is an issue of inadequate details in the contract documents, it may lead to the delays of project completion and also affects the cost. Conflict in the contract documents may results in misunderstanding of the actual requirement of a project (CII, 1986).

2.6 STRATEGIES THAT CAN CRASH A PROJECT SUCCESSFULLY

A successful project crashing can ensure the project to be finished on time. To do so, a suitable strategies and accurate techniques may come in handy. A project crashing is not limited to a specific type of project crashing. In simpler words, project crashing is a term used for method of shortening the project duration. So, depending on the situation, all type of strategies and procedure in shortening the projects duration is considered as project crashing strategies.

2.6.1 Hired more labour workers.

During construction, the rate of the progress of a project may show that the project will take longer time than initial planning work time. This will undoubtedly lead to project delay. Project delay is a situation where the project could not be finish on the original planned time. It is an important matters and a serious problem that may occur in the construction industry (Al-Khalil & Al-Ghafly, 1999). Projects delay will cost all the parties that involved in the projects such as manager, contractor and owner.

However, an experience manager could forecast the estimated finish duration of a project at midway of the project. This will let the manager came up with a plan or strategies to avoid the project delay. One way to avoid project delay is by implementing the project crashing. Project crashing and project delay will always have a relationship. Once a company does not intend to delay the project, they will opt to the project crashing. However, by crashing a project does not fully guaranteed that the project will not be delayed. A suitable techniques and strategies of implementing the project crashing will help to prevent the project delay and deliver the project within time.

In order to avoid project's delay, the rate of the progress for current situation need to increase. One of the factors that can affect the rate of the progress in a project is the manpower. Manpower or a workforce is considered as one of the resources in projects. A normal amount of manpower required for an activity will take the project into a normal rate of progress. This is because a labour worker is a normal person and has a limit to their strength. Hence, one way to ensure that the project can be finished on time is by hiring more workers. The higher the workforce is, the higher the rate of the project's progress is.

By having extra workers, certain activities that use different resources can be run simultaneously. This will increase the rate of the progress of a project. Furthermore, the original worker will feel slightly at ease having extra manpower to assist them. Having too much work on the worker's shoulder will make him feel down and they will self-compassionate themselves for the situation that they are in. Self-compassionate can be includes as being kind to oneself when challenged with personal weakness or hardship

(Krieger *et al*, 2013). As a normal human being, it is natural to feel grateful and gladly when received help from others. Moreover, the additional of worker will indirectly increase their motivation to finish their work as soon as it can be.

Besides that, having extra worker will create a mutual competition among the worker themselves. It is a good and healthy competition that will speed up the progress of the project. The same situation can be seen in the making of Malaysia's Kuala Lumpur Convention Centre (KLCC) where two different teams compete against each other. Two different contractors are given the task of completing respective tower according to the design. Fierce competition between these two sides can be seen as they completing their task within the given duration.

2.6.2 Expanding the working hours and shift system

In construction, time is considered to be very essential. Each and every time loses will be treat as a waste especially towards contractor. This is because if the project exceed the original planning time, the contractor needs to pay a sum of money known as Liquidate and Ascertained Damages (LAD) to the developer. For every contractor, the liquidated ascertained damages are considered to be nightmare because the amount that they need to pay to the developer depends on how many days that the teams delay the project. According to Eaggleston (2009, p. 3), liquidated damages is an agreed price between both parties that need to paid for breach or non-performance.

Time constraints lay under one of the triple constraints in managing a project. The triple constraints are critical factors that can determine the success of a project. The triple constraint consists of scope, time and cost and it must be balanced in order to most likely ensure project success (Catanio, Armstrong, & Tucker, 2011). Most of the managers face difficult problems to deliver the project within time.

In order to deliver the project within time, some activities may need to be speed up. The managers have several ways to speed it up such as increase the workforce of the project. But, if the manager decides to stick with his currently workers, he may expand

the working hours. By expanding the working hours, the project can be finished on time as the worker gets to work more time compared to normal working hours.

Besides that, applying the worker shift system may also helps to shorten the duration of the project. This technique is very useful in order to ensure that the project is always running. Unfortunately, the system will increase the total cost of the project as the project is always running. The indirect cost such as machinery and electricity will depend on the activities that they need to do whereas the direct cost such as labour cost is a fixed cost.

Plus, there are several drawbacks of applying the working shift system. It may affect the performance and the quality of the project. This is because an activity that is performed by different people may results in different quality. Plus, the quality of a person doing the job in a day and night is not the same. Nonetheless, the working shift system may keep the progression of the project run day by day that will hence shorten the duration of the project.

2.6.3 Awarding additional incentives to workers

A labour worker is a normal human being. They also have feeling, emotions and limitations. These human characteristics may be affected morally and mentally. If they are feeling appreciated, they will become high motivated in doing whatever they are being told to do so. On the other hand, if they are feeling not appreciated, unwanted and rejected, they will feel down and not motivated to do their respective jobs.

A successful manager must be able to deliver the project within time, scope and cost. But a brilliant manager should know how to bring the best in their workers so that they can control the triple constraints that are time, scope and cost. The simplest and easiest way to bring out the best in the workers is by motivating them. A motivated worker will feel useful and wanted in the project that will hence speed up the process of finishing a certain work within time or even less time. Work motivation has been traditionally studied from the view point of individual needs and factors such as monetary rewards such as salary and non-monetary rewards or fulfilment of basic

psychological needs such as personal growth have been considered crucial (Murtonen *et al*, 2008).

The same concept goes to the project crashing. A motivated worker will boost up the project and at the same time enjoying their work or rather, not having the feeling of worried of getting late to finish up the project.

A motivation towards workers can be classified into two categories that is monetary and non-monetary type of motivation. A monetary type of motivation is by offering them incentives or increases their salary. This action will be effective for workers that are in need of money or saving them for future purposes. According to Syed Burhanuddin Hilmi Syed Mohamad *et al,* (2012), the payment system is one of the main factors that can influence the work motivation especially in construction project and also highlight that due to the application of project crashing, motivation is a main factor that will influence the successful of a project.

On the other hand, the non-monetary types of motivation are by offering the workers reward, tokens of appreciation or even vacations. Either way, these kind of attention from upper management will help the workers to be in high spirit and also will give them more encouragement in order to perform in every activity

2.6.4 Adding resources

In construction, there may be a time where problems regarding resources arise. For instance, late shipment or waiting for the right time to purchase certain material. These problems regarding resources can still lead to the projects delay. This is because if there are no resources needed to carry out the task, it will postpone the task that will hence affect the whole project. If a project is running late, project managers might be able to bring the project back on track by adding extra resources (Eisner, 2002).

Tibben-Lembke and Mitchell (2007) indicates that in order to shorten the critical path or those activities whose durations will determine the total project length, it is necessary to increase the resources allocated to activities on it. A resource is an essential

part of project that is required to carry out the activities in the project. Resources can be divided into three important parts that are work, material and cost. Work resources include manpower and all that can be categorized as workforce such as backhoe. By adding workforce, the rate of the progress of the project can be increase as more manpower doing the activities.

The most important parts of resources are material resources. Without material resources, a project could not even take place. Material resources are material needed to perform activities such as brick, mortar or cement. By having extra material resources, certain activities can be done simultaneously. The third part of resource is cost resources. In a project, the cost of travelling, car gas or even eating during work hour is considered as cost resources. To put it simply, it is an indirect cost of supporting the needs of the worker regarding the projects.

To execute the project crashing, the main focuses are on the activities on the critical path. This is because the activities on the critical path are the one that determines the total duration of a project. According to Kuhl and Tolentino (2008), the critical path can cause a project to be delay because there is no slack on that path. Since the target is activities on the critical path, the resources on the activities that are not critical can be re-allocated. In other words, allocate unused resources on the activities that are not critical to the activities that are critical in the projects. By having extra resources, the activities that are critical can be done in faster progression. This will lead to the successful project crashing.

2.7 THE CHALLENGES IN PROJECT CRASHING

In implementing the project crashing, there are several challenges that need to be faced. The challenges may be occurred in three stages in the implementation of the project crashing method that are before implementation, during implementation and after the implementation of project crashing.

2.7.1 Budgetary

Before executing project crashing, the manager should consider about it thoroughly first. To implement a project crashing meant that they were prepared for the challenges that they may face especially in the budget section. Project crashing takes up quite a lot of money because its sole purpose is shortening the duration of the project that will directly increase the cost of the project.

The main challenge in implementing project crashing is budgetary problems. In order to finish up the project behind schedule, the manager needs to add extra resources that will also increase the total cost. However, if they do not have enough budgets to add more resources, the contractor will face a dilemma here. The situation is either the contractor uses his own cost to support the resources or let the projects delayed that will affect him eventually. If the project gets delayed, the contractor will pay a penalty to the developer that is known as liquidated ascertained damages or LAD. The contractor will always try to prevent from paying the LAD's because it will cost them quite a lot of money for every day that the projects extended.

In certain points, the contractor might also face budgetary loss. After implement the project crashing techniques, the contractor still could not finished their work on time. This situation will be a very big loss to them because they have spent quite a lot of budget to crash a project and yet, they could not finish the projects on time. Could be worse, the contractor then need to pay the LAD's to the developer as a penalty.

2.7.2 Agreement of each department or person

To execute the project crashing is not an easy matter. Not every person related to the construction of a project will agree with the project crashing. People with different post and jobs will have different opinion regarding the project crashing. They will act according to their interest of jobs. A lack of communication and coordination between parties involved in the projects may cause major variations that could impact the project adversely (Arain *et al*, 2004). For instance, the contractor might say yes to project crashing, but the same situation could not be said towards developer. This is because the

developer might think that the project crashing will cause him to spend even more money than it is already have.

Besides that, although a project crashing can shorten the duration of a project, but it also cost lots of money. This kind of thinking might causes a person to reject the project crashing. It is not easy to get everyone to think similarly because as a normal human being, everyone has their own interest that need to be satisfied.

Apart from that, even if the management agrees to the project crashing, things will be differently with workers. Labour workers might feel uneasy about the implementation of project crashing. This might be because the project crashing will doubled or tripled their work. The worker might also be unmotivated due to the project crashing. It is a challenge for a manager to motivate the worker and get the entire worker to work with high spirit and high efficiency. If the manager does not know how to motivate his worker, then it will be very bad as unmotivated worker will produce low quality of work.

2.7.3 Contract change

An undergoing project always takes up more time than anticipated. O'Brien (1998) states that even the most prepared and planned project may necessitate changes due to various factors. Because of that, the project might end up finish exceeding the given time. In order to finish the project within time, the duration of the project is shortening. In implementing the project crashing, the total cost will be increased. A project crashing may shorten the duration of the project, but if something were to happen during the implementation of the project crashing, it will become new challenges for the contractor and managers.

During the crashing stages, the contract can be suddenly changes. This may be because of the changes in material or resources needed for the projects. Instead of shortening, the duration of the project might be delayed. This is because without the resources needed, the project cannot proceed. It will hence delay the projects.

Besides that, the changes in contracts may also include the changes in scope. Changes in scope before the implementation of project crashing is alright, but if the changes of scope occurred during the project crashing process is implement, it will cause the project crashing to be wasted. The purpose of project crashing is to cut the project duration. If the scope of the work is changed, then the project crashing will be less effective. Worst, to implement the project crashing will increase the total cost of the projects.

