EFFECT OF MANAGING TECHNICAL RISK TOWARDS REDUCING COST OF PRODUCTION IN PROJECT

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SUPERVISOR'S DECLARATION

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

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STUDENT DECLARATION

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

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Dedicated to my parents

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Abstract

In world life today, there are always risks. In a project, the risk will become the strongest obstacle to ensure the project is successful which means it meets the goal without affecting the cost. Risks that appear in projects will affect the cost directly and usually will result in cost overrun. This study focuses on the cost for production which is also an important factor to be managed in a project. This study aims to reduce the production cost for project without affecting the scope and quality of the project. A company is impossible to reduce the cost through cutting in the material being used because it can directly affect the quality. Therefore, the objective of this study is to find whether by managing technical risks according to project phases, the production cost can be reduced. Statistical Package for Social Science (SPSS) software has been used to find the linear regression and Pearson correlation of the questionnaire imposed. The outcome shows that in execution phase, wrong in cost estimation risk is the most important to be managed to reduce the cost, while in planning phase, the environmental risk and operation risk are the most important to be managed to reduce the cost. In future, it is suggested that a comparison is made between two or more company in getting more accurate result and in analyzing the exact value for cost in a sample project. As the conclusion, project managers should focus to manage those risks that have strong relationship to ensure that they can reduce the cost of production in order to maintain the project scope and quality.

Abstrak

Dalam kehidupan dunia hari ini, sentiasa terdapat risiko. Di dalam projek, risiko akan menjadi penghalang yang paling kuat untuk memastikan projek berjaya yang mana ia memenuhi matlamat tanpa menjejaskan kos. Risiko yang muncul dalam sesuatu projek akan memberi kesan secara langsung kepada kos dan biasanya akan menyebabkan lebihan kos. Kajian ini memberi tumpuan kepada kos pengeluaran yang juga merupakan faktor penting yang akan diuruskan dalam sesuatu projek. Kajian ini bertujuan untuk mengurangkan kos pengeluaran bagi projek tanpa menjejaskan skop dan kualiti projek. Adalah mustahil bagi sesebuah syarikat untuk mengurangkan kos melalui pengurangan dalam bahan yang digunakan kerana ia secara langsung boleh menjejaskan kualiti. Oleh itu, objektif kajian ini adalah untuk mencari sama ada dengan menguruskan risiko teknikal mengikut fasa projek, kos pengeluaran dapat dikurangkan. Pakej Statistik untuk Sains Sosial (SPSS) perisian telah digunakan untuk mencari regresi linear dan ujian korelasi Pearson terhadap soal selidik yang digunakan. Hasilnya menunjukkan bahawa dalam fasa pelaksanaan, salah di dalam risiko anggaran kos adalah paling penting untuk mengurangkan kos, manakala dalam fasa perancangan , risiko alam sekitar dan risiko operasi adalah yang paling penting untuk mengurangkan kos. Pada masa akan datang , adalah dicadangkan perbandingan dibuat antara dua atau lebih syarikat untuk mendapatkan hasil yang lebih tepat dan dalam menganalisis nilai yang tepat untuk kos dalam projek sampel. Sebagai kesimpulan , pengurus projek perlu memberi tumpuan untuk menguruskan risiko yang mempunyai hubungan yang kuat dalam memastikan mereka boleh mengurangkan kos pengeluaran bagi mengekalkan skop projek dan kualiti.

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CHAPTER 1

INTRODUCTION

1.1 Title

Effect of managing technical risk towards reducing cost of production in project.

1.2 Background of Study

In the world life today, there are too many projects and high demand from the customers. Besides that, there are also have many companies was built to compete each other. The result of this issue is that some company cannot survive in industries. The other major factor that gives an effect to the company is the cost of production are too high. Nowadays, the increasing of life standard cause the production cost becomes high but unfortunately, the customers still do not want to purchase an expensive product. Company need to fight with their production cost to ensure they can provide a product with low market price and affordable for the customers. Costing is the most important in production because it shows how well the manager manage the project. Cost of production might be affected from many aspects such as scope that does not clear and other problem during the process.

The improvement of our built environment was contributed by the construction projects that are mostly made the national headlines being financial disasters, rather than significant engineering achievements. The investigation made by the government in the middle of 1990s, shows that more than quarter of the construction schemes completes over their capital cost limit (HM Treasury, 1996). Further to this, a survey of construction industry clients was conducted and he was found that nearly one third complained that their projects commonly overran budget (Barrick, 1995). This problem sustained through the latter part of the decade with the Construction at Clients Forum reporting that sixty percent of clients said that cost targets were not being achieved. After a decade, only forty-five per cent of projects are being accomplished within budget. The construction industry has therefore gained a bad reputation for delivering facilities over budget. This main cause of this research was to investigate the problem of construction project cost overruns.

The third phase of a hospital redevelopment project was an example project. At £152m, Guys House doubled its original budget (NAO, 1998). It was reported that there are the increasing some cost which unavoidable due to changes in the health service's statutory requirements, building regulations and a new liability for tax, but other increases might have been avoided. These involve the increasing due to failure to freeze design, significant design changes, and interruptions to the building works, a large number of disputes and claims and the insolvency of major works package contractors. It was clearly shown that the cost increase because of the problem that we never aspect that will be happening during the project.

As we know, the risk was always coming in any running project. The risk will become worst during running the project. When the project run and risk are getting worst affect to the project, it will be automatically affect the cost and then the price also will be affected. This was the relationship we might directly found. Even the risk can be control of the project manager but it is still has a small effect either to the budget or scope of the project. But, if we detect it at the first phase of the project

and provide a contingency plan, the risk might be controlled very well. According to V. M. Rao Tummala and John F Burchett (1999) have stated that in managing a project, a quality system is usually engaged in order to achieve the expectations and objectives of a company. In order to control and optimize the quality in relation to project risks, costs and benefits the quality system should be restructured. It also has to accomplish that project, to get a satisfaction from both internal and external customers. Due to the high inherent risks associated with the building of an extra high voltage (EHV) trans- mission line, a new approach was required to improve the information required to monitor and control such risks which need to be completed on-time and within budget.

Cost overrun and time were related to the projects that cause the risk in construction being the main concern. Besides, risk can be expressed as an exposure to economic loss or gains arising from involvement in the construction process it has regarded this as an exposure to loss only. The variable in the process of a construction project become as a risk in relation to construction whose variation results in uncertainty as to the final cost, duration and quality of the project. Based on previous studies, clearly shows that the risk might be affect the cost and it became a major factor contribute to the cost overruns. Nowadays, many companies have practices on the risk assessment to detect and provide contingency plan to face the risk in projects. However, sometimes a manager forgets about the technical risk that have a high probability to appear in the project.

The purpose of this study is to study the way on how to reduce the cost of production by managing the technical risk. Technical risk is a type of risk that we will never aspect. It included overall process during the production of the product, since the company cannot reduce other costs in the production such as cut the cost of material. In the project, there has some problem that known as triple constraint. The managers were used the project management triangle to analyze or understand the difficulties that may come up due to implementing and executing a project. All

projects inconsiderate of their size will have many constraints. Although there are many such project constraints, these should not be the barriers for the effective decision making and for successful project execution. There are about cost, time and scope. If we change one of the constraint it might be affect to the other side. So, in this study we will study on cutting the cost without affecting the triple constraint which is by managing the risk that might be appearing in the project. Quality is the main objective of every delivery, not a project management triangle division. Hence, the project management triangle symbolizes the quality. The thought that mention 'high quality comes with a high cost' are usually come under many project managers, which to some extent is true. To accomplish project deadlines by using low quality resources does not ensure the success of the whole project. Same goes with the scope, quality will also be an important deliverable for the project.

In the industry, there are many projects that need to be well managed. In order to manage the project well, there are not only need to have better planning and scheduling, but there also needs a good management on risk. Risk is the strongest enemy of the project because less focuses on the risk appears may cause the project failure. Besides that, in the term of cost risk, it also might affect the cost of production badly if the risk was not managed very well.

There are many types of risk that may appear in the project. On this study, we will decide to specify the research about the technical risk that might be appearing in the project. We believed that by managing technical risk, the company can cut the cost of the production. However, there are proven by other research and in this research we will put an effort to prove it. The risk that related directly to the knowledge base being employed and its technical parts involving such things as understanding, reproducibility and the like are the explanation of the technical risk. Technical risk also includes the whole activities in the project such as design and engineering, manufacturing, technological processes and test procedures.

Technical risk is the risks that are coming from the overall process of the production in the company. Technical risk should manage very well to ensure the cost of production getting lower as have been planned and it will automatically reduce the price of the product. However, the problem in the company is technically risky, which a type of risk that we will never expect to be appeared during the process of production. The company should have a good team in managing the technical risk since it will be appear suddenly during the process. It may be a serious effect to the overall production if the risks are not managed well.

1.3 Problem Statement

Nowadays, world have to face an economic problem and unstable economically. In Malaysia there also has the same problem. Apart from that, the cost to produce the product was increase rapidly and cost to get the equipment also increase. This problem causes the customer have a problem to buy the product that produce by the company because the cost of production increase and it automatically increase the market price of the product. In order to provide customer with good product or services, a company should reduce the cost of production and directly reduce the market price of the product. When the cost of production was successful being reduced, the company will get the customer satisfaction and company also can get the competitive advantages among the other competitors.

There is a problem of reducing the cost of production which is there are no pointers to reduce the price of material and others price because the price is fixed from the supplier. A company should look for the other ways to reduce the cost of production in order to ensure that their product get fulfill the customer demand and gain the competitive advantages. The better ways in cutting the production cost is company should reduce the cost that are coming from their company itself such as managing risk.

In a company, risks always become a big problem to them. Risk may affect the cost very bad and sometimes a small risk capable to change the company goal and objectives. In managing the technical risk, it is needed to be done by people. The company should assign good team and train them to manage the risk that might appear.

In conclusion, for those companies want to reduce the cost of the production, the company need to focus on managing the technical risk. Managing technical risk will not involve too much costing, but the result that the company gets will be a positive result of the cost of production. However, the company should identify the technical risk appear in the production and provide it with a good plan on how to manage the technical risk. Even though the company does not know when the technical risk might be appear, but it still can manage if the entire employee work together and be ready to the risk.

1.4 Aim of this study

This study is focused on the technical risks that might appear in the project and affect the cost of production. I will study on how bad and the production results if the technical risk affects the cost of production. Besides, this research also will study about the technical risk, when the types of risk will be appearing and how well a company ready to face the technical risk. We cannot expect when the risk will appear because the technical risk not same as other risks. Furthermore, the technical risks involved in the entire process of production in a project. In short, the purpose of this research is to study the effect of technical risk towards reducing cost of production in industries.

1.5 Scope of study

The scope of this research is to study about the ways to manage the technical risk appear in production and its effects on the cost. This study is also conducted with the purpose to identify the technical risk appears in the company during the production. This study will be conducted at an industry at Terengganu which is PETRONAS. This company is actively involved in oil and gas industry. As we know that PETRONAS have many plants and I decide to choose one from the plant which is a gas processing plant. This study will be conducted in PETRONAS because oil and gas industry is most risky industry. It will help this study in gaining data. Besides, PETRONAS was chosen because PETRONAS is a big company in Malaysia. Hopefully the this company ready to help in accomplishing this study.

1.6 Significance of study

Nowadays, the cost of production becomes a famous topic to discuss among managers in a company and it also sameness to the customers. Cost becomes a primary criterion that is looked by customers besides the quality of the product. However, the price of the product depends on the cost of the production. Mangers should know the best ways to reduce the cost of the production first then the price of the product will automatically reduce.

This study will be conducted in order to study about the relationship between technical risk and cost of production. As we know, the managers are difficult to reduce the price of materials and others cost in the production because all of the cost is fixed. That is why I have decided to conduct a study about the technical risk affect the cost of production. For those industries that are wanting to reduce the cost of production, they should give a bit attention on their technical risk, so they can reduce the cost and the price of the product. Besides that, the company will gain the competitive advantages if they are success to implement and manage the technical

risk. In addition, in a project there is no any budget to recover the technical risk because the technical risk have never been expected to appear. It can happen to the workers and machinery as an example. The benefits of this study are more to the industries especially in getting the competitive advantages and fulfill the customers demand.

Besides that, this research also will be significant to others student. This study will show to them that the important of managing the risk well because they will go and work in industries later on. So, before they go to work they will know how important to manage the risk and the effect of the risk to the project and the cost of the project.

Last but not least, this study will give a lot of benefits to all people either individual or group. After this research, the company will realize that there have several ways to control and reduce the cost due to the increasing price of the material. I also believe this research is very helpful to all of the company due to the world economic problem and it also will continue until the economy is recovered by the responsible person. In this study, I want to study about managing the technical risk can reduce the cost of production. This study can help me to know what the technical risk really mean and how the technical risk might affect the cost of production. To manage the technical risk, all of the people start from upper level to the lowest level should give cooperation to ensure the process is successful. Lastly, the information obtained in this study can then be publicized and used as a guide to do research in the near future.

1.7 Research Objective

1. To identify the technical risk appear in production in industries
2. To measure effect of technical risk toward cost of production

1.8 Research Question

1. What are the technical risks may appear in the production

2. How well a technical risk may affect the cost?

1.9 Expected results

In this study that's been conducted it more focusing on technical risk that appear in the production of a project or production to produce a product. Based on the objective of this study, the researcher want to study about the ways to identify and manage the technical risk that appears in a project. Besides that, the researcher also wants to identify the impact of the technical risk appear towards the cost of the project.

The expected outcomes for this study is wanting to reduce the cost of the production product by managing the technical risk. Based on previous studies, failure to manage technical risk causing in a lot of loose. For example in Chunnel project the manager failed in managing the technical risk and effect due to that event the actual cost of the project was over then baseline cost where US$2. 25billion need to add to complete the project. Researcher hopes that it can help a lot of industries that have a problem in cutting the cost of production and to fulfill the demand of customers that want a product with the lowest price rates. However, the increasing cost of living nowadays, it is seen possible to cut the cost of a product directly through the price of materials used. That the purpose of this study being conducted.

Last but not least, researcher expects that by managing the technical risk, cost of production will be reduced. The organization can satisfy the customers by reducing the price rate of the product because the cost to produce the product was decreased without any effect on the quality of the product.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Project risk management is important and should have in any project in the world. The risk in the project will give a big effect to the overall of the project in every scope such as schedule, quality and cost. The risk also makes the project performance are low rather than what the organization low. It is important to ensure projects are running smoothly and to deliver a quality product or services to the customers. There are many ways to detect and identify risk. While the risk has been identified, they should manage and avoid as well as an organization can. When the risk getting worse, the other problem might come and it can be the root cause for the filing of the project and delay. In an organization, failing to manage the risk show to customers that the organization is very low in performance and not capable to manage a project. There can give an effect either for the company or individual in the company.

Since the customers have a lot of demands, so project manager should have a ways to manage it all with some flexible decisions. It's purpose to ensure their customers are satisfied with the project deliveries and company can provide customers' demands without any defect. Normally, the risk comes from the customers because they have the ability to control the project.

