ASSESSMENT OF CONSTRUCTION PLANNING:

MAINTENANCE OF PIPING SYSTEM AT BUKIT SEKILAU KUANTAN CASE STUDY

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ABSTRAK

Sektor pembinaan adalah sektor yang sangat penting dan produktif dalam ekonomi Malaysia. Sesebuah projek dianggap berjaya jika dapat disempurnakan dengan kos yang telah dianggarkan, dalam tempoh masa yang dijadualkan dan mengikut spesifikasi kualiti yang ditetapkan. Namun begitu, terdapat juga kontraktor yang gagal untuk siapakan projek dalam tempoh masa yang dijadualkan. Ada kemungkin keadaan ini boleh dikaitkan dengan tempoh masa yang ditetapkan tidak sesuai. Objektif utama kajian ini adalah perancangan pembinaan untuk menyelenggara sistem perpaipan di Bukit Sekilau Kuantan. Perancangan jadual sedia ada telah dianalisis untuk mengenal pasti faktor yang menyebabkan berlaku kelewatan dalam projek. Setelah mengenalpasti faktor yang mempengaruhi kelewatan projek ini, perancangan semula telah dibuat dengan mempertimbangkan faktor jumlah hari hujan, jumlah hari cuti umum dan juga jumlah hari yang diperlukan bagi mendapatkan kelulusan permit dari pihak yang terbabit. Oleh yang demikian, perancangan optimum dapat dicapai dan projek tersebut dapat disiapkan mengikut masa, kos, kualiti yang ditetapkan dan operasi dapat dlaksana selaras dengan perancangan. Setelah memperolehi hari bekerja yang optimum dalam perancangan pembinaan, cadangan-cadangan tertentu boleh dibuat untuk memperbaiki serta menambah baik perancangan pembinaan dan boleh menjadi garis panduan untuk perancangan pembinaan pada masa akan datang.

ABSTRACT

Construction sector is a very important and productive sector in the Malaysian economy. A project is considered successful if it can be completed at an estimated cost, within a scheduled period and in accordance with specified quality specifications. However, there are also contractors failing to complete the project within a scheduled period. There is a possibility that this situation can be caused by the time set is less precise. The main objective of this study is construction planning to maintain the piping system in Bukit Sekilau, Kuantan. Existing schedule planning has been analyzed to identify factors that cause delays in the project. After identifying the factors affecting the delay of the project, reschedules planning were made taking into account the number of days of rain, the number of public holidays and the number of days required to obtain approval from the parties concerned. Therefore, optimum planning can be achieved and the project can be completed on time, cost, quality and operations can be implemented in line with the plan. After obtaining optimum working days in construction planning, certain recommendations can be made in order to improve construction planning and can be the guideline for future construction planning.

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LIST OF ABBREVIATIONS

GDP	Gross Domestic
MP	Malaysia Plan
RM	Ringgit Malaysia
JKR	Jabatan Kerja Raya
TNB	Tenaga Nasional Berhad
LPT	Lebuhraya Pantai Timur
PLC	Project Life Cycle
PMP	Project Management Plan
P-I	Probability-Impact
KUP	Koridor Utiliti Pahang
NCR	Non-Compliance Construction Repairs
EOT	Extension of Time
CPM	Critical Path Method

CHAPTER 1

INTRODUCTION

1.1 Introduction

The construction sector is a very important and productive sector of the Malaysian economy. As a developing nation Malaysia has realized the pivotal role of the construction sector not only in economic growth but also in improving the quality of life and living standards of Malaysian people. Over the last two decades it has been contributing between 3 to 5 per cent of the aggregate economy gross domestic product (GDP). The construction boom in Malaysia began in early 1990s, just after the launch of Vision 2020. Today Malaysian construction industry continues to grow significantly in the domestic as well as international market. Malaysia recognized the importance of the construction sector since its independence in 1957 when the industry was low-tech, labour intensive crafts-based industry (Kamal, 2012).