2.7.4 Dissatisfaction of stakeholder

A stakeholder is a person or a group that has either directly or indirectly interests towards the projects. The stakeholder is regards as people who hold the power to kill the project. Because of that, their needs and expectations need to be fulfilled. The project will go more smoothly if the stakeholder supports the project. If the stakeholder does not give his support to the project, the project will likely to be unsuccessful.

The project crashing will be hard to proceed if the stakeholder's opinion always changes. The aim of the crashing is to deliver the project within time. The process of project crashing is that when the project looks likely to delay, the activities on the critical path will be cut in order to deliver the project within time. Sometimes, the activities that is cut or the performance on the activities that is crashed might make the stakeholder dissatisfied. As the stakeholder's expectations does not fulfilled, the stakeholder may ask the scope of the projects to be changed.

2.7.5 Maintain the quality of the project

When implementing the project crashing, that is to say by shortening the project's duration, the quality of the project will be affected as well. Schexnayder (2000) states that quality in construction can be defined as meeting or exceeding the needs of the customer. The quality of the project may be affected by the triple constraint. Failure in managing the triple constraint would greatly affects the quality of the project. When implementing the project crashing, it is quite difficult to maintain the

balance of the triple constraint as more cost is being incurred throughout the project and the time of the project will be lesser.

Syed Burhanuddin Hilmi Syed Mohamad *et al*, (2012) states that the use of crashing approach will make the labour productivity decline and it will give an impact to the quality of work at construction site whilst also affect the work quality for the whole project.

2.8 IMPACTS OF PROJECT CRASHING

The implementation of project crashing can lead to various impacts. The most obvious impacts that it can cause is towards triple constraints. The triple constraint consists of cost, time and quality. By implementing the project crashing, it will definitely alter the relationship between these three traits.

In terms of cost, project crashing may sometimes required the contractor to incur more cost for the project crashing to be effective. This is because the cost is needed in order to ensure that the activities will always running in a fast pace. According to Syed Burhanuddin Hilmi Syed Mohamad *et al*, (2012), many contractors would agree that project crashing will cost them more.

However, it is not necessarily the cost is needed to do the crashing. There could be other ways that does not involve the using of extra cost in crashing a project. For instance, provide a longer working period. By providing a longer working time, the duration of the activities can be shortened since the activities are always running. Besides that, the quality of the project may be affected as well. A quick and short time given for a project would cause the project to be less quality compared to a longer period of time. This is because the quality of the project depends on the quality of the material and performance of the worker.

In conjunction with that, the impact of project crashing is actually depends on the strategies used for the project crashing. The strategies used for crashing a project will determine the impacts that it will cause.

2.9 CORRELATIONAL FRAMEWORK

The relationship between the two traits of variable is concluded and illustrated into a form of correlation framework as follow:

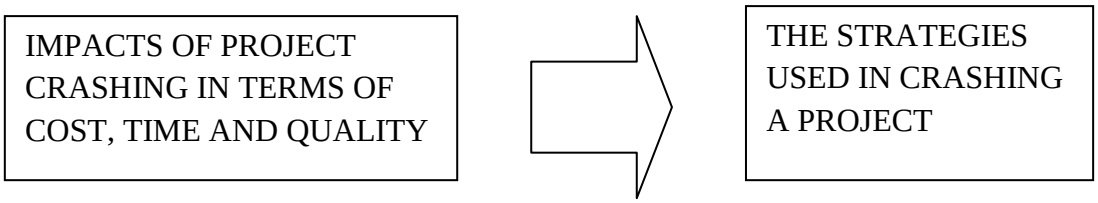


Figure 2.2: Correlational frameworks

CHAPTER 3

RESEARCH METHODOLOGY

3.1 INTRODUCTION

This chapter will explain and covers several aspects and sections. The research is basically carried out according to the research objectives and it consists of research design, research method, population and sampling, data sources and data collection method, the development of measure design of question and statistical techniques. This chapter will also explain the detailed about the scope of the research paper.

3.2 RESEARCH DESIGN

The design for this research is descriptive study that is used to gain information of a real situation about the behaviour, attitudes or other criteria of a particular group. The use of descriptive study is majorly to collect and get an overview look of the population through the situations (Rubin and Babbie, 1997). In simpler words, the descriptive study is done by describing the real situations in a population.

In accordance with that, by using the descriptive analysis, the research objectives can be answered. This is because the method used for this research is questionnaire which consists of questions related to the project crashing. According to Bickman and Rog (1998), the questions asked such as “what was” or “what is” can be answered by using the descriptive method. As for questions like “how” or “why”, conducting an experiment can simply answer that type of questions. The answer for the

research questions is interpreted from data in terms of frequencies or means that is necessary for a descriptive study.

In conducting research, it generally has two types of method namely qualitative method and quantitative method. Qualitative method is an empirical research that does not involves statistics or number. Quantitative method on the other hand is a data collection by using statistics or numerical analysis to analyze the raw data. For the purpose of this research, the method used is quantitative method that is the use of questionnaire. Depending on the number of population, the questionnaire will be distributed on construction industry in Kuantan area.

3.3 POPULATION AND SAMPLING

The population is the entire group of people or events from which the sample is selected and to which the study findings will be generalized. It can also refer to the entire group of people, events or things that attracts the researcher to investigate (Cavana et al., 2001). In selecting a population for study, the research question or purpose of the research will determine a suitable type of population that is to be researched. The important thing is that the population must meet a set of criteria of interest to the researcher. As for this research, the population will consist of contractor, developers or consultant companies from Kuantan area. The unit analysis for this study is the number of individuals who response to the questionnaire.

From the information gathered from CIDB, the list of the contractor company G7 can be obtained. The population of the contractor company in Kuantan is 78. As for the developer companies, the total developer companies in Kuantan is 45. This information is acquired from the Real Estate and Housing Developers' Association Malaysia (REHDA) website. Meanwhile, the consultant companies in Kuantan consist of 11 companies. Together, the total number of population is 134.

After the population has been determined, it needs to be sampling. A population sample is the selected people from the population that are chosen to be participated in the research. In easier word, the population sample is a smaller number that are chosen

with a certain ways of sampling method that will represent the population. Any data obtained from the sample will reflects the overall population.

There are several methods for drawing random samples. As for this research, the type of sampling that will be used is simple random sampling. Simple random sampling is a sampling where every element of the population has a probability of being selected for the sample. It is the most easiest to understand among the type of sampling and it is also the basic selection process of sampling. By using the simple random sampling method, every company in the population will have an equal chance of being chosen.

By having correctly done the random sampling method, the sample size can be determine. There are quite a few ways to determine the sample size, depending on the researcher and his study. The strategies to calculate the sample size includes using a census for small populations, referring to the sample size of an identical type of research, using the published tables and also by following the formulas to find the sample size (Israel, 2009). As for this research, there will be two techniques that will be used to determine the sample size.

The first technique is by referring the formula of finding the sample size to obtain the sample size. The formula used for this research is by referring from Israel's journal which is as follows:

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

n = Sample Size

N = Population Size

e = The level of Precision (Sampling Error)

Figure 3.1: Formula for Sample Size

By referring the formula from figure 3.1, the sample size can be calculated by inserting the existing data that is the population size into the formula. As for the level of precision, this research will used ±5 percent, a number that is averagely used by other researcher. It also follows Israel (2009) claim that the range about the true value of the population is commonly expressed in percentage form that is ±5 percent. All the data can now be applied into the formula.

$$\boldsymbol{n = \frac{134}{1+134(0.05)^2} = 100.375 \approx 101}$$ Respondents

From the above calculation, it shows that 101 set of questionnaire will represents the population size that is 134 in Kuantan. The questionnaire will be distributed for 101 respondents that consist of contractor's companies, developer's companies and consultant's companies.

Another techniques that will be used for this research is by referring the published table. The table is referred from table 2 of Israel journal. The table are as follows:

Table 3.1: Sample size table

Size of Population	Sample size (n) for Precision (e) of :		
	±5%	±7%	±10%
100	81	67	51
125	96	78	56
150	110	86	61
175	125	94	64

By referring the table above, the population size for this research is 134 which lie in between 125 and 150. From there, the sample size that is needed is between 96 to 110 under the category of ±5%. Hence, the value that is obtained from the calculation that is 101 lies in the range of sample size from the table that indicates the number of respondents needed.

3.4 DATA COLLECTION TECHNIQUE

As for this research, quantitative data collection techniques are used through the distribution of questionnaires. A set of questionnaire will be distributed to the construction company that includes contractor, developer and consultant throughout Kuantan area. The questionnaire will be distributed personally by the researcher. This is to increase the percentage of getting the feedback from the respondent and the method is more effective. A small portion of the questionnaire will be distributed via e-mail.

3.5 QUESTIONNAIRE DESIGN

The questionnaire will be developed based on the research objectives, research understanding and by referring to the literature review. In formulating the questionnaire, there are several things that need to be taken into considerations in order to have a useful and relevant data for analysis. The questionnaire must be developed by using a simpler word and terms so that the respondent does not get confused or having a hard time answering the questionnaire.

3.5.1 Development of Questionnaire

The questionnaire consists of four sections that the respondents need to answer. One of them is about demographic criteria and the remaining section is variables for the strategies, challenges and the impacts of project crashing. The questionnaire will be hundred percent in English.

In the questionnaire, it consists of 33 questions that represent 4 major group that are Section A, demographic section (question 1 until question 4), Section B, strategies used in crashing a project (question 5 until question 11), Section C, challenges faced in project crashing (question 12 until question 18) and Section D, the impacts of project crashing in terms of cost, time and quality (question 19 until question 33).

3.5.2 Section A (Demographic)

Section A consists of demographic questions that are personal information about the respondent. The question is about the respondent's gender, years of experience, held positions and from which company. This is to ensure that this research is carried out without cheating. Mainly, questions in section A are to check the respondent's backgrounds.

3.5.3 Section B

In section B, the respondents are asked to choose the rated structure questions based on his opinion or his experience. The questions in this section are based on the research objectives number 1 that is the strategies to crash a project successfully. The rating scale used in this section of question is Likert Scale Ranking. Likert Scale has been commonly used in the rating question because it is easier to answer, easier to read, easier to interpret, easier for the respondents and it is systematic. Likert Scale can be interpret as to determine how strongly the respondents agree or disagree with the criteria. This research will use a five-point scale in this section ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). For clearer situation, refer to the table below:

Table 3.2: Likert Scale Ranking

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

3.5.4 Section C

In section C, the question is about the second research objective that is the challenges faced in project crashing. It consists of seven questions. This section also used the Likert Scale Ranking where the respondent will answer the question based on the scale of 1 to 5.

3.5.5 Section D

In section D, the question is about the third research objective that is to examine the relationship between the impacts and the strategies used in project crashing in terms of cost, time and quality. This question consists of cost factor, time factor and quality factor. Overall, it contains 15 questions that needed to be answered. The format of the question is still using the Likert Scale Ranking.

3.6 DATA ANALYSIS

After the questionnaire is answered, the data obtained will be analyzed. The methods used for analyzing this research are the Statistical Package for Social Sciences software (SPSS) and Microsoft excel. SPSS is a technique used to calculate the statistical data and managing the data obtained from the survey questionnaire.

3.7 PILOT STUDY

Before proceeding further, pilot questionnaire was tested for appropriate wording and questions. It is also used to check whether it was meaningful to the respondents, whether the questions asked are suitable for showing the main points of the research and whether the sequence of the questions asked are smooth or not (Sekaran, 2003).