When this problem happens, the project manager should have an appropriate skill to manage this type of customers. This problem might be solved easily by the expert manager however, other risks are very complicated to solve. It will involve a lot of thing and component in the project. As the ways to manage that, the manager should detect and identify the risk before the project start. It will completely help in develop contingency plan to manager to avoid the risk. Method in the risk identification is used to identify and provide a plan to the risk should be look and written down. In addition, it also needed to make project team aware with the potential risk.

2.2 To identify the technical risk appear in production in industries

Risk can be defined in as negative or positive impacts that affect the objective of the project. Positive impact classifies as the chance to the investment in the project to get higher when the risk is accepted in the project or the investment value gain more than expected.. Companies nowadays are willing to spend large amounts of money and time to provide risk management strategies in a project with the purpose to manage risks associated with their project and business.

In order to make the project successful risk must be managed effectively and efficiently, there has a process which consists of risk assessment, it was included identification of risk, analysis and prioritization the risk and controlling and monitoring risk, it also includes a risk management plan, risk monitoring planning, risk tracking and corrective action if the risk happens. Baskerville, R. (2011) stated

that in a project risk management consists of methodologies for managing software analysis, response planning toward any uncertain event, tracking and control ongoing risk towards communications effort. Project Management Institute (PMI) presents four phases of the project risk management process, start from identification, quantification, response development and control.

Actually, there has a lot of methods to identify a risk. The identification of risks consists of a method used to identify the risks in several activities of project, and the guidance to mitigation plan towards what those risks should look like when written down. Normally, the risk in the project will be identifying while the project is in the planning stage. The problem here is the risk can be detect in the planning stage are only the minor and can be solve easily. The real risk will appear while the project is in the execution stage. The manager should be careful with the risk that appears during the execution because if there are wrongly solve the project may be affected.

During the detection of the risk, basically manager does not know how to identify risk accurately. It only can detect the likelihood of the risk may appear. Besides the manager not know what the relevant method can be used in the different type of project. According to Akintoye A., Taylor C., and Fitzgerald E. (2008), it is important to manage risk in a project. It consider as the need and relevant to all professionals and groups in project such as client groups, design team, project management team and contractors which are concerned with cost, time and quality. The purpose of this study is to find what are the method suitable can be used in each type of project.

The risk is only what we are plan, however it can be changing according to the time by time. In planning process, basically the project manager only briefing to the staff roughly about the project. However, this stage is an important stage because it became a sign whether the project should success or not.

Previous study conducted to integrated analytical framework for effective management of project risks using combination of multiple criteria from decision-making technique and decision tree analysis. First, a conceptual risk management model was developed through thorough literature review. According to Kumar Dey (2011), in the proposed framework, risks are identified using cause and effect diagram, analyzed using the analytic hierarchy process and responses are developed using the risk map. Additionally, decision tree analysis allows modeling various options for risk response development and optimizes selection of risk mitigating strategy.

According to Merritt G. M and Smith P. G. (2004), risk management is a technique for controlling the uncertainty event in a project. A lot of method can be used to measure the risk because there are the advantages to every types of it. However, managers should choose best ways to ensure all of the party is getting right information about a risk.

Brainstorming is a commonly method used for identifying risks in the planning process, It is simple and easy method to explain and normally used to identify risk in project. This method is easy to understand and easy to know probability risk might be appearing in the project because all parties involved in the process to identifying. This method also easier to identify and decide not related risk in the project.

The most difficult aspect of the facilitating type of development is guidance about the form of words to use when describing a risk. Discriminating between today's problems and potential future problems or risk was tricky, but discriminating between a risk and its impact was even trickier. It was possible to eliminate the tendency to do well on known issues such as 'incomplete requirements' or 'insufficient resources' by defining a risk as a potential future problem.

Since, the risk is a large branch in a project, this paper has focused on a type of risk which is technical risk. Technical risk can be defined as risk associated directly with the knowledge base being employed and its technical aspects including such things as understanding, reproducibility and the like. Technical risk also involves the overall activities in the project such as design and engineering, manufacturing, technological processes and test procedures. This type of risk need to be manages well because it happens suddenly and unexpected presence.

2.2.1 Risk identifies in the planning phase

This paper is focusing on the technical risks that appear in the production process in industries. As we know that the technical risk involved the overall process in the production to produce a product. In all industries, the top management is always stress on the risk especially risk that gives them a lot of problems. Technical risks were included in the type of risk that will give a lot of problems to the organization. It can change the project scope and even can make a project fail. It clearly shows that technical risk such an important type of risk that need to be controlled and be defined clearly during the first step on the project.

McGill, J E (2005) state that it is important to note that treatise will concentrate on technical risk as it relates to mineral resources risk issues, and the related impact on the junior and small scale mining sector of South Africa. Mining is very technical industry. Technical risk can relate to any of the technical requirement within mining. Technical risk will be prevalent in all decisions relating to mining, rock engineering and engineering metallurgy as example. In an attempt to identify a unit of measurement for technical risk, acceptability criteria such as times it takes for failure or number of fatalities may be considered. Most often, risk is also calibrated in financial terms.

In the case study of Chunnel project, before the project start during the initiating phase, the scope of Chunnel was to improve the transportation facility and link between England and France. The expectation to develop a tunnel was that this spurs economic improvement, improve European trade, and provide alternative high-speed transportation method to the existing modes. This Chunnel was included 32 miles (51.5 KM) double-rail tunnel with the price US$5.5 billion. This Chunnel project classify as high-level design and respective rough-order of magnitude estimates may have been appropriate. However, the design of the Chunnel was not completed due to the time constraint provided.

. Besides the scope has change, others risk of project is Chunnel project are a large project. Usually large project is a challenge with initial estimates. Difficulties in resources planning, cost estimation and budgeting process is occurs in the project due to the failure to defined scope clearly. In the first estimation, return on investment assumptions that has been made during the planning stages may not prove accurate. The wrong estimation becomes the major factor that could leave a trail of unhappy investors and stakeholders.

In a previous study about the Engineering-procure-construct (EPC), (K.T. Yeo and J.H. Ning, 2001) which about examines the nature and characteristics of EPC projects with special interest in project procurement management. EPC is a new practice in the engineering and construction industry. During the planning phase project manager has identify that EPC challenge is EPC projects face interdependence of activities, phase overlaps, work fragmentation, complex organizational structure, and uncertainty in accurate prediction of desired outcomes. Larger firms usually use matrix organisation for the management of projects to solve problem in the engineering and construction industry. Matrix organisation is a complex structure in organization.

2.2.2 Risk identifying in the execution phase

Execution stage is the most difficult stage. This stage will give big challenge to project manager because during this stage, the risk that discuss in the planning stage will appear. The manager should become the most active person to control the risk and prevent from any failure in managing those define risk. During this stage, the project should be running as what being scheduled at the planning stage. Execution stage will test the ability of manager to handle a project successful.

Basically, risks that easily to appear in this stage are machinery, environment and employee. Manager should ensure all this problem can be manage because these problems will affect the schedule of the project. When schedule are affected where by project running behind schedule, the cost of the project also affected. The project will be running with more than cost that has been plan.

During the implementation phase of Chunnel project, it has delayed and false start from the beginning. It is because there have a problem with politics started immediately, as the project was being fast-tracked with design and construction happening simultaneously. This in itself may not have been a problem, except that the promoters had to obtain approvals from the governments both Britain and France

Other than that, one specific area of technical risk is resource-related risk. Worth and Haystead, in (2002) provide a particularly accurate assessment of the importance of understanding resource related, ‘the assessment of ore reserves is the most important point of any technical evaluation.

There are a number of ways that resource risk can be assessed, both subjectively and quantitatively. Resource modeling depends on subjective interpretation of measured data. It is very difficult to quantify the risk associated with the technique. Resource estimation, however, is based on a series of best estimates from geological, engineering and economic data. Therefore the ability exists to conduct a quantitative resource risk assessment on this information. A good

estimation of the resource will help to manage risk both upside and downside. Various verification procedures can be applied to eliminate resource risk during the entire resource and reserve definition process.

There shown that there are very important in identify the technical risk during the operation. In all aspect of the operation, it will have the technical risk. A best way should be apply to eliminate the risk or it can make the project failure. In addition, technical risk has included all aspect both in the project or organization and out of the organization. All of them should be manage and control in a proper ways. Either it only give a little effect to the project but it still can be categorized as a risk and it still become enemy that need to be avoid in a project. As example, financial problem in a country, it look do not give any affect to our project, however someday the material price will be increased for our project. It directly affects our project and we need to facing with other problem which is cost overruns.

Perry and Hayes have identified some risks sources central project activities. The risks are consisting of physical risk, environmental risk, design risk, logistics risk, financial risk, legal risk, political risk, construction risk and operation risks. All the risks that identified have probability to give effect to the product deliverable, performance, cost, time and quality. Risk strategy that normally used in a project is contingency allowance. The risk strategy involved cost to mitigate and prepared to the risk. According to Dey et al. in his research, he had produced a document of risks and contingency allowance in petrochemical construction project. In the study, he has described specific and systematic procedures to analyze risk in the perspective of project.

Other example of the technical risk that might be appearing and difficult to be managed is problematic engineering and construction industry. The engineering and construction industry faces formidable challenges. As a whole, the industry worldwide continues to perform unsatisfactorily. The engineering and construction suffers from low profit margin which persistent project overruns in schedule and

budget, and is plagued with claims and counter- claims. Profit margin on construction work is 1–2%. It is showed in a recent UK construction industry survey. Construction delay is a critical aspect of project failure. Another survey in UK shows that 52% of UK construction projects end up with claims of some type.

2.2.3 Risk identifying in monitoring phase

Monitoring phase is a phase where by project manager should control and monitor the risk appears in the project. During in the phase of execution, project manager has manage the risk appear in the project. In this phase, the project manager should monitor and control the risk of repetition in the project. There are some ways to eliminate risk from happening in the project and throw it always from this project.

Risk retention, risk transfer, risk reduction, and risk avoidance are all the method that will be used for methods of risk allocation. It can be either takes any one or combination from any of them. Williams and Heims have states that risk retention is the only option because risk prevention or transfer is impractical, avoidance is undesirable, possible financial loss is small, probability of occurrence is unimportant and transfer is uneconomical. Commonly, risk avoidance in construction is identified to be impractical may cause one project to stop or a contractor submitting an over high bid for a project. Risk reduction techniques defined as an outcome of potential impact or probability of occurrence which include the use of alternative contract strategies, different methods of construction, project redesign, more detailed and further in-depth site investigations. Besides that, risk transfer is described as projects and contracts that involve the relationships between client, contractor, subcontractor, design team, insurer and surety.

A part from that, after the risk has been identified project manager should decide the ways to eliminated and avoid the risk. According to the Akintola S Akintoye and Malcolm J MacLeod (2004) there are some example to identify and

analyze risk, risk premium, risk adjusted discount rate, subjective probability, decision analysis, and sensitivity analysis. Methods of decision analysis and decision trees are some example of techniques that usually used in develop risk analysis. These provide decision-making tools in an uncertain environment. The decision tree shows choices that can be choose to decision maker, a number of alternatives and their possible outcomes graphically in a tree form. From the decision tree, project manager and others stakeholders can make decision based on the chain shown by decision tree. The decision tree method is useful in deciding methods of construction, choosing alternative projects, and in contractual problems such as whether to proceed with a claim and assessing the likelihood of a claim succeeding. Decision tree method also can make the project manager know probability of success or failure in the project. Risk premiums in construction projects take the form of contingencies or added margins to an estimate to cover unforeseen eventualities. The amount of the premium varies between projects and is mostly dependent upon attendant risk and the decision-maker's risk attitude. The respondents were asked to identify which of these risk analysis techniques they are familiar with, and ones that are being used by their firms for project risk analysis and management.

In industry, there are too many technical risks will be appearing in the process of the production. Manager should play their role in handling the technical risk rightly to ensure their productivity is in the highest level. As mention, the technical risk becomes a big role in ensuring an organization always in a good condition to compete with their competitor. As we know, mostly of same industry will use same raw material to produce a product. The one thing that can make them differ and gain the competitive advantages is by managing their technical risk in the production process.

All the team members in a project should have good intention to manage the risk. In addition, technical risk may appear in all angles during the project running. So, the job to identify and manage technical risk not only put on the project manager

only. Besides, all the team members should give full support and commitment in ensuring the technical risk might be managed.

2.2.4 Risk identify in closing phase

In closing phase, there not too much risk as others phases. However the risks still have probability to appear especially for project performance, cost, schedule, technical, quality, safety, and profit objectives. Construction Industry Board (CIB) of the UK specifically suggested that the construction industry should be more competitive and aim at reducing construction costs by 30%. Then, about 25% time saving is achievable in a typical construction work package without increasing allocated resources.

McAllister and McManus (2003) also show that for larger US banks estimates of scale economies are increased when they control for risk. In the banking process, the technical risk that might be happen is inefficiency in handling the market. Mostly of the bank in Japan had to face with this type of risk. When they are fail to manage their market, the service they are given is poor. Apart from that, the quality of their organization will be low. When risk and quality factors are being given attention by manager, only the smallest banks exhibit significant economies with the majority of banks experiencing significant diseconomies of scale which appear to get larger with asset size. Estimates derived from the model including risk and quality variables suggested that there are widespread scale inefficiencies in the Japanese banking market. These results suggest that bank minimum efficient scale becomes smaller after controlling for risk, a finding similar to that of Hughes and Mester (2003).

In the closeout phase, there are still having some problem and issues. Teamwork and communication are truly broke down in several areas of the project. The financial or investor of the project were aiming on maximizing their profit and

minimizing their list. Besides, they also refused to accept dealing arrangement for settling some of the key contract disputes. The parties are started to fight and blame others organization to take responsibility towards the lost in project. Overall, teamwork during closeout was focused on each party meeting its own priorities and interests rather than working towards an acceptable solution for all parties involved. However, the parties involved in the project are willing to share the success by each other's.

This project get involvement from various parties which are stand from 700,000 shareholders, 220 international lending banks, British and French governments, many construction companies and many suppliers. This is too many of involvement causes significant logistical and communication challenges. It's too difficult address various parties satisfaction. Change can be viewed in many ways depending on how it impacts cost, time, quality and potential risk, besides the change in scope also may be affected. Issues need to be solved in timely manner to avoid from resulting in significant cost and time variances. It is here where the communication seemed to breakdown. As the solution, the project manager has developed a communication plan with strategic communication channel or vertical and horizontal communication skill. This communication plan could include all the information distribution. However, because of the challenges, this project was take long time to complete which is take about 3.5 years.

Last but not least, in a project, there are most important to identify technical risk. In order to improve efficiency and reduce cost of production, technical risk should be eliminated or control. Technical risk will included and involve in overall process of production, so to control and manage it cooperation are very needed from the bottom employee to the most influence person involved in the project. Sometimes the technical risk we cannot aspect the appearance, but when we alert with their appearance we can easily manage them.