Figure 1.1 The growth of GDP from year 2014-2017

However based on Malaysia Planning (MP), there are many project delay happened during 9th MP – 11th MP. All causes of this delay will cause problems such as loss in terms of cost and also loss of use of such facilities. The examples of intended facilities are hospitals or schools. The period of use of this facility should be completed within the prescribed period and may be used by the user. But due to delay, the user cannot use the facility and the parties concerned will incur additional costs. In a construction project, completion on time is extremely important because time is essential and time is money. Although timely completion is seen as one of the important criteria of the project success, late completion is a common problem in construction projects not only in Malaysia but worldwide. The major consideration and most important parameters for measuring the successful of the project are having the greatest effect on time, cost, and quality.

There are many government projects that are abandoned and cannot be completed according to schedule, plans and programs have to be postponed and disadvantaged many parties. Various efforts and initiatives have been made by the government for ensuring that contractors who get the project can complete according to set time. Government through various government machineries has given motivation to contractors to improve work quality besides increase their skills and competitiveness especially to compete with numbers increasingly contractor every year. However, there are still delay happened in construction project. Delays happen in most construction projects, whether simple or complex. Construction delay could be defined as the time overrun either beyond the contract date or beyond the date that the parties agreed upon for delivery of a project.

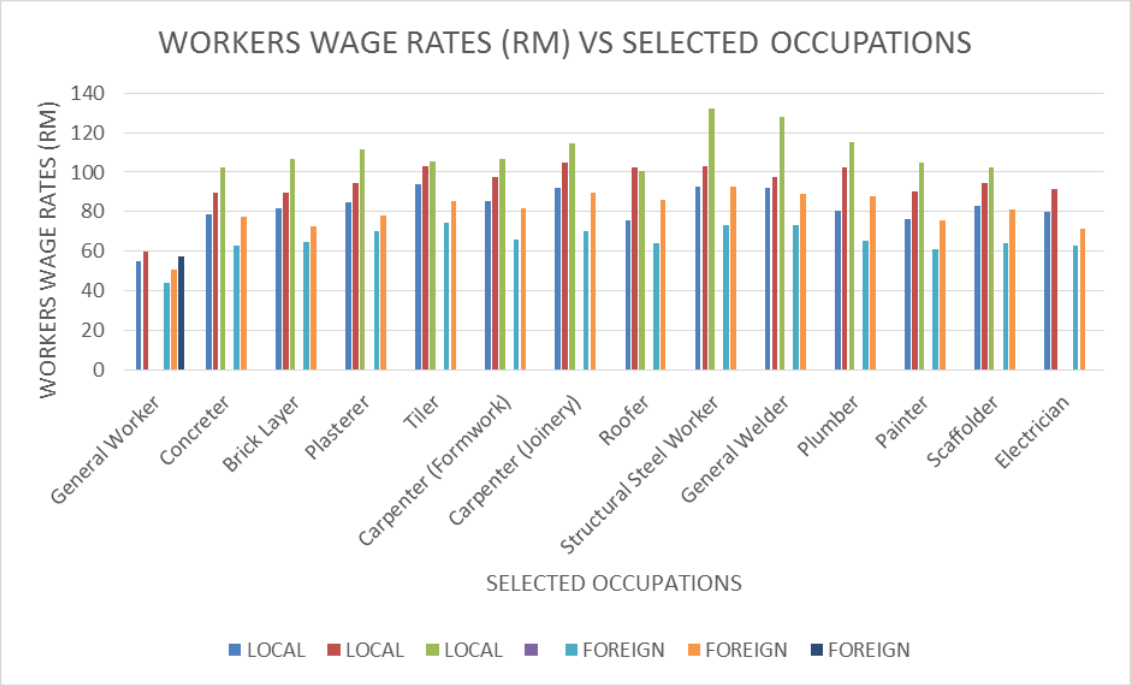


Figure 1.2 Workers wage rates (RM) vs. selected occupations

Figure above shows the workers wage rates based on types of occupations. Manpower shortage was ranked third most important delay cause from the viewpoint of the contractor. Manpower shortage, skilled, semi-skilled, and unskilled, has been a serious delay cause for residential construction projects in Malaysia. Recently, the Malaysia has been experiencing a boom in construction due to wars as well as the high prices of oil resulting in access liquidity and thus a higher demand for investment opportunities. The Malaysian residential construction boom has been accompanied by shortages in foreign manpower leading to higher wages and thus adding to the financial burden on the contractor. This explains the contractor's reliance on cheap, unskilled labor. Additionally, this fact is very revealing in that it ties with the high ranks given by the consultant and the owner to ''Poor planning and scheduling of the project by the contractor'' and ''Incompetent technical staff assigned to the project'' respectively