The pilot questionnaire will be conducted on a smaller group of respondents. For this purpose, 10 respondents will be selected and answer the questionnaire. The respondents selected for this purpose is selected outside of Kuantan area. These tests are to make sure that the questionnaire is easily understood and ensure that the questions are valid.

3.7.1 Screening and Cleaning

In order to achieve an acceptable Cronbach's Alpha coefficient value, few items is deleted from the questionnaire. In Section D, a total of 4 items were deleted from the questionnaire to achieve the acceptable level of Cronbach's Alpha coefficient which is

more than 0.70. As for section B and section C, there was no item that was deleted since the original value has exceeded 0.70 which indicates that the value has reached an acceptable level.

3.8 RELIABILITY

The reliability test is a measure indicates the extents to which the measure was conducted without bias from any factor or error free. It will hence offer consistent measurement across time and across the various items in the instrument. In other words, the reliability of a measure helps to assess the goodness of a measure.

The Cronbach's Alpha coefficient is used as an internal consistency reliability to ensure the reliability of the variables was tested. The closer the Cronbach's Alpha coefficient value is to 1, the higher the internal consistency reliability. According to Gliem (2003), Cronbach's Alpha coefficient value of 0.70 is considered as acceptable level.

3.9 DESCRIPTIVE STATISTICS

To analyse the results of the survey, the SPSS software was used. An analysis of descriptive statistic will be conducted on the individual demographic sections such as gender. Besides that, the strategies and challenges of project crashing is analyze through descriptive statistic to obtain the frequencies.

3.10 CENTRAL TENDENCY

The mean or average is a measure of central tendency that offers a general picture of the data. To answer the research objectives one and two, the total mean for the strategies (Section A) and challenges (Section B) were identified and rank accordingly from the highest mean score to the lowest mean score.

3.11 CORRELATION

In order to answer the research objectives number three, Pearson Correlation Analysis is carried out in order to find the relationship between the independent variables and the dependent variables. A positive value will indicates that the two variables are positively correlated while a negative value indicates that the two variables have a negative correlation.

3.11.1 Spearman's Rank Correlation

In additional, the Spearman's rank correlation analysis is carried out in order to test the degree of agreement between different parties. The respondent consists of three parties that are contractor, developer and consultant. By using Spearman's rank correlation, the agreement relationship between these parties can be observed. If the value is near +1, it indicating a strong positive relationship or agreement. On the other hand, if the value is near -1, it indicating a strong negative relationship or disagreement.

3.12 SUMMARY

In a nutshell, this chapter shows the flow of the research that is going to be conducted. It covers about how the questionnaire was developed and how it is going to be distributed. This chapter also explain about how the data is going to be obtained and managed

Since Kuantan is selected as the scope of the research, the respondent for the pilot test and reliability test cannot be from the same area. The use of descriptive statistics is to answer RO1 and RO2 by identifying the highest mean and ranked it. As for RO3, the correlation analysis is carried out to answer it as well as the hypothesis.

CHAPTER 4

DATA ANALYSIS

4.1 INTRODUCTION

This chapter discusses about the results of the data analysis and findings. The instrument used to carry out this analysis is Statistical Package for the Social Sciences (SPSS) and Microsoft Excel. Among the tests that were carried out are frequencies, reliability test, normality test, Spearman rank correlation and Pearson correlation.

For this research, a total of 134 respondents companies were identified that consists of contractor, developer and consultant companies. From that, 80 questionnaires were distributed by hand while 20 questionnaires were sent through email. Out of 100 questionnaires that were distributed, 54 questionnaires were successfully collected from the respondent. Among that, 25 respondents were contractor, 22 respondents were from developer companies and the remaining 7 were from consultant companies.

Based on the questionnaires that were successfully collected, the response rate achieves 40.3% out of 134. This satisfied and fulfilled the requirement needed to proceed with the data analysis, in line with what was stated by Chatman (2007) that if the response rate achieved is 30% or higher, the result can be used as it is considered as sufficient. Besides that, Sekaran (2003) also states that for the purpose of statistical analysis, a minimum sample size of 30 is considered as admissible.

4.2 DEMOGRAPHIC ANALYSIS

Table 4.1: Table of demographic Analysis

Items	**Frequency**	**Percentage (%)**
Gender		
i) Male	43	80
ii) Female	11	20
Years of experience		
i) 1-10 years	15	28
ii) 11-20 years	25	46
iii) 21-30 years	14	26
iv) 31 years and above	0	0
Highest qualification		
i) Secondary school	5	9
ii) Diploma	4	8
iii) Degree	27	50
iv) Master	18	33
v) PhD	0	0
Work position		
i) Contractors	25	46
ii) Developers	22	41
iii) Consultant	7	13

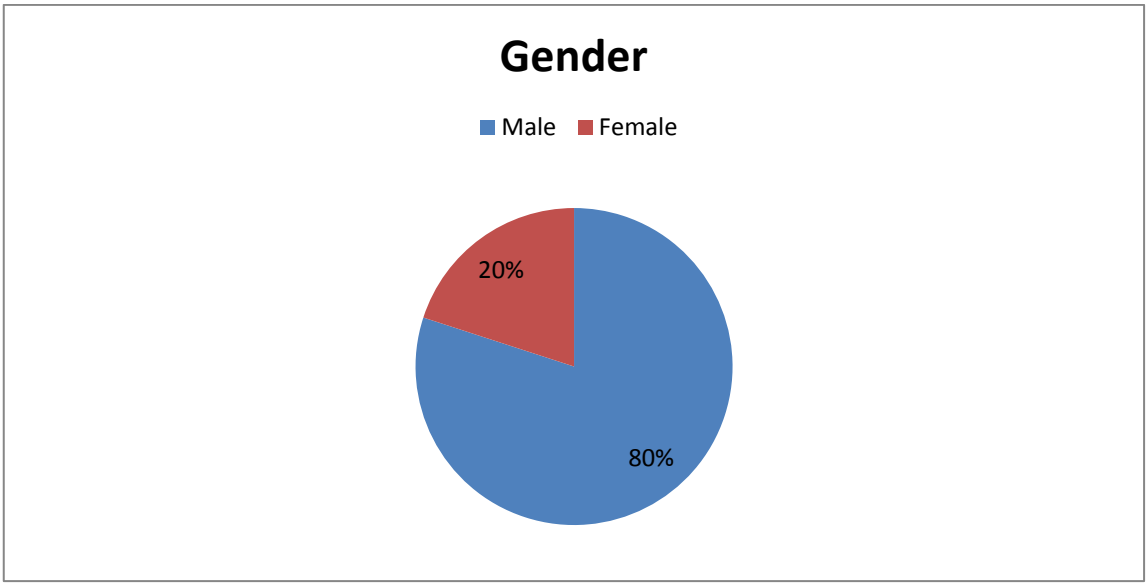


Figure 4.1: Gender

Figure 4.1 shows the percentage of the respondent's gender. The total number of the respondent is 54. From that number, 43 of the respondent is male which equivalent to 80% while the remaining 11 respondents are female with the percentage of 20%. From this figure, we can safely say that construction industries consist of more males than females.

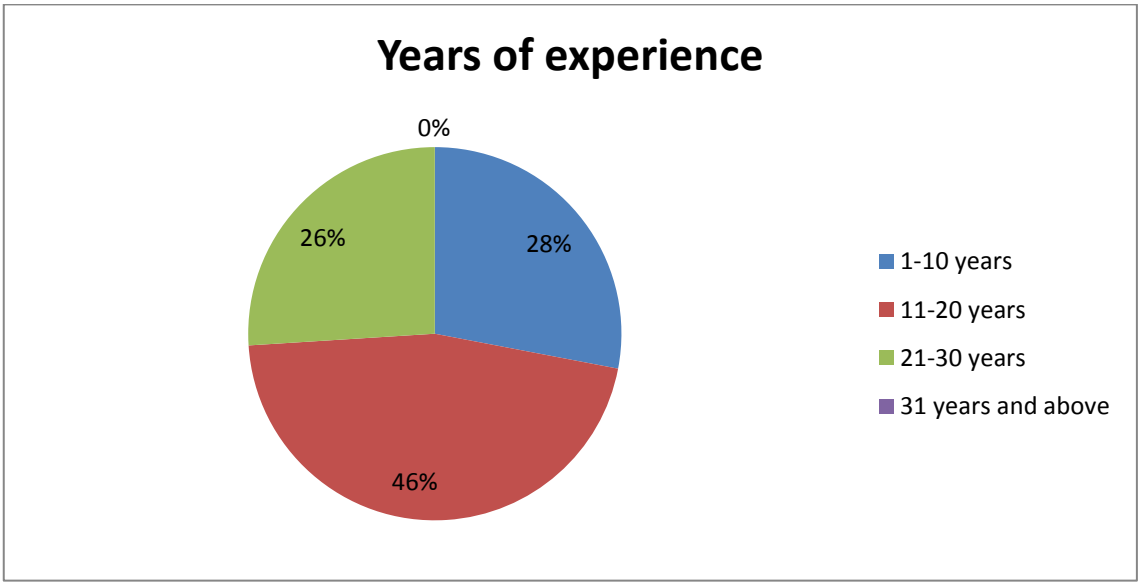


Figure 4.2: Years of experience

Figure 4.2 indicates the years of experience in construction industry for the respondents. From the figure, most of the respondent has experience in construction industry ranging from 11-20 years which is 46% (25 people) followed by 1-10 years which consist of 15 people that is 28%. 26% which equivalent to 14 people of the respondents has an experience of 21-30 years while none of the respondents have more than 31 years or more experience in construction industry.

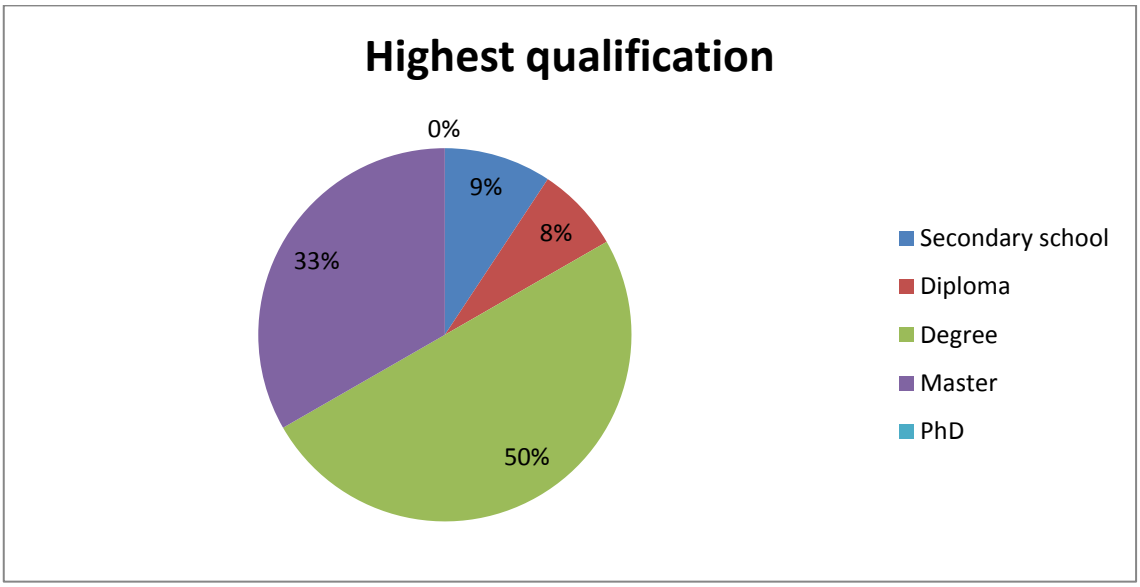


Figure 4.3: Highest qualification

Figure 4.3 displays about the highest qualification or highest education of the respondents. It can clearly be seen that majority of the respondents holds the degree qualification that consists of 27 people for 50% in percentage. Next is 33% of respondent that is 18 people have the master qualification followed by 9% (5 people) of the respondent qualified until secondary school. Only 8% that is 4 people holds the diploma qualification and none of the respondent holds the PhD qualifications.