2.3 To measure effect of technical risk toward cost of production

Basically, in a project there are always have some risk and that risk will give effect to the project. However, there depends on the type of risk whether it gives large or small effect to the project. This paper will study on the effect of technical risk in project towards the cost of production. Cost of production can be differing in a simple word as the cost to produce a product or services.

Normally in the project, there always have their own budget that has been calculate before run the project. The budget has been fixed with consider the entire possible factor that have probability to effect the project. Logically, if the manager can identify the risk in the first phase of the project, the budget to eliminate the risk will be included in the overall budget of project. Apart from that, there is no reason to complete a project with over budget. The question in a project world nowadays is mostly project still complete with over budget. It looked gave the company problem on that.

We look at back on the definition of technical risk at the top of this chapter which is technical risk is a type of risk that we never can aspect their presence. Besides, it also included in overall process of producing a product. From that, we can simply that one of the effect of causes the cost overruns in a project is technical risk. However, this is still on the early stage of research so it cannot simply that. There are a lot of causes that affect the project budget.

Cost overrun is an inherent part of most projects despite the much acquired knowledge in project management. Although some may argue that this is negligible (Flyvbjerg 2009), It is important to note that physical and economic scale of projects today is such that it is driven under the platform of profit to the parent organization, and of national interest (for government projects) by the degree of success defined within the Iron triangle of cost, time, and scope. It is therefore much appreciated to

look at some reasons for delays and cost overrun in the project and their mitigation process, so as to increase the perception of project success.

2.3.1 Effect of technical risk toward cost of production in planning phase

In the planning process, one major factor that has been identified as reasons for cost overrun in most projects is design errors. Due to the event, the actual execution phase of the project unfolds these design errors, trial to make correction in the designing will lead to delay of some activities and cost overrun to the project. It is a design with errors practically means wrong or insufficient representation of project deliverables. Another way design errors could lead to cost overrun and delay could be seen in the fact that project estimations are done base on the produced designs, as such, having errors in design in a form of omission or misrepresentation will mean that the estimation for the project cost will also include these omissions, thereby leading to extra works, and change order, thus resulting in delay and cost overrun. Similarly, designs that are done without extensive investigation of site could contain potential errors. This is because such designs could lead to additional work, revision of scope of work, and contract revision as the actual site conditions begins to float up at the construction phase of the project. These will no doubt affect the overall project delivery time and cost.

This study will stress on the technical risk that can affect the cost of production of project. Normally, a manager will provide the budget and cost to avoid or provide contingency plan for a risk.

Risks that might affect the project and documents their characteristics are determine the risk identification. Participants in risk identification activities can include project manager, project team members, and risk management team, subject matter experts from outside the project team, customers, end users and stakeholders.

All project personnel have to identify risks, while these personnel are often key participants for risk identification.

Donna Ritter (2008) stated that in his project, he needs to assign several experts people in their technology used to help in gathering information needed in their organization. The expert was using simple risk identification which is brainstorming and Delphi technique. The techniques were very helpful in the determine risk and not involved too much cost. We used project risk experts as well as technology experts to participate in this technique. A questionnaire will be used by facilitators to obtain ideas about the project risks that categorized as important risk. After getting the important information the expert will analyze and give feedback about the problems. Consensus may be reached in a few rounds of this process. This technique will help in getting important information without any bias through project team or other parties involved in project. Information gain useful in getting the clearly problem and cost incurred in the project. About the cost it will be depends on the risk attitude of project manager and the stakeholder towards risks.

The planning phase is the most important phase to ensure the project run within the cost and budget. It differ from the risk identification because risk identification is important at the execution phase while cost incurred is most important at planning phase because at this phase all the cost estimation are made. Normally, the cost overrun in a project is cause by wrong estimation at the planning stage.

According to Galway L. (2004), there is a set of issues, which need to be addressed in a critical evaluation of these techniques, what level of aggregation should be used for the components of the schedule or cost? Accuracy of the estimates were required If there are using the estimates to plan reserves or compare competing proposals. Alternatively, quantitative risk analysis framework could be used to measures risk probabilities and impacts, primarily to force us to think hard about the project, whatever the final estimates say.

Besides that, critical path method (CPM) can be used to determine and estimate cost for a project. Quantitative cost risk analysis has been done with techniques largely separate from those for schedule risk analysis to the exception of the cost estimation and resource allocation optimization techniques noted above.

Another technique can be used for cost analysis of complex projects is by obtain cost based on the Work Breakdown Structure (WBS). The WBS is a chain of work required to complete a project. It was breaks a complex project down into components, services, and facilities, with each succeeding level going to a finer level of detail. Two methods can be used in WBS to estimate cost, top-down technique and bottom-up technique. Most effective ways using bottom-up technique in estimate project cost. Bottom-up technique was required team to put cost estimate to the smallest or the bottom work in WBS. From that, the estimate cost for the project become more accurate because it start from the smallest work for estimation.

In a paper which is writing by Project Risk Management Guidance for WSDOT Projects, (2010) they are believe that cost is important and need to be control. The cost is normally affected by technical risk and wrong estimation for the project. Scope control is of course necessary for project management and estimating. Cost estimates are to be reviewed and validated, and a base cost for the project is determined. In addition, technical risk is define as any uncertainty that in the project. If it occurs in the project, would affect one or more technical objectives. The technical risk will affect the cost of a project in Performance, functionality, reliability, maintainability. From the study, it shows that technical risk mostly gives a big effect on the project. It affects in overhaul of the project.

2.3.2 Effect of technical risk toward cost of production in execution phase

In order to ensure project success in perspective of cost control, risk management must be partnered with a properly documented project base cost

estimate. Risk management introduces that in project management there are always have risks and the risk will involve cost overrun, this does not mean cost overrun is inevitable but it means it is possible. In this phase, the cost involved normally to mitigate the risk appears in the project. More worse if the risk cannot be mitigated and cost will affect more than plan.

Transferring risk involves finding another party who is willing to take responsibility for its management, and who will bear the liability of the risk should it occur. In every organization, the aim is to ensure the risk appears is owned and managed by the party that involved and expert about it. To gain the aims, it needs to deal with it effectively. Basically, the organization will prevent from risk transfer because it involves payment. Cost-effectiveness of this must be considered when deciding whether to adopt a transfer strategy. (PMBOK)

Purpose to identify risk in the project is to ensure all the parties involved know where they need to focus to avoid the cost overruns cause of the risk. Risk management should do the risk respond as a way to be aware about some high level risk. The risk identify should be ranked based on their affect towards the cost in the project in the risk register. The mitigation or contingency respond actions to significant risks must be cost effective and realistic. Critical risks must be met with vigorous response actions, lower ranking risks should receive response actions commensurate with their significance.

In addition, Chunnel project is a project to develop an underground tunnel to connect between England and France. This is the largest project that's been taken by privately funded construction. It required the cooperation of two national governments, bankers underwriting the funding for the project, a lot of contractor and regulatory agencies. In this project, new technology has been used in this project construction and engineering. However, some changes or modification required during the project running due to unexpected conditions by various parties. The small changes or modification will directly affect the cost of the project.

This Chunnel was included 32 miles (51.5 KM) double-rail tunnel with the price at initial was US$5.5 billion. High level of design was using for this project. However, with not enough time was provided it is difficult to design and to complete detailed design because it needs to add tunnel air-conditioning. Because of the failure to design the tunnel in right way, the cost of the project needs to add US$200 million. Besides that, the other risk that been identify is any delay or cost throughout the project life would impact the plan cash flow because Eurotunnel had secure a concession agreement for a period of 55 years.

Besides the scope has change, others risk of project is Chunnel project are a large project. Usually large project is a challenge with initial estimates. The problems in the project are lack of defined scope, cost estimating and budgeting difficult. In addition, there also has the largest risk which wrong estimation of the return on investment. When the risk has been proven in the project it was made the investors and stakeholders unhappy. All the parties involved in this project will be in trouble because due to that event the cost estimate at the early planning stage had increased to US$14.9 billion.

In a previous research, the author has been doing a research on a small-scale mining. The author has stressed on a technical risk that should be covered and it affect the project cost. The author has stressed on technical risk which is involved mechanisms in the project. McGill, J E (2005) started mining is a very technical and costly endeavor. As certain initiatives require only limited start-up capital prolonged financial support is often neglected. If operations are going to perform throughout a reasonable LOM (life of mine), then increased access to funding mechanisms will result in the ability to upgrade equipment to improve efficiencies. Small-scale mining permit only being valid for two years, due to that limited time the level of funding available to operators is also limited. As a result of inherent risk in investing in mines with shorter Lifecycle there are not many mechanisms are available for potential operators. This means that less capital is available for technical assistance

in the form of contractors or consultants. This result in most aspect of mineral resources management being ignored by which could sustain an operation over a longer period.

2.3.3 Effect of technical risk toward cost of production in monitoring phase

While the monitoring phase, the cost involved is not too much. It is because the manager had eliminated the risk during the execution phase. So, manager only needs to monitor that the ways they used to eliminate risks are running as they plan.

Sometimes in project also have problem that incurred cost. In the monitoring phase, there still have the communication problem. Communication problems can consider as technical risk because it uncontrollable. Communication problem will affect a lot to the project especially on time and change of scope. Reflecting on the project, it highlights the importance of cultural matters, communication, and contract issues. As the solving of the problem, project manager states there must be only one contract. In the contract should contain clearly defined dispute resolution procedure, selected procedures that acceptable by all parties and with which all parties have agreed to abide. The key element that affects the contract and project is communication. (Hvalfjordur tunnel project manager)

The objectives of a project need to be identified and communicated clearly from the beginning. Communication failure was the largest and most damaging failure of the government of France and Britain. The financial model created was too optimistic given the risks involved, and the fact that the project was essentially run by a banker compounded the problem. By not implementing a contracting method and not having clear goals, scope and objectives at the early stage of the project, that directly linked the rewards to contractors at all levels of procurement chain to those objectives, the government sets the stage for the financial challenges of the tunnel.

A part from that, the cost are not involved too much because after the project are running and near to the ending the stakeholders influence are getting low and cost also getting low. That why only small changes will occurs in this phase. However, the possible to become a factor to make project cost overruns are still exist during this phase.

2.3.4 Effect of technical risk toward cost of production in closing phase

In the closeout phase, there are still having some problem and issues. Teamwork and communication are truly broke down in several key areas. The financial backers of the project were only focused on minimizing their lost and as such refused to accept negotiated arrangement for settling some of the key contract disputes. The parties are started to blame others organization to responsible to the lost in this project. Overall, teamwork during closeout was focused on each party meeting its own priorities and interests rather than working towards an acceptable solution for all parties involved. However, the parties involved in the project seemed to be quite willing to share in the project success.

In closing phase of Chunnel project, all the lost have been covered through share by all the parties involved included the stakeholders. The consequences of this event, Eurotunnel was responsible for roughly 70% of cost overruns on the original contract and TML was responsible for the remaining 30% capped at a maximum 6% of the total cost. In overall, the project was classified by other external parties as success project. The quality of the tunnel was said as impressive. By using the new technology and engineering the project also success although there are a lot problem and risk especially on communication because it involved too many parties to invest in this project.

Another case study that supports this research is a case study on the Indian oil refinery. From this paper, Kumar Dey (2011) stated that Technical risk was the

major risk category for the time and cost overrun of the project. Scope change, engineering and design change, technology and implementation methodology selections were included in technical risk category and it became the major causes of project failure. Prior selection of implementation methodology was crucial for the 'instrumentation and control room' packages, as improper selection could cause major time and cost overrun. All the risk that state to have probability to appear in the project will affect a lot in cost of project. That prove technical risk should be managed well to control the cost. Writer was stress on the technical risk in that project because mostly cost overrun was cause by the type of risk because it was uncontrollable.

In the case study for Faroe Islands project that also in Iceland, the project manager had included a number of incentives in the contract to ensuring a hand-over of the tunnel within the predicted cost budget and time schedule. It also help to encourage contractor provide and practice time and cost-effective methods in develop rock support and rock mass grouting for this project. Early completion bonus if hand-over of the tunnel took place prior to a preset date of completion as the incentives. However, late completion of the project will carry a penalty. Second incentives to encourage contractor is sharing cost savings on technical alternative solutions, on a half basis between the organization and the contractor.

Based on previous research, it clearly shows that managing technical risk is very important in a project to help in reduces cost of production. Failure to manage the technical risk it will cause of loss for a lot of money. It clearly proved by some case study in the previous. The actual cost for that project is far away from the estimated cost. Affect from that the company that managing the project should take responsibility for the effect.

2.4 Conclusion

Last but not least, in organization there are important to control and manage the risk that have possible to appear in a project. In this paper there are more focusing on technical risk that might be reduce the cost of production. There are some journal that are support this study on technical risk can reduce the cost of production. In the first objective in this study, there are focusing on the identifying and manage the technical risk. For information technical risk involved the overall process of producing project. From that, it can be conclude that there are a lot of technical risk needs to be control. All of them incurred the cost of production in the project. There also have provided the ways to identify the technical risk. There are important to know the risk before start to run a project because manager should provide their employee with the plan to prevent the technical risk that might have possible to appear in the project. Without proper planning process the project might fail to complete within the cost. it also involved the time and scope, so the manager should be aware and able to identify and control the technical risk appear in a project before run a project.

In the objective two of this research, it focusing on the effect of technical risk towards cost of production. Based on journal under this study, there are agree that technical risk are given a big effect on the costing in a project. Normally the source of cost overruns in a project is cause by failure to manage and realize the appearance of technical risk. Mostly of the organization are agreeing to prevent technical risk rather than other risk. Technical risks are often we cannot expect the appearance. So, effects of the technical risk are look very bad to the project. however its depends on the severity of risk, if there only a little there are not a problem to manager to manage it, but if there high severity contingency plan should be adopted to prevent a lot of cost overruns in the projects.

CHAPTER 3

Methodology

3.1 Introductions

In this chapter, I will discuss the instruments and methods used to investigate the research about managing technical risk towards the reducing cost of production in an organization.

3.2 Research Method

Generally, research method is using two methods which are quantitative method and qualitative method. Quantitative method usually the result is measured by using numbers and frequency of the variations. Besides, the quantitative method is result that measured by using meaning or experience. In short, the qualitative involved number and can be calculated and qualitative method cannot be calculated. The examples of quantitative methods are surveyed questionnaires, experiments and test of psychometric. Quantitative methods are related to the scientific and experimental approach and are criticized for not presenting the clear description. On the other hand, the qualitative methods provide information which is quite reliable and easy to be analyses statistically.

For the purpose of this study, the data collected and will be analyze by using quantitative method. Quantitative research is a survey design that places heavily emphasis on using formal standardized question and predetermine response options in questionnaires or surveys administered to large number of respondents (Cavana et al,. 2001). This study not take too long time in carried out, a part from that, it is known as cross-sectional study or also known as one-shot study.

The quantitative study is focusing on a population to examine the relationship between independent and dependent variables. There have two designs for quantitative research whether descriptive (subjects usually measured once) or experimental (subjects measured before and after a treatment). A descriptive study establishes only associations between variables. An experiment establishes causality. The two variables will link the relationship and develop the hypothesis for this study.