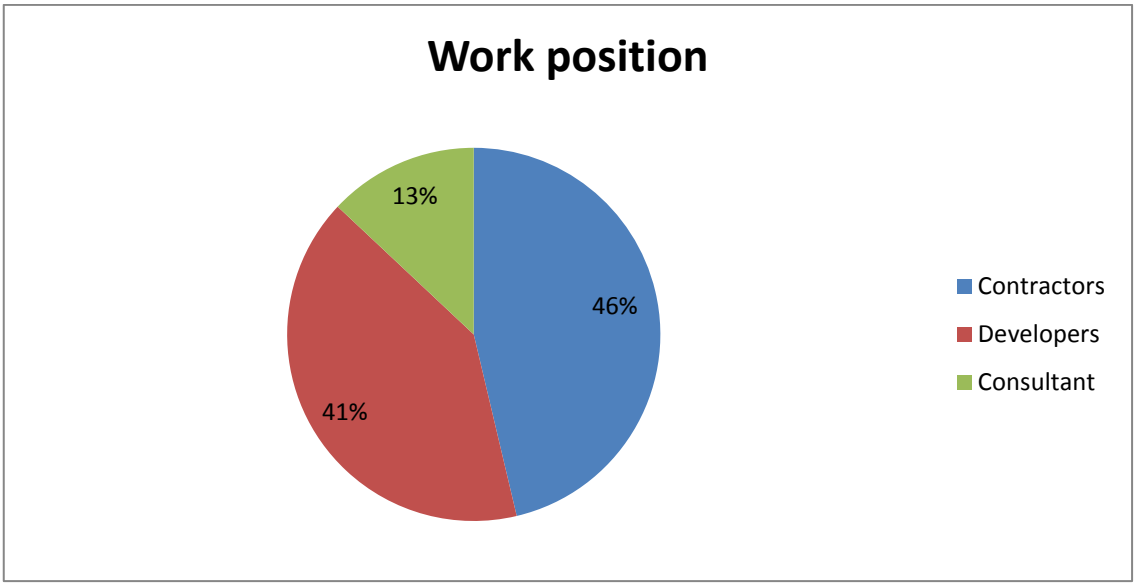


Figure 4.4: Work position

Figure 4.4 shows the work positions of the respondent. In Accordance with the objectives of this research, the work position consists of contractors, developers and consultants. From the figure, majority of the respondents consists of contractors that are 46% or 25 people. Second place is 41% (22 people) of developers and the remaining 7 people works as consultant that takes up 13% of the respondents.

4.3 RELIABILITY ANALYSIS

To ensure that the data is accurate and reliable, the reliability analysis was conducted. The purpose of the reliability test was to find the Cronbach's coefficient alpha. Cronbach's coefficient alpha is a well-known test that was used to indicate how well the consistent reliability inter-items was (Cavana et al., 2001). If the result of the Cronbach's alpha values lies within 0.5 to 0.7, it is considered as acceptable while if the result is more than 0.7, it is considered as good level (Yusoff, 2012 and Mcdowell, 2006). As for this research, the Cronbach's alpha are measured based on each element. The obtained Cronbach's alphas are 0.7 and above.

Table 4.2: Reliability test of the variables

Variables	**Cronbach's alpha value**	**Number of item**	**Number of item deleted**
Strategies	0.751	6	-
Challenges	0.743	7	-
Impacts on cost	0.824	4	2
Impacts on time	0.719	6	1
Impacts on quality	0.740	3	1

Table 4.2 shows the obtained Cronbach's alpha value of the variables for this research. The highest value is 0.824 for 4 items which is the impacts of strategies used in project crashing on cost. The second highest is the strategies of crashing a project successfully with 0.751 for 6 items followed by challenges of project crashing with 0.743 for 7 items. Next is 0.740 for the impacts of strategies used in project crashing on quality which has 3 items and the least is the impacts of strategies used in project crashing on time with 0.719 for 6 items.

In order to achieve these Cronbach's alpha value that ranging from 0.7 to 0.8, there were several items that were deleted. On the impacts of the strategies used in project crashing on cost, there were two elements that were deleted in order to achieve the value of 0.824. Meanwhile, one item was deleted each in the strategies used in project crashing on both time and quality to achieve the value of 0.719 and 0.740 respectively. Apart from that, for the variables of the strategies of crashing a project

successfully and the challenges of the project crashing Cronbach's alpha values was 0.751 and 0.743 respectively which means that there is no need to delete any items in order to achieve the acceptable Cronbach's alpha value.

Sekaran (2013) states that if the obtained Cronbach's alpha value is greater than 0.7, it is good and reliable and the data can be used to further the research. In conjunction with that, it can be said that the Cronbach's alpha value obtained from this reliability test is considered to be good level as they are all exceed the value of 0.7.

4.4 NORMALITY ANALYSIS

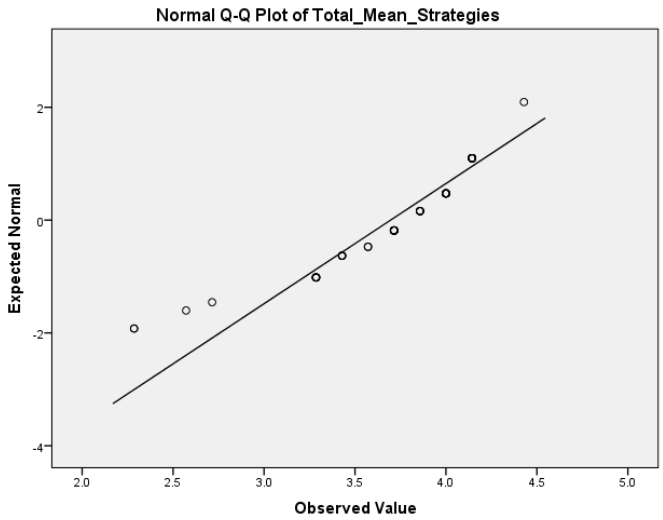
For this research, the normality analysis was carried out to define whether the data is normally distributed or not. The normality analysis consists of two tests that are Kolmogorov-Smirnov and Shapiro-Wilk, depending on the sample size. Kolmogorov-Smirnov test is suitable when the sample size exceed 50, while Shapiro-Wilk test is suitable for the normality of distribution test when the sample size is smaller than 50 (SPSS 14, 2007).

This research received 54 respondents and so, it will follow the Kolmogorov-Smirnov test as it fulfils the requirement needed. In order to determine whether the data distributed is normally distributed or not, it depends on the significant value (sig.). If the significant value are greater than 0.05, it will be considered as normal distributed.

Table 4.3: Normality Test

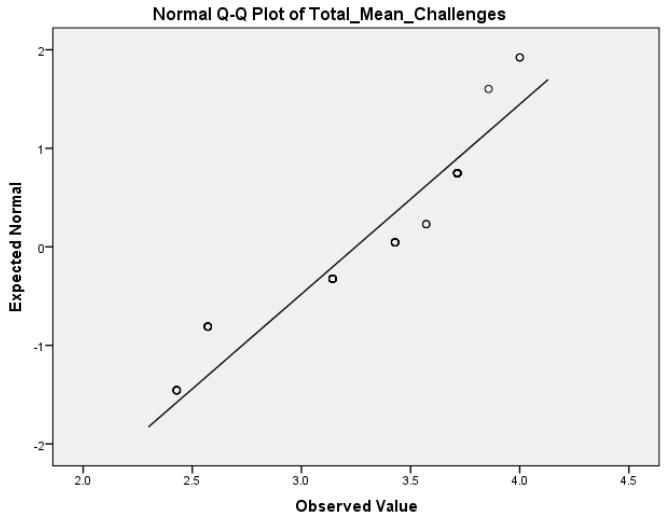
	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
Strategies of successfully crashing a project	0.182	54	0.000
Challenges of project crashing	0.204	54	0.000
Impacts of strategies used in project crashing on cost	0.251	54	0.000
Impacts of strategies used in project crashing on time	0.240	54	0.000
Impacts of strategies used in project crashing on quality	0.176	54	0.000

a. Lilliefors Significance Correction



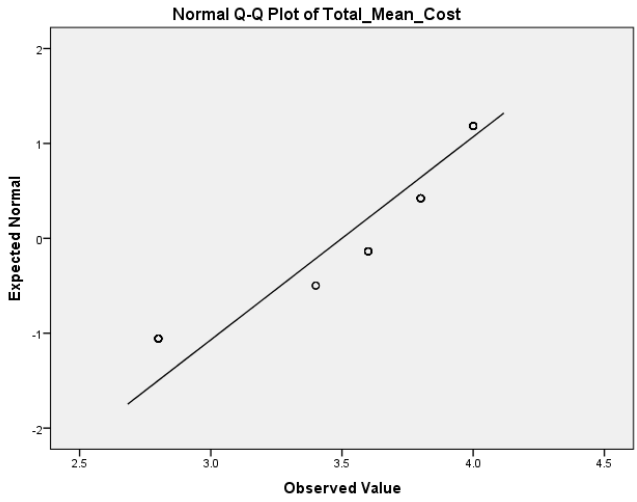
Graph 4.1: Normality graph for strategies

The graph 4.1 shows the normality plot for the strategies used in crashing a project successfully. The graph indicates that the data is not normally distributed since it achieves the significant value of 0.000.



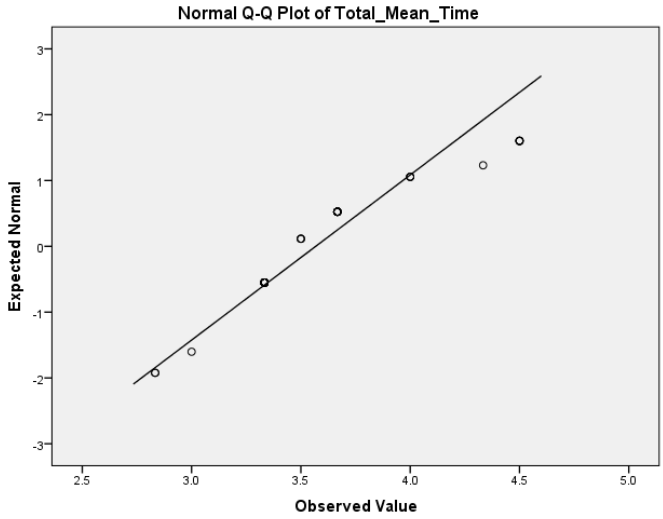
Graph 4.2: Normality graph for challenges

The graph 4.2 indicates the normality plot for the challenges faced in project crashing. According to the graph above, the data is not normally distributed since the data were spread is scattered and does not form a linear.



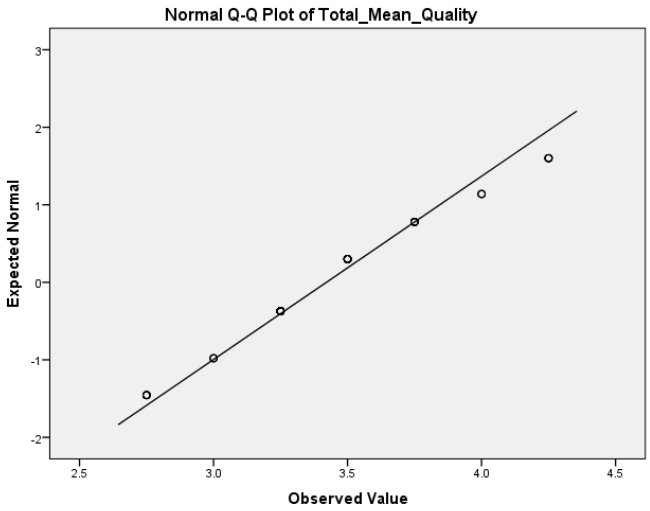
Graph 4.3: Normality graph for the impacts on cost

Graph 4.3 shows the normality plot the impacts of the strategies used in project crashing on cost. As can be seen, the data is considered as not normally distributed and it achieved 0.000 significant values.



Graph 4.4: Normality graph for the impacts on time

The graph 4.4 shows the normality plot for the impacts of the strategies used in project crashing on time. According to the graph, the data can be considered as not normally distributed.



Graph 4.5: Normality graph for impacts on quality

The graph 4.5 shows the normality plot for the impacts of the strategies used in project crashing on quality. Based on the graph, the data is not normally distributed since it achieves the significant value of 0.000.

4.5 DESCRIPTIVE ANALYSIS

As for the descriptive statistic, the data of the research were analyzed by using mean and standard deviation. The purpose of using the descriptive statistic is that to answer the objective number one and two of this research that is; to identify the strategies that can crash a project successfully and the challenges in project crashing. The result of the descriptive statistic will show the highest probability of strategy and challenges preferred by the contractor, developer and consultant. The score of these variables is based on the use of Likert scale ranking.

Table 4.4: Likert scale ranking

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

Through the use of the Likert scale ranking, it helps in concluding and ranking the strategies of crashing a project successfully and challenges faced in project crashing. The finding of mean will indicates the value of average for the data set. Elsewhere, the standard deviation is a measure of the dispersion of a set of data from its mean. The smaller value of standard deviation is better because it means that the dispersion of data does not have much different indicating that the data is more accurate. As for standard deviation range, it can be range as follow:

1. Very good ($x \leq 0.50$)
2. Good ($0.51 \leq x \leq 0.70$)
3. Moderate ($0.71 \leq x \leq 0.90$)
4. Bad ($0.91 \leq x \leq 1.10$)
5. Very bad ($x \geq 1.11$)

4.5.1 Means and Standard Deviation in Strategies of successfully crashing a project

Table 4.5: Mean and standard deviation on strategies of successfully crashing a project

Descriptive Statistics

	N	Mean	Std. Deviation
Increasing manpower	54	4.1667	.77093
Hiring more skilled worker	54	3.9630	.38671
Provide more working hours	54	3.8148	.97272
Introducing shift system	54	3.3519	.85025
Monetary value	54	3.2593	.58874
Non-monetary value	54	3.6111	.56357
Managing the resources	54	3.7037	.60281
Valid N (listwise)	54		

Table 4.5 shows the means and standard deviation for the strategies of successfully crashing a project. According to the table above, the strategies that has the highest probability that can successfully crash a project according to the respondent that consists of contractor, developer and consultant is increasing manpower in vital task. It has the highest mean of 4.1667 while the standard deviation of 0.77093. The standard deviation can be considered as accurate because the value is in the range of moderate level.

On the other hand, the lowest strategies that can successfully crash a project is by giving monetary value such as rise in wages as an incentive to motivate the worker with mean score of 3.2593. The standard deviation is 0.58874 indicates that it is in the range of good level meaning that the data is almost accurate and the data spread does not have much different.

From table 4.5, we can rank the strategies of crashing a project successfully according to the mean obtained from the most agree to disagree.

Table 4.6: Rank of the strategies according to mean

Strategies to crash a project successfully	Mean	Rank
Increasing manpower	4.1667	1
Hiring more skilled worker	3.9630	2
Provide more working hours	3.8148	3
Introducing the shift system	3.3519	6
Monetary value	3.2593	7
Non-monetary value	3.6111	5
Managing the resources	3.7037	4

4.5.2 Means and Standard Deviation in Challenges of project crashing

Table 4.7: Means and standard deviation in challenges of project crashing

Descriptive Statistics

	N	Mean	Std. Deviation
Using own pocket money to cover the cost of the project	54	2.7778	.94503
Prevent from paying the Liquidated Ascertain Damages (LAD)	54	3.1852	1.36083
Sudden changes in contract	54	3.3148	.57705
Changes of material and resources in the middle of the project	54	3.6852	.60887
Changes in scope	54	3.0741	.79745
Balancing triple constraint	54	3.4259	.60194
Maintaining the same workforce	54	3.2778	.85598
Valid N (listwise)	54		

Table 4.7 shows the mean and standard deviation on challenges of project crashing. From the table above, it can be seen that the highest challenges according to the respondent was the changes of material and resources in the middle of the project with the mean score of 3.6852 and the standard deviation is 0.60887. The standard deviation is almost accurate and the data spread does not have much different since the value falls in the range of good level.

Meanwhile, the lowest mean on challenges of project crashing is by using own pocket money to cover the cost of the project. The mean obtained is 2.7778 while the standard deviation is 0.94503 that falls under the range of bad. According to the value of standard deviation, the value shows that the data spread is large.

From table 4.7, the mean obtained regarding the challenges of project crashing enable it to be ranked. The ranked challenges of the project crashing are according to table 4.8.

Table 4.8: Rank of the challenges of project crashing according to mean

Challenges of project crashing	Mean	Rank
Using own pocket money to cover the cost of the project	2.7778	7
Prevent from paying the Liquidated Ascertain Damages (LAD)	3.1852	5
Sudden changes in contract	3.3148	3
Changes of material and resources in the middle of the project	3.6852	1
Changes in scope	3.0741	6
Balancing triple constraint	3.4259	2
Maintaining the same workforce	3.2778	4

4.6 CORRELATION ANALYSIS

Correlation analysis is a statistical technique that can indicates whether the pairs of variables have relationships or not and also how strongly the pairs of variables are related. It is considered as one of the successful method to study the relationship between a pair of variables. As for this research, the Pearson correlation was used to study the relationship between the strategies used in project crashing and its impacts on the triple constraint that are cost, time and quality. The Pearson correlation coefficient value can be interpreted from the table below:

Table 4.9: Pearson Correlation Coefficient

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

4.6.1 Relationship between increasing manpower and the impacts on triple constraint

4.6.1.1 Correlation between increasing manpower and the impacts on cost

Table 4.10: Correlation between increasing manpower and the impacts on cost

Correlations

		Increasing manpower	Total Mean Cost
Increasing manpower	Pearson Correlation	1	-.194
	Sig. (2-tailed)		.160
	N	54	54
Total Mean Cost	Pearson Correlation	-.194	1
	Sig. (2-tailed)	.160	
	N	54	54

Table 4.10 shows the correlation between the strategies used in project crashing that is by increasing the manpower in vital task with the impacts on cost. The Pearson

correlation, r is -0.194. This indicates that there is negligible negative relationship between the two variables. Also, there is no significant relationship between each other as the significant value is 0.160 which is more than 0.05.

4.6.1.2 Correlation between increasing manpower and the impacts on time

Table 4.11: Correlation between increasing manpower and the impacts on time

Correlations

		Increasing manpower	Total Mean Time
Increasing manpower	Pearson Correlation	1	.136
	Sig. (2-tailed)		.325
	N	54	54
Total Mean Time	Pearson Correlation	.136	1
	Sig. (2-tailed)	.325	
	N	54	54

Table 4.11 shows the correlation between the strategies used in project crashing that is by increasing the manpower in vital task with the impacts on time. There is negligible relationship between the two variables as the Pearson correlation coefficient, r, is 0.136 and there are no significant relationship between each variables since the significant value is more than 0.05.

4.6.1.3 Correlation between increasing manpower and the impacts on quality

Table 4.12: Correlation between increasing manpower and the impacts on quality

Correlations

		Increasing manpower	Total Mean Quality
Increasing manpower	Pearson Correlation	1	.084
	Sig. (2-tailed)		.544
	N	54	54
Total Mean Quality	Pearson Correlation	.084	1
	Sig. (2-tailed)	.544	
	N	54	54

Table 4.12 shows the correlations between the strategies used in project crashing that is by increasing the manpower in vital task with the impacts on quality. The Pearson correlation is 0.084 indicating that there is negligible relationship between both variables. However, there is no significant relationship between each of the variables since the significant value is 0.544 which is more than 0.05.

4.6.2 Relationship between hiring skilled worker and the impacts on triple constraint

4.6.2.1 Correlation between hiring skilled worker and the impacts on cost

Table 4.13: Correlation between hiring more skilled worker and the impacts on cost

Correlations

		Hiring more skilled worker	Total Mean Cost
Hiring more skilled worker	Pearson Correlation	1	-.104
	Sig. (2-tailed)		.453
	N	54	54
Total Mean Cost	Pearson Correlation	-.104	1
	Sig. (2-tailed)	.453	
	N	54	54

Table 4.13 indicates the correlations between the strategies used in project crashing that is by hiring more skilled worker with the impacts on cost. The Pearson correlation obtained is -0.104 which indicates that there is a negligible negative

relationship between the two variables. The significant value obtained is 0.453 indicating that there is no significant relationship since the value is bigger than 0.05.

4.6.2.2 Correlation between hiring skilled worker and the impacts on time

Table 4.14: Correlation between hiring more skilled worker and the impacts on time

Correlations

		Hiring more skilled worker	Total Mean Time
Hiring more skilled worker	Pearson Correlation	1	-.432**
	Sig. (2-tailed)		.001
	N	54	54
Total Mean Time	Pearson Correlation	-.432**	1
	Sig. (2-tailed)	.001	
	N	54	54

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

Table 4.14 shows the correlations between the strategies used in project crashing that is by hiring more skilled worker with the impacts on time. From the table, the Pearson correlation, r is -0.432 indicating that there is a moderate negative relationship between the two variables. Besides that, there is a significant relationship between these two variables at the 0.01 level.

4.6.2.3 Correlation between hiring skilled worker and the impacts on quality

Table 4.15: Correlation between hiring more skilled worker and the impacts on quality

Correlations

		Hiring more skilled worker	Total Mean Quality
Hiring more skilled worker	Pearson Correlation	1	-.393**
	Sig. (2-tailed)		.003
	N	54	54
Total Mean Quality	Pearson Correlation	-.393**	1
	Sig. (2-tailed)	.003	
	N	54	54

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

Table 4.15 shows the correlations between hiring more skilled worker strategies that is used in project crashing with the impacts on quality. The Pearson correlation, r is -0.393 indicating that there is a weak negative relationship between each variable. The significant value of 0.03 indicating that there is a significant relationship at 0.01 levels.