The first necessary need to express the analyzing of quantitative data is by arrange the information and identify the overall patterns. After these patterns have been specify, then, secondly, it is important to find the correlations among variables. It is important to recognize whether they are correlated or no and if so, how strongly. Thirdly is expecting that the researcher has a prior explanations for affirming the causal relations between variables, the question then come up of how far changes in the causal (predictor, independent) variables can clarify changes in the caused (response, dependent) variables. At the end, the issues come up of how far results can be referred to be an accurate data of the population as a whole, if the data are from a sample. To fulfill these four functions, the political scientists use a range of techniques which are description, association, explanation, and inference. The choice of these techniques varies according to a considerations number and especially the level of measurement.

Political scientists used the method of quantitative as an assortment of perspectives, involving, the study of arms races, of political violence, of political

stability, and of the performance of legislators, but the most important use has been in the area of electoral attitudes and actions, where data can simply analyses.

3.3 Population and Sampling

A “population” consists of all the subjects you want to study. Only defined population from which the sample has been selected was describes as any illation from a sample and this was call as the target population. In statistics, some information is needed to be determined by the whole group from the population that consists only of people. Population is well defined with explicit inclusion and exclusion criteria. The research question or purpose of the study in selecting a population will need to recommend a suitable definition of the population to be studied, in terms of position and restriction to a particular age group, sex or occupation. In order to ensure that those to be included and excluded are clearly spelt out, the population must be fully defined.

In this paper**,** it will be conducted in a plant of oil and gas company at Kerteh, Terengganu which known as PETRONAS. This population for this study is a department in PETRONAS also known as Gas Processing Plant A (GPP A). In GPP A it will divide to four plants which are GPP 1, 2, 3 and 4. A plant will be selected in the sampling process. The main objective of this study is effect of managing technical risk towards reducing the cost of production. The staff in the plant will consider as the population for this research. The PETRONAS is a big company in Malaysia, that the reason this company will be chosen as the scope of this study. Moreover, the oil and gas are the most risky industry. Besides that, due to the increasing of cost, PETRONAS is a company that targets to cut costs in their production. In every project that handling by this company has full of risk and dangers. It will help in getting accurate data about technical risk and reduce cost.

When the population has been set up, then it needs to be sampled because the population is too big for the research. Population sample gives a definition of a group of people or events comes from a population. A research study is performed on a sample from a population. The target is to be able to get out the true facts about the sample that will also be true of the population. You need to have a sample that is representative of the population, in order to have a truly reflect the population. Simple random sampling, stratified sampling, cluster sampling and systematic sampling are the four methods involve. The superlative method to use is a randomly select your sample from the population, in order to obtain a representative sample. A study that huge, are recommended to use random sampling or a carefully matched sample is said to have external validity. The percentage of the population to be studied, assigning each individual within the population a number and using random selected numbers from a table of numbers and giving each individual an equal possibility to be chosen for inclusion in the study are required by the simple random sampling to defining the population study. In this manner, adequate random sample of the general population will becomes represent the whole sample.

For this study, the respondents that will be involved in this study were a project manager, engineer and others staff that were work for a project. For the information, those who are involved in project at the plant will be randomly selected to help in complete this study. The assume of population are 100 workers. Krejcie R.V and Morgan D.W. state sample size needed for 100 population is 80. The questionaire will be distributed in 90, however the expected questionaire will be response is about 85.

From the responds questionnaire, to complete this study, 80 respondents will be selected randomly from the plant site to help in this research. They all are being to answers a questionnaire based on the objective of this study which is managing technical risk can reduce the cost of production.

Table 3.1: Population and sampling

Population	100
Sample Size/ Respondent	80

3.4 Data Collection Method

The data collection method used in this study was aimed at effect of managing technical risk towards reduce cost of production. To conduct this study, I will use two data collection instruments were used which is survey to the site.

3.4.1 Primary data

In this study, in order to collect the primary data, a survey questionnaire technique will be used. The survey questionnaire will be provided to respondents in the company by personal administrated. I will go to the company and distributed to the respondents that are randomly selected to accomplish this study. This will be the fastest, easy and effective ways to obtain the data from the questionnaire. After respondents answers the questionnaires, they will directly send the answers sheet. It easier ways to collect all the questionnaires that has been distributes.

3.4.2 Secondary data

Besides obtain data from the primary data, this study also referring through secondary data to get the result. Secondary data is a collective of data that gain from the literature review. The secondary data are obtained from the journals, magazines, reference books, published articles, websites and handouts of published modules.

3.5 Development of Measure: design and questionnaire

Primary method that will be used in this to ensure the result of this research more accurate, the survey method will be conducted to the some selected constructions site. This survey is purpose to see by managing technical risk can reduce the cost of production or not. This method will be conducted parallel with the interview. In this method, it is easy to see from all angle of strong and weakness of the organization towards managing the risks.

This survey will be done by using questionnaire. I was preparing a questionnaire that related to this study which consists of four parts and two sections. These four parts are represent the phase or stage in the project which are planning phase, execution phase, monitor and controlling phase and closing phase. All the information that is related and important to this study will be jotting down in a note book. Finally, I will compile all the useful information in this method will be reported to finish this research.

3.5.1 Questionnaire

Questionnaire is a question that researcher will distributed to the respondents. Respondents should answer all the questions except they are given choice to not answer the question. Questionnaire also a method to complete this study and it purpose to collect data from respondent.

To complete this study, questionnaire has developed and it will distribute to the respondents at the study area. As we know, primary source to collect data is by using questionnaire. Questionnaire should be develop and ensure respondents can understand well the question that ask in that.

The questionnaire that will be develop contain for three sections which are part A (respondents particular), part B (identifying technical risk in production process) and part C (effect technical risk towards cost). All the part consists of scale

for measurement such as five likert scale. Respondents should answer the entire question.

In part A, there consist of four questions. This part is particular to all respondents to answer. First question in this section is gender of the respondents. It has only two choices which male and female. Then question about age. Age will be divided to categories which are below 30, 31-40, 41-50 and 51 and above.. The last question in this part is the respondent's position in their company. This question needs the respondents state the position. All these data are needed to help researcher in analyze the respondents involved in sampling.

For part B, the instruction to respondents will be stated at the top of the page. This part will be divided to four parts which represent the four phases in project, planning, execution, monitoring and controlling and closing phase. The questions that answer are based on the phase in the project. This phase consist of five point likert scale question which need respondents to rank and put the level. For ranking, one (1) is the lowest and five (5) the higher rate. For the leveling, it almost same, but respondents need to put the number that represent the level of technical risk that have high probability and impact to the project.

For part C, the type of question and data collected is almost same with part B. part C also will be divided to the four phases in the project, same as part B. it also using five point likert scale as a medium to collect data. However, the difference between these parts is question for part B focuses on ways to identifying and mitigate risk, for part C question more focusing towards cost that effected by the technical risk. .

Lastly, in the questionnaire respondents are allowed to give their idea and recommendation toward the study. The idea and recommendation given are useful for this research and for future study.

3.6 Conceptual Framework

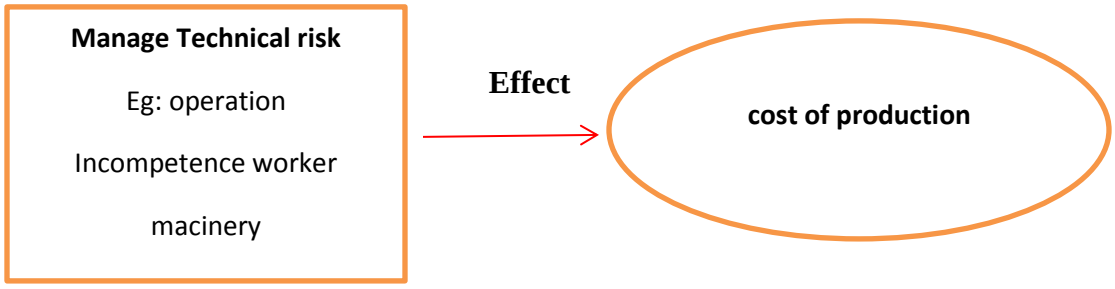
Framework of study is about the ways in order to complete this study. Technical risk is a major risk in project. It consists in overall process of the project such as design, engineering, operation and manpower. This research will conducted in order to reduce cost in the production process of a project. Due to the increasing of the cost of living and material market trade, it seems to be relevant to conduct this research. It is very possible to reduce cost by using cheap material or cut the wages rates of worker because it related to quality of product and performance of the job.

In this research, the independent variable is technical risk in project. Every project will faces this type of risk. The technical risk should be managed very well because it will affect the scope and quality of the product. Apart from that, every change will incur the cost of the project. Due to that event, if the risk cannot be managed from the beginning phase of the project it will lead to cost overruns.

According to that event, the dependent variable to this research is reducing cost. In this paper, it will be study the relationship between the two variables which are independent and dependent variable. In simple, this study is about to reduce the cost of production by managing technical risk in projects.

Last but not least, in this paper it will study about the ways of an organization identify and mitigate the technical risk since we know that the technical risk is uncontrollable. Besides that, it will be study the effect of managing technical risk towards reducing cost of production of a project.

Figure 3.1: Theoritical Framework



Descriptive statistic involves transformation or raw data into a form that would provide information to describe a set of factors in a situation. Descriptive statistic example included frequencies, measure of central tendencies and dispersion. Measure of central tendencies used to achieve this goal. Mean, median and mode is used to measure the central of tendencies. The mean or average is a measure of central tendency that offers a general picture of the data without unnecessary inundating one with each of the observations in a data set. Besides, the median is the central item in a group of observation when they are arranges either in ascending or descending order. Lastly is mode, to measure of central tendency. To measure dispersion, the standard deviation also can be used

For measure of depression is depends on measurement of scale used. Measurement of dispersion are include the range, standard deviation and the variance also the inter quartile range. Range refers to the extreme values in a set of observation. Then, variance is a value that calculated by subtracting the mean from each if the observation in the data set, taking the square of this difference and dividing the total of these by the number of observations less one. Lastly is standard deviation, it offers an indication of the spread of a distribution or the variability in the data.

Moreover regression analysis also using thoroughly simple regression is a scatter diagram or the value of the correlation coefficient indicates a strong linear relationship between two variables then it would make sense to fit a line to the data points to predict one variable when the values of the other are given.

Besides, the reliability of the data will be concluded. Reliability is a measure indicates the extents to which the measure was conducted without bias from any factor or error free. Hence offers 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.

Descriptive statistic is the best statistical technique can use in order to analyze and calculate the result of this study,. For instant, descriptive statistic is used to measure all the variables in this study by analyze the data that had collected. Lastly, Statistical Package for the Social Science (SPSS) as the statistical analysis tool in collection data. When the result been analyze the relationship between both variables will be obtain.

3.7.1 Research Hypothesis

Ho: Managing technical risk can reduce cost of production in project

H1: Managing technical risk can reduce cost of production in project

3.8 Limitation of Study

The study was based on questionnaire and response bias has not been taken care of. The answer given by employee sometime not accurate. Moreover to get the accurate data from respondent are too difficult regarding the company will not tell much about the company. In addition, the failure to manage risk will show the weakness of an organization. That becomes a problem by which organization willing to show their weakness.

3.9 Summary

To summaries overall, this chapter clearly shows the flow of research will be conducted soon. Methodology helps to learn how to use libraries and other information resources, enables critical evaluation of literature; develops special interests and skills. Helps to understand the attitude of others and creates awareness of the special needs of the research process. Describes and analyzes methods, throw

light on their limitations and resources, clarify their presupposition and consequences, relating their potentialities.

Besides that, all the statistical analysis use in the research purpose ensures the validity and reliability. Validity is defined as the extent to which the instrument measures what it purports to measure and reliability is defined as the extent to which a questionnaire, test, observation or any measurement procedure produces the same results on repeated trials. In short, it is the stability or consistency of scores over time or across raters.

Chapter 4

RESULT AND DISCUSSION

4.1 Introduction

This chapter will focus on the findings and results of the study. The results for this study were been obtained from the survey were coded, edited and analyses using SPSS program. Data were segregated to obtain a description of the respondents' characteristics. Prior to hypothesis testing, reliability test was done followed by a brief discussion on the item analyses of independent variable and dependent variable.

The empirical analysis begins by testing all the hypotheses included in the study by looking at the differences in factors related to gender, age and position of respondent in company. Next, hypothesis testing was done to find out whether the technical risks are effect the cost of production in project. The final analysis use correlation technique in examining the relationship between the technical risks and cost of production. From the result of data analysis the conclusion will be made for this study. As the conclusion, this chapter is focusing in answer all the objective that state for this study.

4.2 Scale Verification

In this study, some important factor to be considered is scale using to obtain data. Scale verification will discuss about the scale been using to analyze data. The scale that been using will determine the acceptance level of the result for this study. Scale verification is the first point of consideration in the study before analyzing the data was to assess the reliability of the independent variables. Reliability refers to the extent to which a scale produces consistent results if measurements are made repeatedly. According to Nunnally (1967), she recommended a value of 0.5 above as the acceptable levels of reliability coefficient while Malhotra (1996) suggested that a value of 0.6 or less generally indicate unsatisfactory internal consistency reliability.

Before the questionnaire been distributed to the respondents, pilot study has been conducted. It purposes to measure the reliability for the question in the questionnaire. All the parameters in the questionnaire have being measure to ensure the reliability. Table 4.1 shows that all the value of reliability coefficient to all scale being measured. The Cronbach's alpha coefficient of all variables ranged from 0.7 and above. Cronbach's alpha were measured according to each objective and also measured by overall of the questionnaire. In overall the value of Cronbach's Alpha found is $\alpha = 0.813$. For objective 1 which to identify the technical risk in project the value that obtain is $\alpha = 0.959$ while for objective 2 the value of Cronbach's Alpha coefficient is $\alpha = 0.729$. All the values that obtain from the reliability test shows that it were acceptable according to Malhotra (1996).

Table 4.1: Reliability Coefficients
(Cronbach Alpha)

Variables	**Alpha Coefficients** **N= 80**
Independent	
Technical risk in project	**0.959**

Dependent	
Cost affected	**0.729**
Overall	**0.813**

4.3 Analysis of Data

As mentioned previously, the statistical technique particularly appropriate to determine the dimensional nature of a number of variables is factor analysis. It is a procedure that groups items on the basis of correlations. The main aims to identify the strongest relationship between two variables in this study by using the identification scale. This statistical technique is excellent for the investigation of the underlying structure of a questionnaire. Those items that refer to or share the same dimension should correlate with one another and the factor analysis uses this to uncover composite variables. The highest value of correlation will answer the research objective either reject or accept the hypothesis.

In this present study, the method will use is regression and correlation between the variables. According to Stockburger, regression models are used to predict one variable from one or more other variables. Regression models provide the scientist with a powerful tool, allowing predictions about past, present, or future events to be made with information about past or present events. The scientist employs these models either because it is less expensive in terms of time and/or money to collect the information to make the predictions than to collect the information about the event itself, or, more likely, because the event to be predicted will occur in some future time. Sykes (1986) state the regression analysis using in research is a statistical tool for the identifying relationships between variables. Usually, the investigator seeks to ascertain the causal effect of one variable upon another. For example, the effect of a price increases upon demand.

Mathematically, the line representing a simple linear regression is expressed through a basic equation: Y = a0 + a1 X. Here X represents the "independent variable." While, Y is represents the "dependent variable". Additionally, a0 is the y-intercept (the value of Y when X is zero) and a1 is the slope of the line, characterizing the relationship between the two variables.

4.4 Normality Test

Before the relationship of independent and dependent variable being define, the test of normality for each variables need to be done. The purpose of test of normality is to define either the data for the independent and dependent variables is normally distributed or not. To define either it normal or not it should be based on the value of significant number in Shapiro-Wilk test. It's the most powerful normality test available and is able to detect small departures from normality (analyse-it, 2008). If the significant number show it greater than 0.05, it consider as normal. Then if the significant number is greater than 0.05 it will be consider as not normal. According to the table below, the normality test for data planning and closing phase is normally distributed. While for the execution phase, monitoring phase and cost of production is not normal distributed. However, based on the GraphPad Software (2013), if the departure from normality is small, you may choose to do nothing. Statistical tests tend to be quite robust to mild violations of the Gaussian assumption.

Table 4.2: Normality Test

	Shapiro-Wilk		
	Statistic	**df**	**Sig.**
planning phase	.978	80	.183
execution phase	.936	80	.001
monitoring phase	.954	80	.006
closing phase	.975	80	.122
Cost of production	.950	80	.003

According the table 4.2, data for planning phase, closing phase and cost of production considers as normal since the significant value for those data is greater than 0.05. While, for execution phase and monitoring phase, it considered as not normally distributed because the significant value for those data is lower than 0.05.

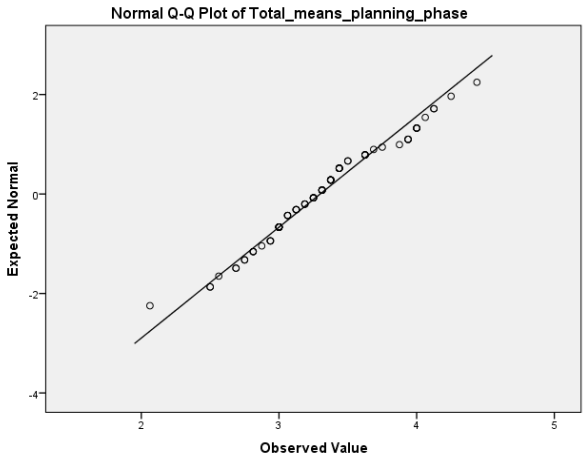


Figure 4.1: Normality graph for planning phase

The figure 4.1 shows normality plot for planning phase. According the graph, it shows the data is normally distributed.

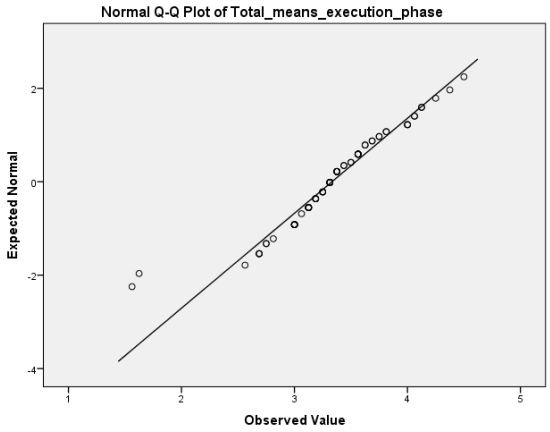


Figure 4.2: Normality graph for execution phase

Figure 4.2 shows the normality plot for execution phase. The data is normal but the data at the beginning shows have large different. That the reason significant value for execution phase for normality test is lowers than 0.05. However, the small different not effect on overall result and it can be assume as normal.

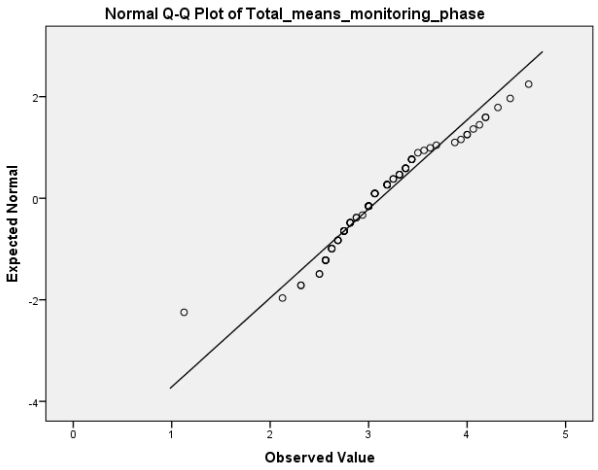


Figure 4.3: Normality graph for monitoring phase

Figure 4.3: shows the normality plot for monitoring phase. The data seem as normally distributed, however there has some data spread large from the linear line.

The effect the data is significant value for normality test is lower than 0.05. The data can assume as normally distributed because the spread not seem too much from the line.

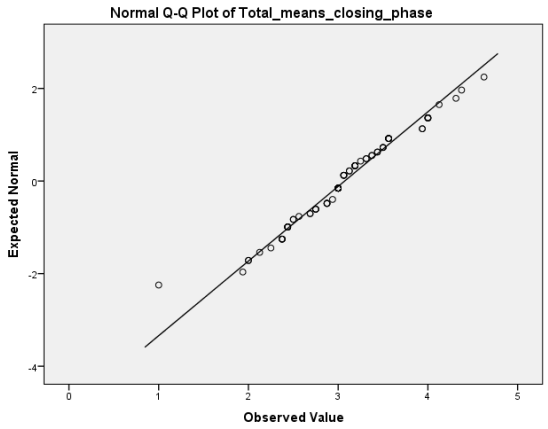


Figure 4.4: Normality graph for closing phase

Graph 4.4 shows the normality plot for closing phase. According to the graph above, the data seem as normally distributed.

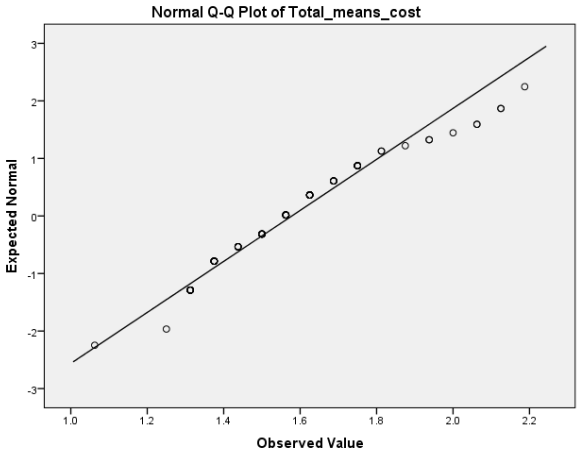


Figure 4.5: Normality graph for cost of production

Figure 4.5 shows the normality plot for cost of production. The data for cost of production seem normally distributed according the graph.

4.5 Profile of Respondents

Respondent that selected to accomplish this study is employee in a division of PETRONAS which known as Gas Processing Plant A (GPP A) located at Kerteh, Terengganu. A total of being obtained for data analysis was 80 of employees. Based on this data, a demographic profile of respondents is presented in Table 4.3. There are three (3) demographic characteristics discussed which include gender, age, and position in the company.

Table 4.3: Demographic Profiles of the Respondents

Respondents Characteristics	**Frequency (n= 81)**
Gender	
Male	71
Female	9
Age Group	
30 years old and below	26
31 – 40 years old	25
41 – 50 years old	27
51 years old and above	2
Position in Company	
Manager	1
Engineer	15
Contractor	4
Staff	54
Others (technician)	6

From the table 4.3, demographic profile of the respondent the first characteristic being measured is gender of the employee in that company. Table shown that mostly of the respondents answer the questionnaire is male which 71 (88.8%) compared to female which is only 9 (11.3%). From the data that been analyze, it clearly show that the company being observe is dominated by male. Their project team has majority contain of male members rather than female.

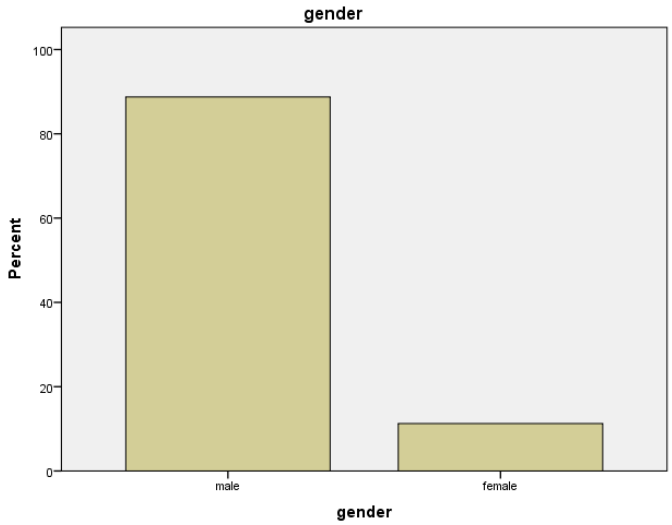


Figure 4.6: Frequency for gender in percentage

While, the second characteristic that measured in the questionnaire is about the age of the employee in the company. The highest frequency for age of employee in company is in range 41 – 50 years old which have 27 (33.8%). Then the lowest frequency is employee that have 51 years old and above which have only 2 (2.5%) of them. For the age of employee 30 years old and below, the frequency is 26 (32.5%). Lastly, the employee that have range of age 31 – 40 years old is 25 (31.3%) involved in this study. All of the respondent obtain is involved in project and automatically as a project team.

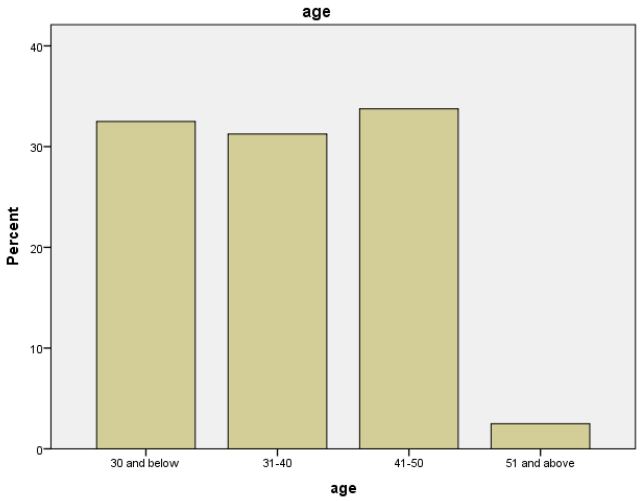


Figure 4.7: Frequency for age in percentage

Last characteristic that observed in this study is position in the company. It purposes to know their position and the experience in the project. The employees who hold high position will give a good answer while the lower position will give the answer based on their experience. For this characteristic, it classified in five (5) groups that represent them which are manager, engineer, contractor, staff and others. For the other, the respondents indicate the position that represents them. Respondent that holds position as staff for the PETRONAS Company has the highest frequency in this study. It accounted for 54 (67.5%) respondents involved in this study. For group of manager is the lowest frequency in order to the low population of manager involved in a project. The number of respondent obtain from the manager group is only 1 (1.3%). Respondents hold position as engineer accounted involved in this study are 15 (18.8%). Then, the respondent represent group of contractor for company is accounted 4 (5%) from total respondent. Lastly, group that being classified in this characteristic is others position. Employees involved allowed stating their position by their own that represent themselves. It was accounted for 6 (7.5%) of respondent and all of them state they are technician for PETRONAS.

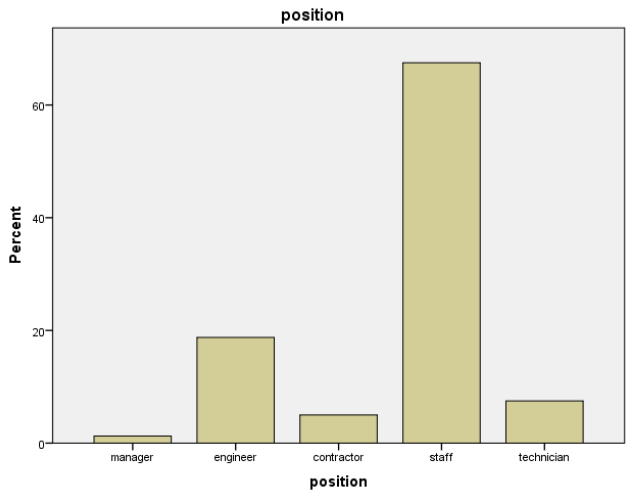


Figure 4.8: Frequency for position employee in percentage

4.6 Descriptive Statistic

For the descriptive statistic, the data were analyzed by using mean and standard deviation. It will show the highest probability of risk and cost involved in the production. The data that collected by using likert scale which 1) highly unlikely 2) unlikely 3) possible 4) moderate possible 5) highly probable. Each variable involved had been determined through mean and standard deviation. Through that, it can be conclude and rank from high to low probability that the variable appear in production. Besides that, the variable been grouped according to phase of the project and dependent variable group.

For mean it shows the value of average for the data set. It will show the technical risk that will have the high probability to appear in project. It cans simply that which technical risk that has high value of mean will have high probability to appear in project.

For standard deviation, it means a measure of the dispersion of a set of data from its mean. The more spread apart the data, the higher the deviation. Standard deviation is calculated as the square root of variance (investopedia, 2013). The smallest value of standard deviation is good because it show that data is about accurate because the dispersion of data not has much different. For standard deviation, it can be range:

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 ($x \geq 1.11$)

4.6.1 Means and Standard Deviation in Planning Phase

Table 4.4: Mean and standard deviation for variable in planning phase

Descriptive Statistics

	N	Mean	Std. Deviation
scope change	80	3.3750	.60326
communication failure	80	3.4375	.86922
machinery problem	80	3.4250	.80779
not clear scope	80	3.1375	.91047
incompetence worker	80	3.2125	.95060
less quality material	80	3.2250	.79516
engineering problem	80	3.2375	.71589
design error	80	3.1375	.74194
stakeholder influence	80	3.1750	.83855
technical requirement	80	3.4125	.80652
wrong in resource allocation	80	3.2125	.86703
wrong in cost estimation	80	3.3625	.94459
physical risk	80	3.3125	.82052
environmental risk	80	3.5250	.67458

operation risk	80	3.5250	.79516
other risk	80	3.0750	.99078
Valid N (listwise)	80		

Table 4.4 show means and standard deviation for the technical risk in planning phase. According to the table above, the technical risk that has highest probability to appear in planning phase of a project environmental risk. The technical risk has the mean 3.5250 and standard deviation is 0.6746. Standard deviation shows it in range good, and the data is almost accurate and the data spread not have much different. The risk have same value of mean with operation risk, however the standard deviation value had differ them where environmental risk have small value compare to operation risk. The other technical risk show the lowest probability to appear because the mean for it is 3.075 and standard deviation is 0.99078. The value of standard deviation is in bad range, it show there have much different in the spread of data and it not accurate compare to the environmental risk.