4.6.3 Relationship between providing more working hours and the impacts on triple constraint

4.6.3.1 Correlation between providing more working hours and the impacts on cost

Table 4.16: Correlation between providing more working hours and the impacts on cost

Correlations

		Provide more working hours	Total Mean Cost
Provide more working hours	Pearson Correlation	1	-.282*
	Sig. (2-tailed)		.039
	N	54	54
Total Mean Cost	Pearson Correlation	-.282*	1
	Sig. (2-tailed)	.039	
	N	54	54

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

Table 4.16 shows the correlation between providing more working hours strategies and the impacts on cost. From the table, there is a weak negative relationship between the variable as the Pearson correlation, r is -0.282. There is a significant relationship at 0.05 levels since the significant value is 0.039.

4.6.3.2 Correlation between providing more working hours and the impacts on time

Table 4.17: Correlation between providing more working hours and the impacts on time

Correlations

		Provide more working hours	Total Mean Time
Provide more working hours	Pearson Correlation	1	.057
	Sig. (2-tailed)		.680
	N	54	54
Total Mean Time	Pearson Correlation	.057	1
	Sig. (2-tailed)	.680	
	N	54	54

Table 4.17 shows the correlation between providing more working hours strategies and the impacts on time. Pearson correlation, r is 0.057 indicating that there is a negligible relationship and no significant relationship since the significant value is more than 0.680.

4.6.3.3 Correlation between providing more working hours and the impacts on quality

Table 4.18: Correlation between providing more working hours and the impacts on quality

Correlations

		Provide more working hours	Total Mean Quality
Provide more working hours	Pearson Correlation	1	.124
	Sig. (2-tailed)		.370
	N	54	54
Total Mean Quality	Pearson Correlation	.124	1
	Sig. (2-tailed)	.370	
	N	54	54

From table 4.18, there is a negligible relationship between providing more working hours strategies and the impacts on quality. Besides that, there is no significant relationship since the significant value is 0.370 which is more than 0.05.

4.6.4 Relationship between introducing shift system and the impacts on triple constraint

4.6.4.1 Correlation between introducing shift system and the impacts on cost

Table 4.19: Correlation between introducing shift system and the impacts on cost

		Introducing shift system	Total Mean Cost
Introducing shift system	Pearson Correlation	1	-.033
	Sig. (2-tailed)		.811
	N	54	54
Total Mean Cost	Pearson Correlation	-.033	1
	Sig. (2-tailed)	.811	
	N	54	54

Table 4.19 shows the correlation between introducing shift system strategies and the impacts on cost. The Pearson correlation, r is -0.033 indicating that the relationship

is negligible negative relationship as well as no significant relationship since the significant value is 0.811.

4.6.4.2 Correlation between introducing shift system and the impacts on time

Table 4.20: Correlation between introducing shift system and the impacts on time

Correlations

		Introducing shift system	Total Mean Time
Introducing shift system	Pearson Correlation	1	.179
	Sig. (2-tailed)		.196
	N	54	54
Total Mean Time	Pearson Correlation	.179	1
	Sig. (2-tailed)	.196	
	N	54	54

According to table 4.20, there is a negligible relationship between introducing shift system strategies and the impacts on time. There is also no significant relationship between both of the variables since the significant value is more than 0.05.

4.6.4.3 Correlation between introducing shift system and the impacts on quality

Table 4.21: Correlation between introducing shift system and the impacts on quality

Correlations

		Introducing shift system	Total Mean Quality
Introducing shift system	Pearson Correlation	1	.328*
	Sig. (2-tailed)		.016
	N	54	54
Total Mean Quality	Pearson Correlation	.328*	1
	Sig. (2-tailed)	.016	
	N	54	54

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

Table 4.21 shows the correlation between introducing shift system and the impact on quality. The Pearson correlation, r is 0.328 indicating that there is a weak

relationship between the variables. The significant value of 0.016 indicating that there is a significant relationship between the two variables at 0.05 levels.

4.6.5 Relationship between giving monetary value and the impacts on triple constraint

4.6.5.1 Correlation between giving monetary value and the impacts on cost

Table 4.22: Correlation between giving monetary value and the impacts on cost

Correlations

		Giving monetary value	Total Mean Cost
Giving monetary value	Pearson Correlation	1	.521**
	Sig. (2-tailed)		.000
	N	54	54
Total Mean Cost	Pearson Correlation	.521**	1
	Sig. (2-tailed)	.000	
	N	54	54

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

Table 4.22 shows the correlation between giving monetary value and the impacts on cost. The Pearson correlation, r is 0.521 indicating that there is a moderate relationship between the variable. There is also a significant relationship at 0.01 levels.

4.6.5.2 Correlation between giving monetary value and the impacts on time

Table 4.23: Correlation between giving monetary value and the impacts on time

Correlations

		Giving monetary value	Total Mean Time
Giving monetary value	Pearson Correlation	1	.728**
	Sig. (2-tailed)		.000
	N	54	54
Total Mean Time	Pearson Correlation	.728**	1
	Sig. (2-tailed)	.000	
	N	54	54

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

Table 4.23 shows the correlation between giving monetary value strategies and the impacts on time. From the table, there is a high relationship between the variables

with the Pearson correlation, r of 0.728. The significant value indicates that there is a significant relationship between these two variables at 0.01 levels

.

4.6.5.3 Correlation between giving monetary value and the impacts on quality

Table 4.24: Correlation between giving monetary value and the impacts on quality

Correlations

		Giving monetary value	Total Mean Quality
Giving monetary value	Pearson Correlation	1	.633**
	Sig. (2-tailed)		.000
	N	54	54
Total Mean Quality	Pearson Correlation	.633**	1
	Sig. (2-tailed)	.000	
	N	54	54

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

From table 4.24, it is shown that there is a moderate relationship between giving monetary value and the impacts on quality and also indicates that there is a significant relationship at 0.01 level.

4.6.6 Relationship between giving non-monetary value and the impacts on triple constraint

4.6.6.1 Correlation between giving non-monetary value and the impacts on cost

Table 4.25: Correlation between giving non-monetary value and the impacts on cost

Correlations

		Giving non-monetary value	Total Mean Cost
Giving non-monetary value	Pearson Correlation	1	-.150
	Sig. (2-tailed)		.278
	N	54	54
Total Mean Cost	Pearson Correlation	-.150	1
	Sig. (2-tailed)	.278	
	N	54	54

Table 4.25 shows the correlation between giving non-monetary value strategies and the impacts on cost. Pearson correlation, r obtained is -0.150 while the significant value is 0.278. Both of these indicates that the relationship is negligible negative relationship and hence, there is no significant relationship since the value exceeds 0.05.

4.6.6.2 Correlation between giving non-monetary value and the impacts on time

Table 4.26: Correlation between giving non-monetary value and the impacts on time

Correlations

		Giving non-monetary value	Total Mean Time
Giving non-monetary value	Pearson Correlation	1	.190
	Sig. (2-tailed)		.169
	N	54	54
Total Mean Time	Pearson Correlation	.190	1
	Sig. (2-tailed)	.169	
	N	54	54

From table 4.26, there is a negligible relationship between giving non-monetary value strategies and the impacts on time. The significant value is 0.169 indicates that there is no significant value between both variables.

4.6.6.3 Correlation between giving non-monetary value and the impacts on quality

Table 4.27: Correlation between giving non-monetary value and the impacts on quality

Correlations

		Giving non-monetary value	Total Mean Quality
Giving non-monetary value	Pearson Correlation	1	.146
	Sig. (2-tailed)		.291
	N	54	54
Total Mean Quality	Pearson Correlation	.146	1
	Sig. (2-tailed)	.291	
	N	54	54

Table 4.27 shows the correlation between giving non-monetary value strategies and the impacts on quality. The Pearson correlation, r is 0.146, meaning that there is a

negligible relationship while 0.291 significant value indicates that there is no significant relationship between these two variables.

4.6.7 Relationship between managing the resources and the impacts on triple constraint

4.6.7.1 Correlation between managing the resources and the impacts on cost

Table 4.28: Correlation between managing the resources and the impacts on cost

Correlations

		Managing the resources	Total Mean Cost
Managing the resources	Pearson Correlation	1	.067
	Sig. (2-tailed)		.630
	N	54	54
Total Mean Cost	Pearson Correlation	.067	1
	Sig. (2-tailed)	.630	
	N	54	54

Table 4.28 shows there is a negligible relationship between managing the resources strategies and the impact on cost. There is no significant relationship since the significant value of 0.630 is more than 0.05.

4.6.7.2 Correlation between managing the resources and the impacts on time

Table 4.29: Correlation between managing the resources and the impacts on time

Correlations

		Managing the resources	Total Mean Time
Managing the resources	Pearson Correlation	1	.229
	Sig. (2-tailed)		.095
	N	54	54
Total Mean Time	Pearson Correlation	.229	1
	Sig. (2-tailed)	.095	
	N	54	54

From table 4.29, there is a weak relationship between managing the resources and the impacts on time with Pearson correlation, r of 0.229. The significant value of 0.095 indicates that there is no significant relationship among the variables.

4.6.7.3 Correlation between managing the resources and the impacts on quality

Table 4.30: Correlation between managing the resources and the impacts on quality

Correlations

		Managing the resources	Total Mean Quality
Managing the resources	Pearson Correlation	1	.184
	Sig. (2-tailed)		.182
	N	54	54
Total Mean Quality	Pearson Correlation	.184	1
	Sig. (2-tailed)	.182	
	N	54	54

From table 4.30, the Pearson correlation, r of 0.184 shows that there is a negligible relationship between managing the resources with the impacts on quality while the significant value of 0.182 indicates that there is no significant relationship between both variables since the significant value is more than 0.05.

4.6.8 Summary of correlation between the strategies used in project crashing and the impacts

Table 4.31: Summary of Pearson correlation on the impacts of the strategies used in project crashing on triple constraint (cost, time and quality)

Strategies used in project crashing	**Impacts**		
	Cost	Time	Quality
Increasing manpower	-0.194	0.136	0.084
Hiring more skilled worker	-0.104	**-0.432****	**-0.393****
Provide more working hours	**-0.282***	0.057	0.124
Introducing the shift	-0.033	0.179	**0.328***

system			
Giving monetary value	**0.521****	**0.728****	**0.633****
Giving non-monetary value	-0.150	0.190	0.146
Managing the resources	0.067	0.229	0.184

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

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

4.7 SPEARMAN'S RANK CORRELATION ANALYSIS

The respondent of this research consists of three different parties that are contractors, developers and consultant. For that, Spearman's rank correlation analysis was carried out in this research in order to find the agreement between the respondent. In the Spearman's rank correlation, the correlation coefficient value of +1 indicating a strong positive relationship in terms of agreement while the correlation coefficient value of -1 indicating a strong negative relationship which could also mean disagreement.

4.7.1 Spearman's rank correlation for the strategies to crash a project successfully

In this section, the spearman's rank correlation was carried out in order to find the relationship of agreement or disagreement between contractor, developer and consultant on the strategies to crash a project successfully. The number of element, N involves in this section is seven that consist of increasing manpower, hiring more skilled worker, provide more working hours, introducing the shift system, giving monetary value, giving non-monetary value and managing the resources.