4.6.2 Means and Standard Deviation in Execution Phase

Table 4.5: Mean for variable in execution phase

	N	Mean	Std. Deviation
	Statistic	**Statistic**	**Statistic**
scope change	80	3.4375	.72642
communication failure	80	3.3000	.78595
machinery problem	80	3.3875	.73766
not clear scope	80	3.2875	.87430
incompetence worker	80	3.2875	1.03354
less quality material	80	3.3500	.84344
engineering problem	80	3.4375	.85453
design error	80	3.3000	.93321
stakeholder influence	80	3.0750	.72522
technical requirement	80	3.4125	.75797
wrong in resource allocation	80	3.3375	.76214

wrong in cost estimation	80	3.4750	.77908
physical risk	80	3.3875	.78746
environmental risk	80	3.3625	.81511
operation risk	80	3.4250	.88267
other risk	80	3.0500	1.01757
Valid N (listwise)	80		

Table 4.5 show means and standard deviation for the technical risk in execution phase. According to the table above, the technical risk that has highest probability to appear in execution phase of a project is wrong in cost estimation with the value for mean shown in data analysis is 3.4750 and standard deviation is low with is 0.77908. The standard deviation can be considered as accurate because the value of standard deviation is in range of moderate. The other technical risk show the lowest probability to appear because the mean for it is 3.0500 and standard deviation is 1.01757. According to the value of standard deviation, the data have large value of spread data is large. The value of standard deviation is fall in range of bad.

4.6.3 Means and Standard Deviation in Monitoring Phase

Table 4.6: Mean for variable in monitoring phase

	N	Mean	Std. Deviation
	Statistic	Statistic	Statistic
scope change	80	3.0125	.83429
communication failure	80	3.2250	.82638
machinery problem	80	3.2250	.85647
not clear scope	80	2.9875	.89292
incompetence worker	80	3.0875	.90279
less quality material	80	3.1500	.88732
engineering problem	80	3.2000	.76968
design error	80	2.9750	.89972
stakeholder influence	80	3.1000	.86566
technical requirement	80	2.9875	.83429

wrong in resource allocation	80	3.1625	.71942
wrong in cost estimation	80	3.1500	.76473
physical risk	80	3.1500	.94266
environmental risk	80	3.2500	.86420
operation risk	80	3.2000	.95996
other risk	80	3.0500	1.06617
Valid N (listwise)	80		

Table 4.6 show means and standard deviation for the technical risk in monitoring phase. According to the table above, the technical risk that has highest probability to appear in monitoring phase of a project is environmental risk with the value for mean shown in data analysis is 3.25 and standard deviation with is 0.8642.for this phase design error shown the lowest probability to appear because the lowest mean which is 2.975 and standard deviation is 0.89972. at this phase the technical risk start to going slow that why it has low value of mean if compare to the two phase above. Since the standard deviation value for both high and low means is not too much different, the data can be considered as accurate because both value of standard deviation fall in same range, moderate. The value of the data spreading is not too large.

4.6.4 Means and Standard Deviation in Closing Phase

Table 4.7: Mean for variable in closing phase

	N	Mean	Std. Deviation
	Statistic	Statistic	Statistic
scope change	80	2.9375	.95922
communication failure	80	3.0750	.96489
machinery problem	80	3.1250	.90533
not clear scope	80	2.8125	1.00749
incompetence worker	80	2.9500	.89866
less quality material	80	3.0000	.82677
engineering problem	80	3.2000	.78595

design error	80	2.8500	.95599
stakeholder influence	80	3.1500	.74799
technical requirement	80	3.2375	.76710
wrong in resource allocation	80	3.1250	.75263
wrong in cost estimation	80	3.1375	.82283
physical risk	80	3.1750	.91090
environmental risk	80	3.2875	.82973
operation risk	80	3.1750	.88267
other risk	80	2.9125	.99612
Valid N (listwise)	80		

Table 4.7 show means and standard deviation for the technical risk in closing phase. This is the last phase in project and at this phase actually not too much risk compare to other phase. However it depends to the management to manage the project in closing phase. According to the table above, environmental risk is the most probable to appear in this phase. This because it has higher mean compare to other which 3.2875 and standard deviation is 0.82973. For standard deviation value, there can be considered as accurate data because it in range moderate. The data spread value not too large and the respondents have almost same idea about the data. Hence, the lowest mean show it will have lower probability to appear at this phase is not clear scope with mean 2.8125 and standard deviation is 1.00749. For the lowest mean, it has large value of standard deviation. The value of standard deviation falls in bad range. It shows the respondents have different idea about the data.

4.6.5 Means and Standard Deviation in Cost of Production

Table 4.8: Mean for variable in cost of production

	N	Mean	Std. Deviation
	Statistic	Statistic	Statistic
redesign cost	80	3.6375	.78343
training cost	80	3.5500	.79396

maintenance cost	80	3.8875	.72903
delay and penalty	80	3.7000	.70081
over budget	80	3.8375	.80259
insurance coverage	80	3.5750	.82332
Others	80	3.0625	1.14011
Valid N (listwise)	80		

Table 4.8 show the means and standard deviation for variable involved in cost of production. In addition, cost of production is dependent variable. Referring the table, cost that have the high value mean is maintenance cost, 3.8875 and the standard deviation is 0.72903. Since the value of standard deviation falls in moderate range, the data can be considered as accurate because there have not large spread value of data. This show that maintenance cost is the most cost that will affected in production cost. Then for the lowest cost that has low affect in production is other cost where the mean is 3.0625 and it has the highest standard deviation, 1.14011. For the standard deviation for the lowest means, it falls in very bad range. The data tabulated not accurate because it has large value of spread data. The respondents have their idea towards the data.

4.6.6 Total Mean Score and Standard Deviation

Total means score show the total mean for each group. The independent group is planning phase, execution phase, monitoring phase and closing phase. Hence, the dependent variable is cost of production.

For the total means, the group of independent variable that has highest value of means is execution phase with 3.3320 and standard deviation is 0.49178. The standard deviation fall in range very good and it show the data is accurate. This show the risk will highly appear mostly in execution phase rather than other phase. For the dependent variable, cost of production, the total means is 1.5781 and standard deviation is 0.22557. For the standard deviation in cost of production, the data also

accurate because it falls in range very good. The respondents have almost same idea towards the data set.

Table 4.9: Total means and standard deviation

Descriptive Statistics

Total mean	N	Mean	Std. Deviation
planning phase	80	3.2992	.44868
Execution phase	80	3.3320	.49178
Monitoring phase	80	3.1195	.57033
Closing phase	80	3.0719	.62032
Cost of production	80	1.5781	.22557

4.7 Correlation

To determine the relationship and the strong of an independent variable relate to the dependent variable, correlation technique has been used. Correlation is a statistical technique that can show whether and how strongly pairs of variables are related. Although this correlation is fairly obvious, the data may contain unsuspected correlations. It may also suspect there are correlations, but do not know which are the strongest. An intelligent correlation analysis can lead to a greater understanding of your data.

For this study, the data distribution used the Pearson correlation coefficient to analyze the data. According to website creative research system Pearson correlation is the technique to works with linear relationships.

The correlation also should see through each group where the total of the variable been compute to become one group.

Table 4.10: Overall correlation

Correlations

		Planning phase	Execution phase	Monitoring phase	Closing phase	Cost of production
Planning phase	Pearson Correlation	1	.695**	.598**	.388**	.252*
	Sig. (2-tailed)		.000	.000	.000	.024
	N	80	80	80	80	80
Execution phase	Pearson Correlation	.695**	1	.731**	.542**	.295**
	Sig. (2-tailed)	.000		.000	.000	.008
	N	80	80	80	80	80
Monitoring phase	Pearson Correlation	.598**	.731**	1	.776**	.237*
	Sig. (2-tailed)	.000	.000		.000	.034
	N	80	80	80	80	80
Closing phase	Pearson Correlation	.388**	.542**	.776**	1	.245*
	Sig. (2-tailed)	.000	.000	.000		.029
	N	80	80	80	80	80
Cost of production	Pearson Correlation	.252*	.295**	.237*	.245*	1
	Sig. (2-tailed)	.024	.008	.034	.029	
	N	80	80	80	80	80

Based on the table 4.10, correlation between execution phase and cost of production stated that they are the strongest correlation compare to other correlation. The value for Pearson correlation shown is 0.295. It means that execution phase and cost is strongly positive correlation. It can reject null hypothesis since the significant value show lower than 0.05. The significant value is 0.008. Strong positive correlation means that it has strong relation between the variables. If the independent variable increases, same goes with the dependent. It can simply, the technical risk in execution phase can reduce the cost of production if it been managed. The statistical significant is ($r = 0.295$, $n = 80$, $p < 0.05$).

Secondly, the planning phase also has the positive correlation. The value for Pearson correlation is 0.252. It means strong positive correlation. It also has strong relationship between the costs of production. The value for significant is 0.024 < 0.05. It can reject null hypothesis which mean cost can be reduce if technical risk in planning phase being managed. The statistical significant is ($r = 0.252$, $n = 80$, $p < 0.05$).

Then the third of higher correlation is between closing phase and cost of production. The correlation, r is higher than monitoring phase. It shows that the relationship between closing phase and cost of production is higher rather than monitoring phase. The Pearson correlation for closing phase and cost of production is 0.245 and the significant is 0.029. According to significant value, it can reject null hypothesis because significant value less than 0.05. Statistical significant is ($r = 0.245$, $n = 80$, $p < 0.05$).

Lastly is correlation between monitoring phase and cost of production. This is the weakest correlation in this study. Even though it weakest correlation but it still positive correlation between these two variables. The correlation value, r is 0.237 and significant value is 0.034. This relation also reject null hypothesis. The statistical significant between these two variables is ($r = 0.237$, $n = 80$, $p < 0.05$). Between monitoring phase and cost of production, there still have relationship where by managing technical risk at this phase can reduce the cost of production.

4.8 Regression

Item analysis was done to describe the respondents perception based on their experience involved in project. In this study, there has been used the five likert scale whereby respondent can rank the technical risk that is highly possible to exist in each project that can affect the cost of production. In this study, sixteen example of technical risk been identify and allow the respondent to rank according to the level of

possible to exist in project. the technical risk that been listed in the questionnaire are scope change, communication failure, machinery problem, not clear scope, incompetence worker, less quality material, engineering problem, design error, stakeholder influence, technical requirement, wrong in resources estimation, wrong in cost estimation, physical risk, environmental risk, operation risk and other technical risk.

In this section, employee also allowed to state the technical risk that not been listed yet in the questionnaire. It can help a lot in result. The technical risk identification were analyzed by phase according to the Project Management Body of Knowledge which have four (4) major phase in project which are planning phase, execution phase, monitoring phase and closing phase. There were analyzed on the regression model by looking at each item from the dimensions used.

Regression model analysis is a statistical tool for the investigation of relationships between variables (sykes, 1986). To analyze the result from the data set, there should have the coefficient table. It will show the value for significant of each set of variables. The significance value also known as P-value. It needed to helps researcher to decide the result. If the significance value is lower than 0.05, that means reject Ho. While if the significance value higher than 0.05 that means accept Ho. The regression model has been done by each phase of project to ensure the data more accurate and can differentiate which phase has the large effect.

Research hypothesis for this study are;

Ho: Managing technical risk cannot reduce cost of production

H_i: Managing technical risk can reduce the cost of production

4.8.1 Planning Phase

As mention before, the regression line is to define the relationship between the dependent and independent variable. For this study, the dependent variable is

technical risk while the independent variable in cost of production. In addition, the regression was analyzed according to phases in project life cycle.

In the planning phase, normally the risk is low because the project manager still in progress to identify the risk that they will be facing in project. However, this is the important part for the manager to conduct the team towards success of a project. If they are fail to identify risk that they might be facing they will have problem to meet the project objective. Basically, in planning phase they will provide guidance to the team member to control and avoid the risk.

For this study, there have sixteen (16) of technical risk (independent variable) identify and seven (7) cost affected (dependent variable). Regression model will show the relationship for all of the variables. The table below shows the regression model for the planning phase.

Hypothesis for planning phase is:

Ho: Managing technical risk in planning phase cannot reduce cost of production

H1: Managing technical risk in planning phase can reduce cost of production

Table 4.11: Regression for planning phase

Coefficients[a]

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	1.160	.183		6.324	.000
Planning phase	.127	.055	.252	2.302	.024

Table 4.11 above, it shows the regression between planning phase and cost of production. Table gives us the t tests for the slope and intercept. In multiple regressions we will get individual tests for each predictor. According to the table

above it show the significant value for planning phase is 0.024. The significant value is smaller than 0.05, alpha value. That means it reject null hypothesis and support the hypothesis one. It shows in planning phase manager should manage the technical risk because the technical risk has relationship with cost of production. In simple, managing technical risk can reduce the cost of production in planning phase.

Table 4.12: Model summary for regression in planning phase

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.252[a]	.064	.052	.21967

Model summary will show the value of correlation for planning phase and cost of production. R value is 0.252 and it shows that relationship between technical risk in planning phase and cost of production is strong positive correlation.

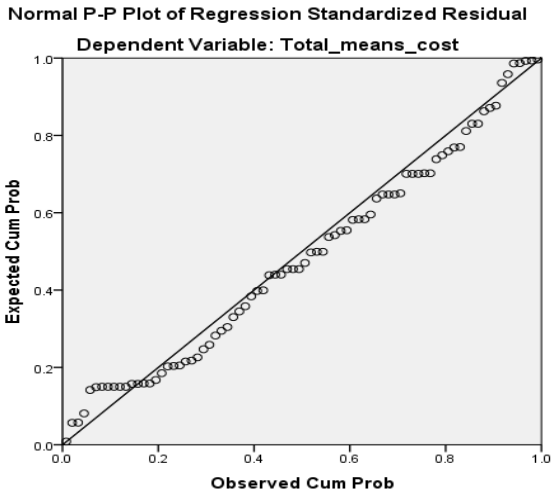


Figure 4.9: Linear regression for technical risk in planning phase

Graph 4.9 above shows the evidence that regression between technical risk in planning phase and cost of production is positive. If the risk increases in planning phase, the cost of production also increases.

4.8.2 Execution Phase

Execution phase is a phase where by the project team will carry out all the work. In other word, the project starts to running after the planning phase. The project execution phase is the second phase in the project life cycle. In this phase, you will build the physical project deliverables and present them to your customer for signoff. The project execution phase is usually the longest phase in the project life cycle and it typically consumes the most energy and the most resources.

According to journal of project management methodology, once a project moves into the Execution Phase, the project team and the necessary resources to carry out the project should be in place and ready to perform project activities. The Project Plan should have been completed and base lined by this time as well. The project team and specifically the Project Manager's focus now shifts from planning the project efforts to participating in, observing, and analyzing the work being done.

Execution phase is the most difficult phase because at this phase the project will face the risk by real. The entire contingency plan to eliminate or avoid risk should be implementing at this phase. Level of risk in this phase is getting increase compare to planning phase. Manager should use all their skill to handle and manage risks that appear in the project when entering this phase.

Same with planning phase, there have sixteen (16) of technical risk (independent variable) identify and seven (7) cost affected (dependent variable). It will show the table of regression model to analyze the relationship for all of the variables. The table below shows the regression model for the execution phase.

Hypothesis for execution phase is:

Ho: Managing technical risk in execution phase cannot reduce cost of production

H1: Managing technical risk in execution phase can reduce cost of production

Table 4.13: Regression for execution phase

Coefficients[a]

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	1.128	.167		6.749	.000
Execution phase	.135	.050	.295	2.722	.008

Table 4.13 shows the regression between technical risk in execution phase and cost of production. As mention, this phase is the most danger phase because the risk discuss will appear directly at this phase. The significant value this phase is 0.008. It also reject null hypothesis since the significant value is less than alpha value, 0.05. When it reject null hypothesis that means there is has relation between costs of production. At this phase, project team should work hard to avoid or eliminate technical risk that has higher probability to appear because it will directly affect towards the cost of production.

Table 4.14: Model summary for regression in execution phase

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.295[a]	.087	.075	.21694

Model summary shows the value of correlation, R and R square. The correlation value shows how strong the relationship between technical risk in

execution phase and cost of production. According table 4.14 above, the correlation, R value is 0.295. That shows the technical risk in execution phase has strong positive relationship with cost of production. The value of R is bigger than other phase and it show in execution phase there is the strongest relationship with dependent variable. In execution phase, if the technical risk increases, the cost of production also increases.

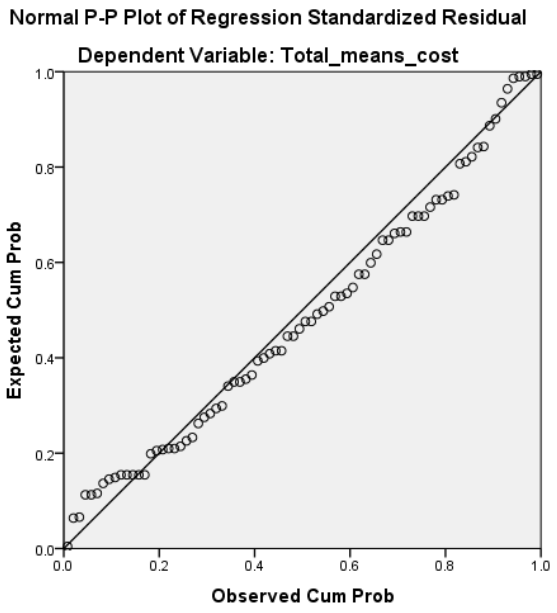


Figure 4.10: Linear regression for technical risk in execution phase

The figure 4.10 above clearly support the statement above that relation between technical risk in execution phase and cost of production is strongly positive. The technical risk in execution phase should be managed well to reduce cost and to avoid from cost overrun in production. When the technical risk increase, the cost of production also increases, the chart has proven of the relation for these variables.

4.8.3 Monitoring Phase

Monitoring phase is the third phase in project life cycle. When entering this phase, the risk for a project going slow. The monitoring phase refers to the manager

and project team work to monitor and control all the risk that happen in the execution phase. This phase also to ensure the plan for minimize or eliminate risk will be work for the project. Besides that, monitoring and controlling phase is about to monitor all key parameters in project such as cost, schedule, risks. If there is something wrong to the project, corrective actions will be applied when needed.

According to websites of best practices in project management, monitoring and controlling process oversees all the tasks and metrics necessary to ensure that the approved and authorized project is within scope, on time, and on budget so that the project proceed with minimal risk. This process involves comparing actual performance with planned performance and taking corrective action to yield the desired outcome when significant differences exist. Monitoring and Controlling process is continuously performed throughout the life of the project.

The independent variable and independent variable still same as the two phase before where there have sixteen (16) of technical risk (independent variable) identify and seven (7) cost affected (dependent variable). It will show the table of regression model to analyze the relationship for all of the variables. The table below shows the regression model for the monitoring phase.

Hypothesis for monitoring phase is:

Ho: Managing technical risk in monitoring phase cannot reduce cost of production

H1: Managing technical risk in monitoring phase can reduce cost of production

Table 4.15: Regression for Monitoring Phase

Coefficients[a]

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	1.286	.138		9.321	.000
Monitoring phase	.094	.044	.237	2.155	.034

Table 4.15 shows the regression between technical risk in monitoring phase and cost of production, dependent variable. This is the third phase in project life cycle that purpose to monitor all the work done and control the risk appear in execution phase. From the table above, significant value for monitoring phase is 0.034. At this phase, it reject null hypothesis and supports the hypothesis one, managing technical risk can reduce the cost of production. When it reject null hypothesis that means there is has relation between costs of production.

Table 4.16: Model summary for regression in monitoring phase

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.237[a]	.056	.044	.22054

Model summary above shows the value of correlation (R) and R square. The correlation value shows how strong the relationship between technical risk in monitoring phase and cost of production. According table 4.16 above, the correlation, R value is 0.237. That shows the technical risk in monitoring phase has strong positive relationship with cost of production. The monitoring phase, it has the lowest value of correlation compare to other phase. The relationship between the

technical risk monitoring phases is the weakest compare to other. However, it still has positive relation between the variables because the value of R is positive.

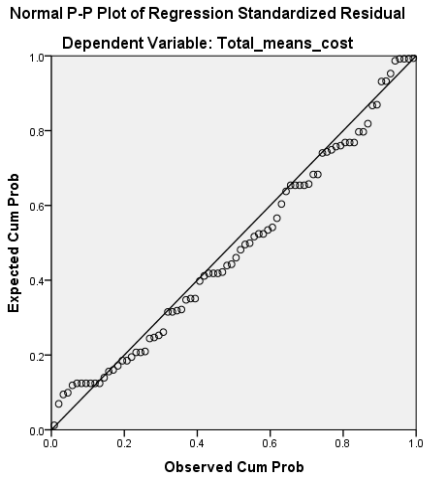


Figure 4.11: Linear regression for technical risk in monitoring phase

Figure 4.11 shows the linear regression between technical risk in monitoring phase and cost of production. It shows that although monitoring phase has weakest relation but the relation still positive. The technical risk in monitoring phase also have relationship between cost of production and have ability to reduce the cost although not strong compare to other phase.

4.8.4 Closing Phase

Last phase in project is closing phase. In this phase the project is almost done. Only certain work like clearance left to be done. The risk at this phase is going slow down not much compare to execution phase. According to website Method 123, the project closure phase is the fourth and last phase in the project life cycle. In this phase, you will formally close your project and then report its overall level of success to your sponsor.

Project Closure involves handing over the deliverables to your customer, passing the documentation to the business, cancelling supplier contracts, releasing staff and equipment, and informing stakeholders of the closure of the project.

After the project has been closed, a Post Implementation Review is completed to determine the projects success and identify the lessons learned.

The Project Closeout Phase is the last phase in the project lifecycle. Closeout begins when the user accepts the project deliverables and the project oversight authority concludes that the project has met the goals established. The major focus of project closeout is administrative closure and logistics (project management guidelines, 2006).

Hypothesis for execution phase is:

Ho: Managing technical risk in closing phase cannot reduce cost of production

H1: Managing technical risk in closing phase can reduce cost of production

Table 4.17: Regression for Closing Phase

Coefficients[a]

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	1.305	.125		10.433	.000
Closing phase	.089	.040	.245	2.227	.029

Table 4.17 shows the regression between technical risk in closing phase and cost of production. Closing phase is the last phase in project where mostly all the work had done at this phase. Normally risk wills go slow for this phase however there are still have the ability of risk to exist, especially technical risk. Referring the

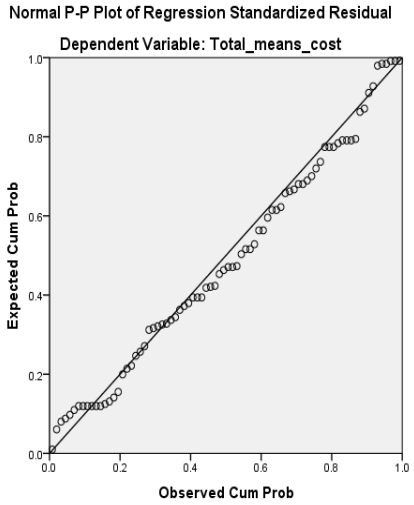
table above, significant value for closing phase is 0.029. At this phase, it also reject null hypothesis because the significant value is less than 0.05. It supports the hypothesis one, managing technical risk can reduce the cost of production. When it reject null hypothesis that means there is has relation between costs of production.

Table 4.18: Model summary for regression in closing phase

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.245[a]	.060	.048	.22012

Model summary above shows the value of correlation (R) and R square. The correlation value shows how strong the relationship between technical risk in closing phase and cost of production. According table 4.18 above, the correlation, R value for technical risk in closing phase and cost of production is 0.245. That shows the technical risk in closing phase has strong positive relationship with cost of production. That means the technical risk have relationship with cost of production. In order to reduce cost, technical risk in closing phase also should be manage.



Graph 4.12: Linear regression for technical risk in closing phase

Figure 4.12 shows the linear regression between technical risk in monitoring phase and cost of production. It is a proven that relationship between technical risk and cost of production is positive. The technical risk in closing phase also have relationship with cost of production and have ability to reduce the cost, same as technical risk in others phases.

4.9 Rank

After all the analysis had done, phase in project that gives effect towards cost of production being rank according the large impact to the lowest impact.

Table 4.19: Ranking for the group

Rank	Phases	Means	Correlation	Regression
1	Execution Phase	3.332	0.295	0.008
2	Planning Phase	3.299	0.252	0.024
3	Closing Phase	3.120	0.245	0.029
4	Monitoring Phase	3.072	0.237	0.034

4.10 Conclusion

There are a lot of technical risks being discussed on this paper. Each phase have their own risk that give effect much on the cost of production. As the conclusion, to ensure the project success, the risk should be eliminated and minimize their effect to the project. In a project there is difficult to cut the cost of project by reducing the material using or used the less quality material. It will work to cut cost but the product does not have quality.

Each phase has the difference technical risk that give high impact towards cost of production. The technical risk in each phase that has high means and low

standard deviation should give more focus because it has the high probability to appear in project and automatically impact to the cost of production.

In regression result, each phase has the relationship with the cost. However the execution phase show the lowest value of regression and higher in correlation. This phase should give more focus in order to reduce the cost of production in project. Then, for monitoring phase, it was the phase that gives low impact towards reducing cost because it has low value of correlation and high value for regression.

For the correlation of each phase, the correlation show how strong the independent variables relate to the dependent variable. There will have three (3) types of correlation, strong positive correlation, strong negative correlation and zero correlation. In production of a project, there is very possible to get zero correlation. Zero correlation means that if one thing happens, it has no bearing on whether something else happens. Then for negative correlation, if one thing happens, then something else definitely does not happen. Lastly for positive correlation, a positive correlation is if one thing happens, then something else is going to happen.

In summary a strong correlation indicates how likely something is to happen, a strong correlation means something is very likely to happen, or the occurrence of two things are greatly related. Hence, a weak correlation suggest that two things are not really related and if one thing happens it do not have much effect on a second thing happening. According to investopedia website, a relationship between two variables in which both variables move in tandem. A positive correlation exists when as one variable decreases, the other variable also decreases and vice versa.

As the conclusion, in order to reduce the cost of production in a project, manager should give more focus on the strong positive correlation. The reason is when the technical risk appears in the production process of project the probability to have impact on the cost of production also high.

Chapter 5

Conclusion

5.1 Introduction

This chapter highlights the implications and conclusion of the research undertaking to answer the two stated objective in chapter 1, to identify technical risk in production and to investigate the impact of cost towards managing technical risk. The findings of this research have specific implications towards the industry in reducing the cost. This is followed by discussion on the limitation of the present research, taking into consideration the research process and structure that should be considered in any future research endeavor. Finally, these chapters present some recommendations for further research in the effective organizational communication.

The first objective is to identify technical risk in production. From this research, the technical risk had been identify than it been analyze according to four phase of project in project life cycle. The risk that been identify and prioritize according to the high probability to appear in the production. The method used for answering the objective one is using value of mean. Those has higher value of mean has highest probability to appear in project.

For planning phase, the technical risk that been identify have highest probability to appear are operation risk, communication failure and machinery problem. Then for the execution phase, wrong in cost estimation, scope change and technical requirement are the technical risk might appear in this phase. for monitoring phase the technical risk been identify are environmental risk, communication failure and machinery problem. Lastly for closing phase technical risk that might appear are environmental risk, wrong in resources estimation and engineering problem.

For objective two, the result been obtain by using regression and correlation. It is based on hypothesis testing. Thus reject null hypothesis show that the independent variable have a relationship with the dependent variable. For this study, the result had been obtain through phase of project, the most high correlation and lower regression is the most affected to the cost of production. In this study the result shown that the most affected is execution phase. technical risk in execution phase will give high impact to the cost of production in project, then followed by planning phase, closing phase and monitoring phase.

5.2 Implication

Cost for a project being the major topic that need to be discussed nowadays. Living cost for a person nowadays being increase rapidly and same goes with the material used for a project. The improvement of our built environment was contributed by the construction projects that are mostly making the national headlines being financial disasters, rather than significant engineering achievements.A research conducted by the government in the middle of 1990s, shows that more than one quarter of construction project schemes complete over their capital cost limit (HM Treasury, 1995). Based on the research, a survey about

the construction industry clients was conducted the result to the survey shown nearly one third complained that their projects commonly overran budget (Barrick, 1995).

According the phase above, it show that the important of having good cost management towards a project. This research was focusing on production area where by to reduce cost. This research was look at the small area of a project to see whether it help to reduce the cost or not. Cost management is important to be managing to ensure the success of a project. Besides that, it also helps in build company reputation. In project management field, the reputation is most important thing to allow survival in industry and provide company a new competitive advantage to compete with the other company.

The British Standard for project management BS60794 1996 defined project management as a motivation to the entire of project team with purpose to achieve the project objectives on time and to the specified cost, quality and performance. Hence the project management also discuss about planning, monitoring and control of all aspects of a project. According to Attinson (1999) cost, time and quality as the success criteria bundled into the description. The researcher has filtered the success criteria to become more specific through taking customers view. Mostly customer had suggests only two parameters that are too important in ensuring project success which are time and budget. Besides that, mostly of the writers about project agreed that cost, time and quality should be used as success criteria, but not exclusively. Temporary criteria are available during the delivery stage to gauge whether the project is going to plan. These temporary criteria measurements can be considered to be measuring the progress to date, a type of measurement which is usually carried out as a method of control. In the citation above it clearly show that cost is the most important thing to be managing to ensure the project success.Besides focusing on cost, this carried out research also focus to the technical risk. By managing technical risk, it can reduce the cost of production in a project. The risks that appear in the project can affect the cost directly and will result in cost overrun. The success

parameters to measure the successful of projects are on ability to complete all task on time, within specific budget and with requisite performance (technical requirement). The main barriers to achieve success are the changes in the project environment (Chapman 2006). The problem multiplies with the size of the project as uncertainties in project outcome increase with size (Zayed et al. 2008). Based on case study of oil refinery construction projects, the project are exposed to uncertain environment because of such factors as planning and design complexity, presence of various interest groups, resource unavailability, climatic environment, the economic and political environment and statutory regulations (Dey and Ramcharan 2008). Other risk factors include the complexity of the project, the speed of its construction, the location of the project and its degree of unfamiliarity.