4.7.1.1 Spearman's rank correlation between contractor and developer for strategies

Table 4.32: Spearman's rank correlation between contractor and developer

Correlations

			Contractor	Developer
Spearman's rho	Contractor	Correlation Coefficient	1.000	.901**
		Sig. (2-tailed)	.	.006
		N	7	7
	Developer	Correlation Coefficient	.901**	1.000
		Sig. (2-tailed)	.006	.
		N	7	7

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

Table 4.32 shows the Spearman's rank correlation between contractor and developer. The correlation coefficient between these two groups is 0.901 indicating that there is a strong positive relationship. The significant value is 0.006 indicating that there is a significant relationship between them because the value is lower than 0.01.

4.7.1.2 Spearman's rank correlation between contractor and consultant for strategies

Table 4.33: Spearman's rank correlation between contractor and consultant

Correlations

			Contractor	Consultant
Spearman's rho	Contractor	Correlation Coefficient	1.000	.796*
		Sig. (2-tailed)	.	.032
		N	7	7
	Consultant	Correlation Coefficient	.796*	1.000
		Sig. (2-tailed)	.032	.
		N	7	7

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

From table 4.33, there is a positive relationship between contractor and consultant because the correlation coefficient is 0.796. Besides that, the significant of 0.32 indicates that both of the parties have a significant relationship at 0.05 levels.

4.7.1.3 Spearman's rank correlation between developer and consultant for strategies

Table 4.34: Spearman's rank correlation between developer and consultant

Correlations

			Developer	Consultant
Spearman's rho	Developer	Correlation Coefficient	1.000	.624
		Sig. (2-tailed)	.	.134
		N	7	7
	Consultant	Correlation Coefficient	.624	1.000
		Sig. (2-tailed)	.134	.
		N	7	7

Table 4.34 shows the spearman's rank correlation between developer and consultant. From the table, there is no significant relationship between the two parties as their significant value is 0.134 which is more than 0.05 and their correlation coefficient is 0.624.

4.7.2 Spearman's rank correlation for the challenges in project crashing

In this part, the Spearman's rank correlation is carried out in terms of challenges faced in project crashing from contractor, developer and consultant responds. The number of items, N in this section is seven. It consist of the use of own pocket money to cover the cost of the project, prevents from paying the Liquidated Ascertain Damages (LAD), sudden changes in contract, changes of material and resources in the middle of the project, changes in scope of the project due to the dissatisfaction of the stakeholder, maintaining and balancing the triple constraint and maintaining the same workforce.

4.7.2.1 Spearman's rank correlation between contractor and developer for challenges

Table 3.35: Spearman's rank correlation between contractor and developer

Correlations

			Contractor	Developer
Spearman's rho	Contractor	Correlation Coefficient	1.000	-.286
		Sig. (2-tailed)	.	.535
		N	7	7
	Developer	Correlation Coefficient	-.286	1.000
		Sig. (2-tailed)	.535	.
		N	7	7

Table 3.35 shows the Spearman's rank correlation between the contractor and developer. The correlation coefficient is -0.286 indicating that both of the parties did not have mutual agreement. The significant value of 0.535 indicates that both of them did not have a significant relationships since the value is higher than 0.05.

4.7.2.2 Spearman's rank correlation between contractor and consultant for challenges

Table 4.36: Spearman's rank correlation between contractor and consultant

Correlations

			Contractor	Consultant
Spearman's rho	Contractor	Correlation Coefficient	1.000	-.436
		Sig. (2-tailed)	.	.328
		N	7	7
	Consultant	Correlation Coefficient	-.436	1.000
		Sig. (2-tailed)	.328	.
		N	7	7

Table 4.36 shows the Spearman's rank correlation between contractor and consultant. From the table, there is no mutual agreement by both parties as the correlation coefficient is -0.436 and also there is no significant relationship since the significant value is 0.328 which exceed 0.05.

4.7.2.3 Spearman's rank correlation between developer and consultant for challenges

Table 4.37: Spearman's rank correlation between developer and consultant

Correlations

			Developer	Consultant
Spearman's rho	Developer	Correlation Coefficient	1.000	.946**
		Sig. (2-tailed)	.	.001
		N	7	7
	Consultant	Correlation Coefficient	.946**	1.000
		Sig. (2-tailed)	.001	.
		N	7	7

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

From table 4.37, there is a strong positive relationship between developer and consultant since the correlation coefficient value is 0.946 and has a significant relationship at 0.01 levels.

4.7.3 Spearman's rank correlation for the impacts of the strategies used in project crashing in terms of triple constraint (cost, time and quality)

In this section, the Spearman's rank correlation used in terms of the impacts of the strategies used in project crashing on cost, time and quality. The number of items, N is a combination of cost group, time group and quality group which totals up to 15 numbers of items.

4.7.3.1 Spearman's rank correlation between contractor and developer for impacts

Table 4.38: Spearman's rank correlation between contractor and developer

Correlations

			Contractor	Developer
Spearman's rho	Contractor	Correlation Coefficient	1.000	.437
		Sig. (2-tailed)	.	.103
		N	15	15
	Developer	Correlation Coefficient	.437	1.000
		Sig. (2-tailed)	.103	.
		N	15	15

From table 4.38, it can be seen that the correlation coefficient between contractor and developer is 0.437 while significant value is 0.103. This indicates that both contractor and developer do not have a significant relationship.

4.7.3.2 Spearman's rank correlation between contractor and consultant for impacts

Table 4.39: Spearman's rank correlation between contractor and consultant

Correlations

			Contractor	Consultant
Spearman's rho	Contractor	Correlation Coefficient	1.000	.031
		Sig. (2-tailed)	.	.912
		N	15	15
	Consultant	Correlation Coefficient	.031	1.000
		Sig. (2-tailed)	.912	.
		N	15	15

Table 4.39 shows that the correlation coefficient between contractor and consultant is 0.031 while the significant value is 0.912. This indicates that both of them do not have a significant relationship.

4.7.3.3 Spearman's rank correlation between developer and consultant for impacts

Table 4.40: Spearman's rank correlation between developer and consultant

Correlations

			Developer	Consultant
Spearman's rho	Developer	Correlation Coefficient	1.000	.741**
		Sig. (2-tailed)	.	.002
		N	15	15
	Consultant	Correlation Coefficient	.741**	1.000
		Sig. (2-tailed)	.002	.
		N	15	15

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

Table 4.40 shows the Spearman's rank correlation between developer and consultant. The correlation coefficient is 0.741 indicating that both parties have a positive relationship. The significant value is 0.002 indicating that they have a significant relationship at 0.01 levels.

4.7.4 Summary of Spearman's rank correlation coefficient to the contractor, developer and consultant

4.7.4.1 Spearman's rank correlation on strategies

Table 4.41: Spearman's rank correlation for strategies

Strategies		**Contractor**	**Developer**	**Consultant**
Spearman's rho Contractor	Correlation Coefficient	1.000	0.901*	0.796*
Spearman's rho Developer	Correlation Coefficient	0.901*	1.000	0.624
Spearman's rho Consultant	Correlation Coefficient	0.796*	0.624	1.000

4.7.4.2 Spearman's rank correlation on challenges

Table 4.42: Spearman's rank correlation for challenges

Challenges		**Contractor**	**Developer**	**Consultant**
Spearman's rho Contractor	Correlation Coefficient	1.000	-0.286	-0.436
Spearman's rho Developer	Correlation Coefficient	-0.286	1.000	0.946**
Spearman's rho Consultant	Correlation Coefficient	-0.436	0.946**	1.000

4.7.4.3 Spearman's rank correlation on impacts

Table 4.43: Spearman's rank correlation for impacts

Impacts		**Contractor**	**Developer**	**Consultant**
Spearman's rho Contractor	Correlation Coefficient	1.000	0.437	0.031
Spearman's rho Developer	Correlation Coefficient	0.437	1.000	0.741**
Spearman's rho Consultant	Correlation Coefficient	0.031	0.741**	1.000

4.8 SUMMARY OF FINDINGS

In demographic analysis results, majority of the respondents are male (80%) while the rest is female (20%). Most of the respondents have 11-20 years of experience in construction industry with 46%. Second is 1-10 years with 28% followed by 21-30 years (26%). The highest percentage of respondent holds degree qualification (50%) while the master qualification is 33%. Next is the secondary school qualification with 9% and the least is diploma holder (8%). Among the total 54 respondents, 46% of the respondent consists of contractors, 41% of the respondents is developers and the remaining 13% is consultant. This research was conducted based on three objectives:

RO1) To identify the strategies that can crash a project successfully

RO2) To identify the challenges of project crashing

RO3) To identify the impacts of the strategies used in project crashing in terms of cost, time and quality

In order to answer the **RO1** and **RO2**, the descriptive analysis was used. By using the descriptive analysis, the researcher can find the mean score of the subject and rank it according to the highest mean to the lowest mean. Results of the analysis are as follows:

Table 4.44: The total mean and ranking for the strategies to crash a project successfully

Strategies to crash a project successfully	Mean	Rank
Increasing manpower	4.1667	1
Hiring more skilled worker	3.9630	2
Provide more working hours	3.8148	3
Introducing the shift system	3.3519	6
Monetary value	3.2593	7
Non-monetary value	3.6111	5
Managing the resources	3.7037	4

From table 4.44, the total mean for each strategies to crash a project were successfully obtained. The mean includes all the responds from the contractor, developer and consultant. The obtained mean were then ranked accordingly from highest mean score to the lowest mean score.

The first rank strategy is increasing manpower with the mean of 4.17. Second rank is by hiring more skilled worker (3.96) followed by providing more working hours with mean of 3.81. Next is managing the resources (3.70), giving non-monetary value (3.61), introducing the shift system (3.35) and lastly giving monetary value with the mean score of 3.26.

Table 4.45: The total mean and ranking for the challenges faced in project crashing

Challenges of project crashing	Mean	Rank
Using own pocket money to cover the cost of the project	2.7778	7
Prevent from paying the Liquidated Ascertain Damages (LAD)	3.1852	5
Sudden changes in contract	3.3148	3
Changes of material and resources in the middle of the project	3.6852	1
Changes in scope	3.0741	6
Balancing triple constraint	3.4259	2
Maintaining the same workforce	3.2778	4

Table 4.45 shows the mean and ranking for the challenges faced in project crashing. The obtained mean for each of the challenges were then ranked according to the mean score from highest to lowest.

The first ranked challenge is the changes of material and resources in the middle of the project with the mean score of 3.69. Second highest challenges based on mean is balancing the triple constraint with mean of 3.43 followed by sudden changes in contract (3.31). Next is maintaining the same workforce in order to maintain the

performance of the work done with mean score of 3.28 and followed by to prevent from paying the Liquidated Ascertain Damages (LAD) with mean score of 3.19. Ranked sixth is changes in scope with mean of 3.07 and lastly using own pocket money to cover the cost of the project (2.78).

Apart from that, different approach were used to answer **RO3** since the objectives have a relationships that is to identify the impacts of the strategies used in project crashing in terms of cost, time and quality. A correlation analysis was carried out. By implementing the Pearson correlation coefficient, the significant relationship between the strategies used and the impacts on terms of cost, time and quality can be identified.

Table 4.46: The Pearson correlation of the strategies used in project crashing and the impacts in terms of cost, time and quality

Strategies used in project crashing	**Impacts**		
	Cost	Time	Quality
Increasing manpower	-0.194	0.136	0.084
Hiring more skilled worker	-0.104	**-0.432****	**-0.393****
Provide more working hours	**-0.282***	0.057	0.124
Introducing the shift system	-0.033	0.179	**0.328***
Giving monetary value	**0.521****	**0.728****	**0.633****
Giving non-monetary value	-0.150	0.190	0.146
Managing the resources	0.067	0.229	0.184

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

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

Based on table 4.46, the relationship between the strategies used in project crashing and the impacts in terms of cost, time and quality can be seen clearly. By implementing the strategies of hiring more skilled worker, it will have a significant

relationship with the time and quality of the project. By providing more working hours, the cost of the project will be affected and by introducing the shift system, the relationship is with the quality. By giving monetary value such as rise in wages as an incentive to motivate the worker, it will impact the cost, time and quality of the project.

In conjunction with that, the hypothesis still needs to be clarified. All the strategies used in project crashing and the impacts of project crashing in terms of cost, time and quality were analyzed by using the Pearson correlation coefficient.

Table 4.47: Pearson correlation between strategies and impact

Correlations

		Mean Strategies	Mean Impact
Mean Strategies	Pearson Correlation	1	.155
	Sig. (2-tailed)		.263
	N	54	54
Mean Impact	Pearson Correlation	.155	1
	Sig. (2-tailed)	.263	
	N	54	54

Table 4.47 shows the Pearson correlation between the total mean strategies and total mean impacts. Based on the table, the Pearson correlation coefficient is 0.155 indicating that there is a negligible relationship while the significance value is 0.263 indicates that the strategies and the impacts do not have a significant relationship because the significant value is higher than 0.05.Hence, based on the reviewed hypothesis,

H0: There is no relationship between the strategies used and impacts of project crashing in term of cost, time and quality

H1: There are relationship between the strategies used and impacts of project crashing in terms of cost, time and quality

The null hypothesis, H0 is accepted. There is no relationship between the strategies used and impacts of project crashing in terms of cost, time and quality.

In addition, Spearman's rank correlation was carried out as a test of agreement and to identify the similarity in the ranking among the respondents. Since the respondent consists of three different parties which are contractor, developer and consultant, the agreement and disagreement between these parties can be observed. In other words, the researcher can observe the similarity and differences in the contractor, developer and consultant's thinking and perspective.

In Spearman's rank correlation, the higher correlation indicates that there is a high degree of agreement between each party. The closer the correlation coefficient value to +1 indicates a strong positive relationship or agreement while if the value is closer to -1 indicates a strong negative relationship or disagreement.

Table 4.48: Simplified Spearman's rank correlation

Strategies	**Relationship**
Contractor – Developer	Significant relationship
Contractor – Consultant	Significant relationship
Developer – Consultant	Not significant relationship
Challenges	**Relationship**
Contractor – Developer	Not significant relationship
Contractor – Consultant	Not significant relationship
Developer – Consultant	Significant relationship
Impacts	**Relationship**
Contractor – Developer	Not significant relationship
Contractor – Consultant	Not significant relationship
Developer – Consultant	Significant relationship

Based on table 4.48, under the strategies group, there is a relationship and mutual agreement between contractor - developer and contractor – consultant. However, there is no relationship or disagreement between developer and consultant. Under the group of challenges, only developer and consultant have a mutual agreement and relationship while between contractor and developer and between contractor and consultant does not have relationship. Same thing occurred under the impacts where

only developer and consultant have relationship and agreement whereas contractor – developer and contractor- consultant does not have relationship.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATION

5.1 INTRODUCTION

This chapter includes the limitations for this research, recommendations for future research and conclusion of the research. This research is highlighting on the project crashing.

5.2 LIMITATIONS AND RECOMMENDATIONS

Throughout conducting this research, there are certain limitations that the researcher faced. The first and important limitations is the time and cost constraint. Researcher is given a limited time to complete the research. Not only that, the distribution of the questionnaire also took quite a lot of time not to mention waiting for the respondents to reply. The cost for the research can be categorized as high. The cost involves the printing and the fare for distributing the questionnaire. A research needs to have a lot of respondent in order to make data of the research is good and accurate. So, there is a certain amount of cost being incurred to achieve that point. For future research, try to do another method of distributing the questionnaire which could saves time and cost.

Besides that, the content of the questionnaire seems to be hard to understand for certain respondents. Although the use of wording is simplified enough, but the difference in thought and thinking makes certain respondent did not seems to understand. This will hence lead that particular respondent to answer with dishonest.

For future research, try not to use a complicated word and instead, use a direct meaning word so that the respondent does not have to think twice when reading the questionnaire or the research.

Another limitations faced by the researcher is that the respondent took too long to answer the questionnaire. This will results in late of analysing the data. If the questionnaire were distributed by mail, there is high possibility of not getting any responds back because there is no one to insist them to reply the questionnaire.

At the end of this research, it can be concluded that the respondent which consist of contractors, developers and consultants, mostly agrees that by increasing the manpower in vital task is the most successful strategies to crash a projects. As for the challenges, the respondents mostly agrees that the changes of material and resources in the middle of the project is the most difficult challenges faced in project crashing.

5.3 CONCLUSION

In a nutshell, this research is about the investigating of project crashing, the identification of the strategies, challenges and the impacts in terms of cost, time and quality. The questionnaire were successfully distributed and collected. The data were also analyzed and hence answering the research objectives. The reviewed research objectives are as follows:

RO1) To identify the strategies that can crash a project successfully
RO2) To identify the challenges in project crashing
RO3) To examine the relationship between the strategies used in project crashing and the impacts in terms of cost, time and quality.

Through descriptive studies, the research objective 1 and 2 that are the strategies and the challenges in project crashing were successfully answered. The third research objective requires the use of correlation analysis. Meanwhile, the hypothesis were also answered through the use of Pearson correlation. In addition, the use of Spearman's

rank correlation enable the researcher to carried out the test of agreement among the respondent and observe their relationship based on agreement.

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APPENDICES

APPENDIX A

GANTT CHART FYP1

		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														

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 B

Dear Sir / Madam,

First and foremost, thank you for taking part in this survey. The present study is proposed to collect information about the project crashing.

For your information, this is purely an academic study undertaken to fulfil the partial requirement for the Bachelor in Industrial Technology Management at Universiti Malaysia Pahang.

Kindly complete the attached questionnaire based on your honest opinion and experiences. All of the questions are based on individual experience and there are no right or wrong answer.

Thank you very much for your participation and kind cooperation in this survey. Your kind participation and cooperation is highly appreciated. If you have any questions, please do not hesitate to contact me.

Name: Muhammad Redho Bin Mardzuki

Student No. : PB10008

Contact No. : 010-3654954

Lee Chia Kuang

Supervisor

Faculty of Technology

Universiti Malaysia Pahang

OBJECTIVE: This survey is carried out to collect information about the strategies to crash a project successfully, the challenges of project crashing and the impacts of strategies used in project crashing in terms of cost, time and quality. This questionnaire consists of 4 sections. Answer all questions in each section.

SECTION A: DEMOGRAPHIC INFORMATION

PLEASE TICK (√) IN THE BOXES GIVEN BY CHOOSING ONLY ONE OPTION.

1) Gender:

☐ Male ☐ Female

2) Years of experience in construction industry:

☐ 1-10 years ☐ 21-30 years
☐ 11-20 years ☐ 31 years and above

3) Highest Qualification:

☐ Secondary school
☐ Diploma
☐ Degree
☐ Master
☐ PhD

4) Work position:

☐ Contractors
☐ Developers
☐ Others _____

SECTION B: STRATEGIES THAT CAN SUCCESSFULLY CRASH A PROJECT

PROJECT CRASHING IS A METHOD OF SHORTENING THE DURATION OF THE PROJECT.

PLEASE TICK (√) AT THE BEST ANSWER ACCORDING TO THE SCALE

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

5) Strategies to successfully crash a project	1	2	3	4	5
- Increasing manpower in vital task					
- Hiring more skilled worker					
- Provide more working hours for the workers -					
- Introducing the shift system					
- Giving monetary value such as rise in wages as an incentives to motivate the worker					
- Giving non-monetary value such as vacations or tokens of appreciation as an incentive to motivate the worker					
- Managing the resources (work, material, cost) to assist the project					

SECTION C: CHALLENGES IN PROJECT CRASHING

PROJECT CRASHING IS A METHOD OF SHORTENING THE DURATION OF THE PROJECT.

PLEASE TICK (√) AT THE BEST ANSWER ACCORDING TO THE SCALE

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

6) Challenges in project crashing	1	2	3	4	5
- Using own pocket money to cover the cost of the project					
- To prevent from paying the Liquidated Ascertain Damages (LAD)					
- Sudden changes in contract					
- Changes of material and resources in the middle of the project					
- Changes in scope of the project due to the dissatisfaction of the stakeholder					
- Maintaining and balancing the triple constraint that are scope, time and cost					
- Maintaining the same workforce in order to maintain the performance of the work done					

SECTION D: IMPACTS OF THE STRATEGIES USED IN PROJECT CRASHING ON COST, TIME AND QUALITY OF THE PROJECT

PROJECT CRASHING IS A METHOD OF SHORTENING THE DURATION OF THE PROJECT.

PLEASE TICK (√) IN THE BOX GIVEN BY CHOOSING YES OR NO

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

7) Impacts of project crashing on cost of the project	1	2	3	4	5
- Cost for hiring extra labour workers and expanding working hours is high					
- A lot of money is incurred for the purpose of giving incentives to workers					
- The addition of resources require high cost					
- The project's cost keep increasing due to the dissatisfaction of the stakeholder					
- The cost of the project is affected due to the purpose of maintaining the quality of the project					

8) Impacts of project crashing on time constraint	1	2	3	4	5
- The higher number of labour workers and longer working hours will speed up the projects					
- A motivational worker tend to speed up the project					
- Time for purchasing and acquiring the resources affects the overall time of the project					
- Changes in contracts cause the time for the project to be longer					
- The overall time of the project is affected due to the dissatisfaction of the stakeholder					
- To maintain the quality of the project requires longer time					

9) Impacts of project crashing on quality of the project	1	2	3	4	5
- More labour workers and longer working hours will make the projects to be more quality					
- A motivated worker tends to deliver a high quality project					
- The addition of resources affects the quality of the project					
- Changes in contracts affects the quality of the project					

Thank You

APPENDIX C

DEMOGRAPHIC ANALYSIS

Statistics

		Gender	Years of experience	HIghest qualification	Work position
N	Valid	54	54	54	54
	Missing	0	0	0	0

Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	male	43	79.6	79.6	79.6
	female	11	20.4	20.4	100.0
	Total	54	100.0	100.0	

Years of experience

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1-10 years	15	27.8	27.8	27.8
	11-20 years	25	46.3	46.3	74.1
	21-30 years	14	25.9	25.9	100.0
	Total	54	100.0	100.0	

HIghest qualification

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Secondary school	5	9.3	9.3	9.3
	Diploma	4	7.4	7.4	16.7
	Degree	27	50.0	50.0	66.7
	Master	18	33.3	33.3	100.0
	Total	54	100.0	100.0	

Work position

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Contractors	25	46.3	46.3	46.3
	Developers	22	40.7	40.7	87.0
	Others	7	13.0	13.0	100.0
	Total	54	100.0	100.0	