This study had been done with the data analyze and the result are shown in the chapter 4. The study focused on to reduce the cost without decrease the project quality. Based on the increasing of material price, company that involved in project can use this study as their reference to reduce the cost of production with the same price of material. This will become the competitive advantages to a company that start to practice technical risk management. Technical risk management not involved too much cost because normally the risk was come through fault of the employee while doing the project. This study shows that by managing it cost of production can be reduced.

The implication of the finding towards the industry is the most affect to cost is technical risk in execution phase. In this phase, risk normally can give direct impact to the project. Perry and Hayes have identified some risks sources central project activities. The risks are consisting of physical risk, environmental risk, design risk, logistics risk, financial risk, legal risk, political risk, construction risk and operation risks. All the risks that identified have probability to give effect to the product deliverable, performance, cost, time and quality.

In ensure the success in a project, company should give more attention to manage technical risk during the execution phase. Project team must work hard to eliminate or minimize the impact of the technical risk during this phase. Failure to ensure the technical risk managed well will result in cost overrun in project. The second phase that has impact to the cost is planning phase. Both of these phases can help much to help company in reducing cost of production.

Last but not least, those companies that do not manage technical risk in the project will not able to reduce cost without decrease the project quality. It is very possible to do that since mostly material price is almost same in same quality. Company can use this study as their guide in getting their competitive advantage to compete with the other companies in same type of industry.

5.3 Limitation

Although the findings of this study appear to support the general conceptual of technical risk and cost of production, it is imperative to recognize its limitation and therefore the results should be interpreted with a proper degree of caution. First, when respondents with different demographic are included in the sample, the outcome could be biased. Their response may be considered unreliable because they have their own opinion and perception about effective communication in their organization. Biased responses resulted in biased assessment when relating predictors and criterion variables using regression analysis.

Besides that, while the data been collected through using questionnaire, the respondents will not answer it correctly because they make play with the questionnaire. It will result in some error to the answers of questionnaire. The most obvious error in the finding is average error. Some of the respondents answer the questionnaire with moderate answer. It is difficult to get the accurate result. Then, there have some respondents that did not complete answering the questionnaire.

Upon applying the results of this study, it should be focus that the field of survey for this study was carried out at PETRONAS, Kerteh. Staffs in the company may be having different opinion and perception about technical risk in their company. Similar samples could be obtained from other departments to represent the staff's population in the company. However I just only focus to one department only. So, my questionnaire form being distributed to Gas Processing Plant staffs only. I choose randomly eighty staffs that included manager, engineer, contractor and staff to be my respondents. Although the findings may appropriately be generalized for other determination, it should be remembered that the samples consist solely of Gas Processing Plant, PETRONAS.

5.4 Recommendation

This research is about reducing cost of production through managing technical risk in project. This research is adapted through a case study from Goerge Washington University with is Chunnel Project. The project is about to develop an underground tunnel to connect between England and France. This is the largest project that been taken by privately funded construction. It required the cooperation of two national governments, bankers underwriting the funding for the project, a lot of contractor and regulatory agencies. In this project, new technology has been used in this project construction and engineering. However, some changes or modification required during the project running due to unexpected conditions by various parties. The small changes or modification will directly affect the cost of project.

The scope for this study is limited to the Gas Processing Plant, PETRONAS at Kerteh staffs only. This is because constraints of time would have increased if others departments had been included and there too much department in this company. As the recommendation, future research should therefore investigate the viability of models in other department at PETRONAS Company. Similarly, for this

study, there is only one company was focusing to complete the study. in the future research, it can included two or more company with purpose to compare the result in between the company under study. The result for comparing the company can be more useful in future.

In this study, there is focusing on the four phases of the project. each phase have same type of technical risk which is Scope change Communication failure, Machinery problem, Not clear scope, Incompetence worker, Less quality material, Engineering problem, Design error, Stakeholder influence, Technical requirement, Wrong in resources estimation, Wrong in cost estimation, Physical risk, Environmental risk and Operation risk as possible predictors to determine the relationship with dependent variable, cost of production. The predictors for cost of production in this study are redesign cost, training cost, maintenance cost, delay and penalty, over budget and insurance coverage. The present study used correlation to determine the relationship between all predictors and variable. Future research may include more measurement as above to represent measurements components in the communication model.

R-squared is use as a statistical measure of how close the data are to the fitted regression line. It is also known as the coefficient of determination, or the coefficient of multiple determinations for multiple regressions. By referring value of R-square, the smallest value in linear regression is between closing phase and the cost of production. The value of R-square should be improved in future study to get more accurate result in research. However, the r-square for execution phase and cost of production is 0.87. This show the data is almost accurate. The other data should be improve because the large value of R-square show given a set of data points, linear regression gives a formula for the line most closely matching those points. It also gives an R-Squared value to say how well the resulting line matches the original data points.

For future study, this study also can become a guide to add on any incomplete data to be analyzed. All the recommendation can help in getting the accurate data about the technical risk and cost of production. In addition, future research also should embark on longitudinal and cross- sectional study. Longitudinal studies may help us to investigate the endurance of the model. More importantly, it may enable a clearer exposition of cause and effect relationship.

5.5 Conclusion

As the conclusion for this study, the technical risk that should be given more attention is managing technical risk in the execution phase. At this phase it show the largest mean value that mean the technical risk have high potential to appear at that phase. Logically, the existence of technical risk will appear because at that phase the project team had carry out the work to start the production. In make the project success execution phase should run with focus to eliminate the technical risk.

The research objective for this study is to study the effect of technical risk towards reducing cost of production. According to the result of regression and correlation for the data analyzed, four phases of the project had rejected null hypothesis. That means there have relationship between the managing technical risk in project and cost of production. This study proven that by managing technical risk in project can help to reduce the cost of production.

Besides that, in correlation the value for all four phases of project with cost of production show that there have strong positive correlation. The execution phase show the largest value that means the execution phase will have large impact towards reducing cost of production if the technical risks appear at that phase. The second higher is planning phase than followed by closing and monitoring phase.

This chapter is discussing about the implication of study, limitation for study and recommendation for future research. The findings of this research have specific

implications on industry. Perhaps, it also discuss about the recommendation for future thesis. All of this information is important because it can create better thesis in the future.

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APPENDIX A

Questionnaire

Dear Sir / Madam,

First and foremost, thank you for taking part in this survey. The present study is proposed to determine effect of managing technical towards reducing cost of production in project. I really like you to contribute in this survey because your opinion is important for me to collect and do the data analysis.

For your information, this is purely an academic study undertaken to fulfill the partial requirement for the Bachelor in Project Management at University 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 rights or wrong answer. Your response will be treated with the highest confidentiality and will be used only for the purpose of academic research.

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: Mohd Amerul Amin bin Razali

Matrix No. : PB10027

Contact No. : 014-8448352

Email: amienrazali26@gmail.com

SECTION A: Respondent Personal information

Answer all questions. Kindly tick whichever particular is applicable.

1. Gender male ☐ female ☐

2. Age 30 and below ☐ 31-40 ☐

41-50 ☐ 51 and above ☐

3. Position in company: Manager ☐ Engineer ☐

Contractor ☐ staff ☐

Others: ……

SECTION B: Identifying technical risk in production process.

Answer all questions.

1. What methods are used in identification technical risk in company?
   You can choose more than one answer.

Brainstorming	( )
Delphi Technique	( )
Work Breakdown Structure Analysis	( )
Checklist	( )
Risk Matrice	( )
Process Flowchart	( )
Lessons Learn	( )
Expert Judgement	( )
Others: ……..	( )

- For **question 2a until 2d**, by using the following scale, please answer each of the following statement by **circling the appropriate number** to indicate the extent to which high probability or low probability.

  1 = highly unlikely
  2 = unlikely
  4 = possible
  4 = moderate possible
  5 = highly probable

2. Rank the technical risk according probability to appear in project based on phases.

a) **Planning phase**

Technical risk	Rank				
Scope change	1	2	3	4	5
Communication failure	1	2	3	4	5
Machinery problem	1	2	3	4	5
Not clear scope	1	2	3	4	5
Incompetence worker	1	2	3	4	5
Less quality material	1	2	3	4	5
Engineering problem	1	2	3	4	5
Design error	1	2	3	4	5
Stakeholder influence	1	2	3	4	5
Technical requirement	1	2	3	4	5
Wrong in resources estimation	1	2	3	4	5
Wrong in cost estimation	1	2	3	4	5
Physical risk	1	2	3	4	5
Environmental risk	1	2	3	4	5
Operation risk	1	2	3	4	5
Other technical risk:	1	2	3	4	5

b) Execution phase

Technical risk	Rank				
Scope change	1	2	3	4	5
Communication failure	1	2	3	4	5
Machinery problem	1	2	3	4	5
Not clear scope	1	2	3	4	5
Incompetence worker	1	2	3	4	5
Less quality material	1	2	3	4	5
Engineering problem	1	2	3	4	5
Design error	1	2	3	4	5
Stakeholder influence	1	2	3	4	5
Technical requirement	1	2	3	4	5
Wrong in resources estimation	1	2	3	4	5
Wrong in cost estimation	1	2	3	4	5
Physical risk	1	2	3	4	5
Environmental risk	1	2	3	4	5
Operation risk	1	2	3	4	5
Other technical risk:	1	2	3	4	5

c) Monitoring phase

Technical risk	Rank				
Scope change	1	2	3	4	5
Communication failure	1	2	3	4	5
Machinery problem	1	2	3	4	5
Not clear scope	1	2	3	4	5
Incompetence worker	1	2	3	4	5
Less quality material	1	2	3	4	5
Engineering problem	1	2	3	4	5
Design error	1	2	3	4	5
Stakeholder influence	1	2	3	4	5
Technical requirement	1	2	3	4	5
Wrong in resources estimation	1	2	3	4	5
Wrong in cost estimation	1	2	3	4	5
Physical risk	1	2	3	4	5
Environmental risk	1	2	3	4	5
Operation risk	1	2	3	4	5
Other technical risk:	1	2	3	4	5

d) Closing phase

Technical risk	Rank				
Scope change	1	2	3	4	5
Communication failure	1	2	3	4	5
Machinery problem	1	2	3	4	5
Not clear scope	1	2	3	4	5
Incompetence worker	1	2	3	4	5
Less quality material	1	2	3	4	5
Engineering problem	1	2	3	4	5
Design error	1	2	3	4	5
Stakeholder influence	1	2	3	4	5
Technical requirement	1	2	3	4	5
Wrong in resources estimation	1	2	3	4	5
Wrong in cost estimation	1	2	3	4	5
Physical risk	1	2	3	4	5
Environmental risk	1	2	3	4	5
Operation risk	1	2	3	4	5
Other technical risk:	1	2	3	4	5

SECTION C: effect of technical risk towards cost of production

- For **question 1**, by using the following scale, please answer each of the following statement by **circling the appropriate number** to indicate the extent to which high probability or low probability.

  1 = highly unlikely
  2 = unlikely
  3 = possible
  4 = moderate possible
  5 = highly probable

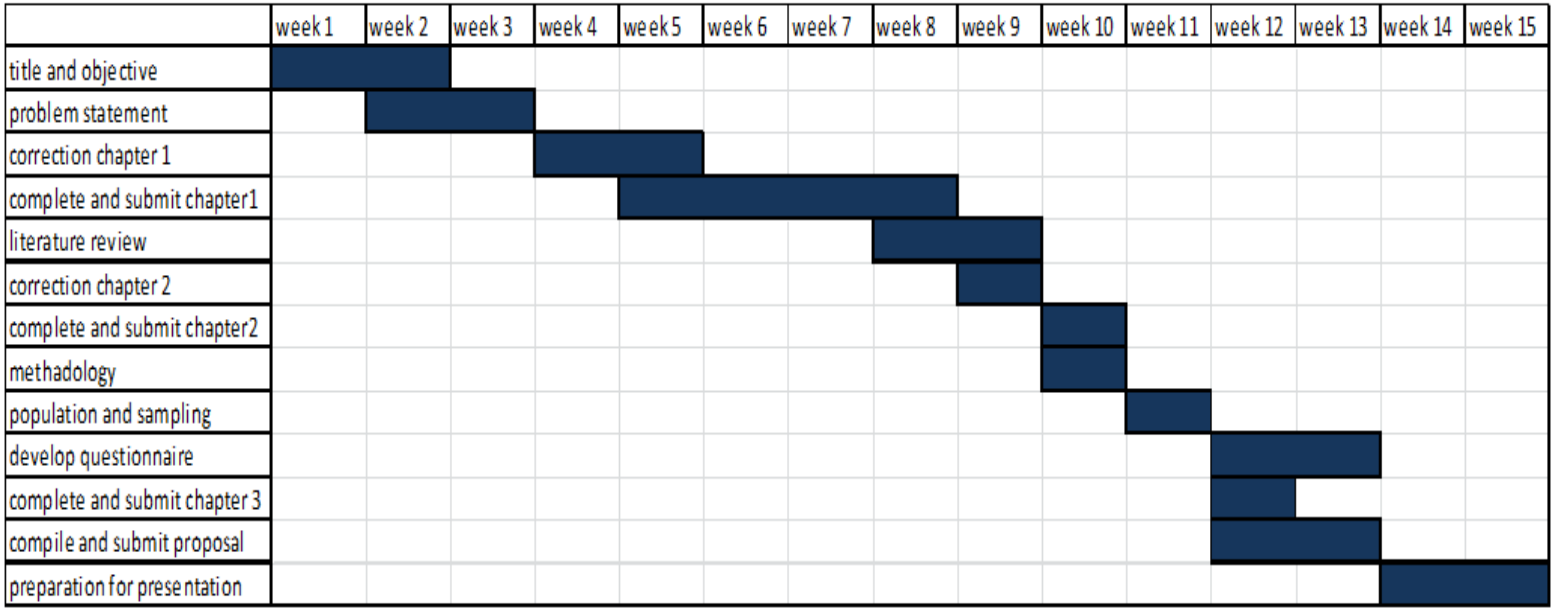
1. Does the technical risk affect in cost of production?

Effect towards cost of production	**Rank**				
Redesign Cost	1	2	3	4	5
Training cost	1	2	3	4	5
Maintenance cost	1	2	3	4	5
Delay and Penalty	1	2	3	4	5
Overbudget	1	2	3	4	5
Insurance Coverage	1	2	3	4	5
Other cost incurred :	1	2	3	4	5

THANK YOU FOR YOUR COOPERATION

APPENDIX B

GANTT CHART FYP 1



APPENDIX C

GANTT CHART FYP 2