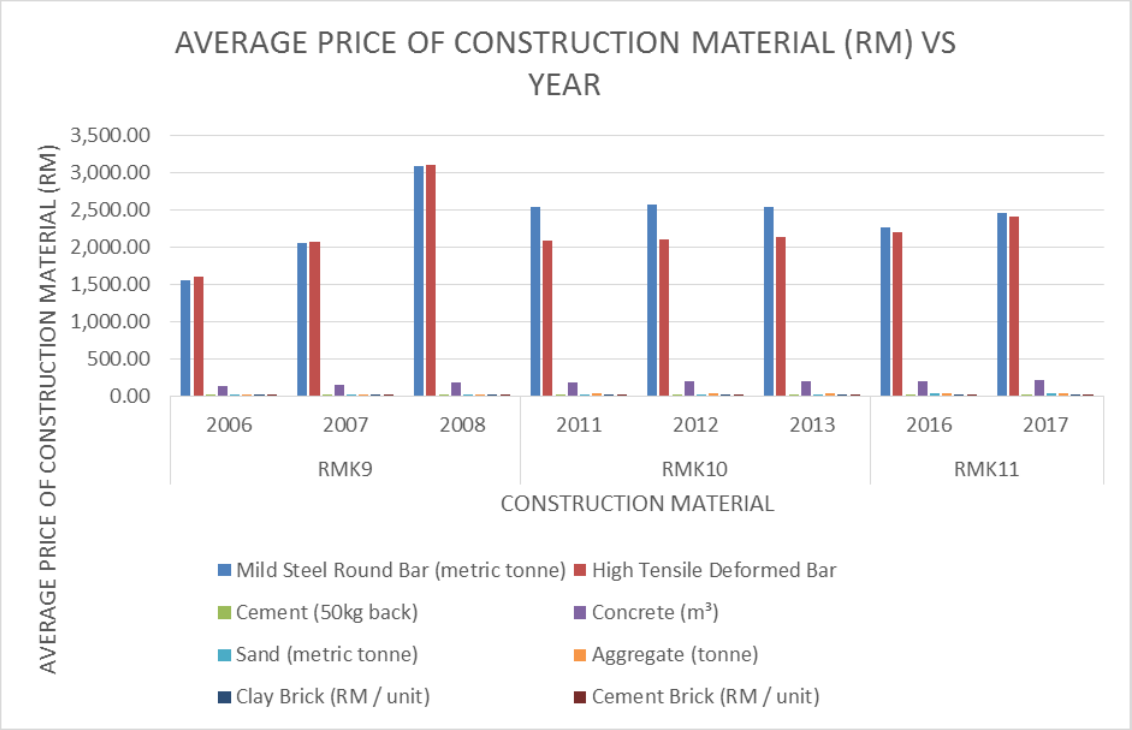


Figure 1.3 Average Price of Construction Material (RM) vs. Construction Materials

Figure above shows the relationship between the average prices of construction material and construction materials. Management of building materials is a system of planning and planning control which is required to ensure the quality and quantity of building materials and equipment are appropriate, timely, and cost-effective and can be obtained within the desired time. It works as a elements to achieve an optimum level of achievement in the use of materials construction and types of materials that are appropriate to use. It's also great relates to the quality, cost and duration of the contract. Overall, management of building materials is a management system practiced for ensuring every successful construction project with great benefits and thus satisfying the customers. But as shown in figure 1.3, there is an increase of construction material price. Thus, it had caused problems for construction industry. For example, the construction of the highway connecting Kuantan, Pahang to Gemuroh, Terengganu (LPT 2) was supposed to be completed in late March 2009 and cost RM2.09 billion. The factors that contribute to higher costs and extending the time of completion is because of the rise in price of building material.

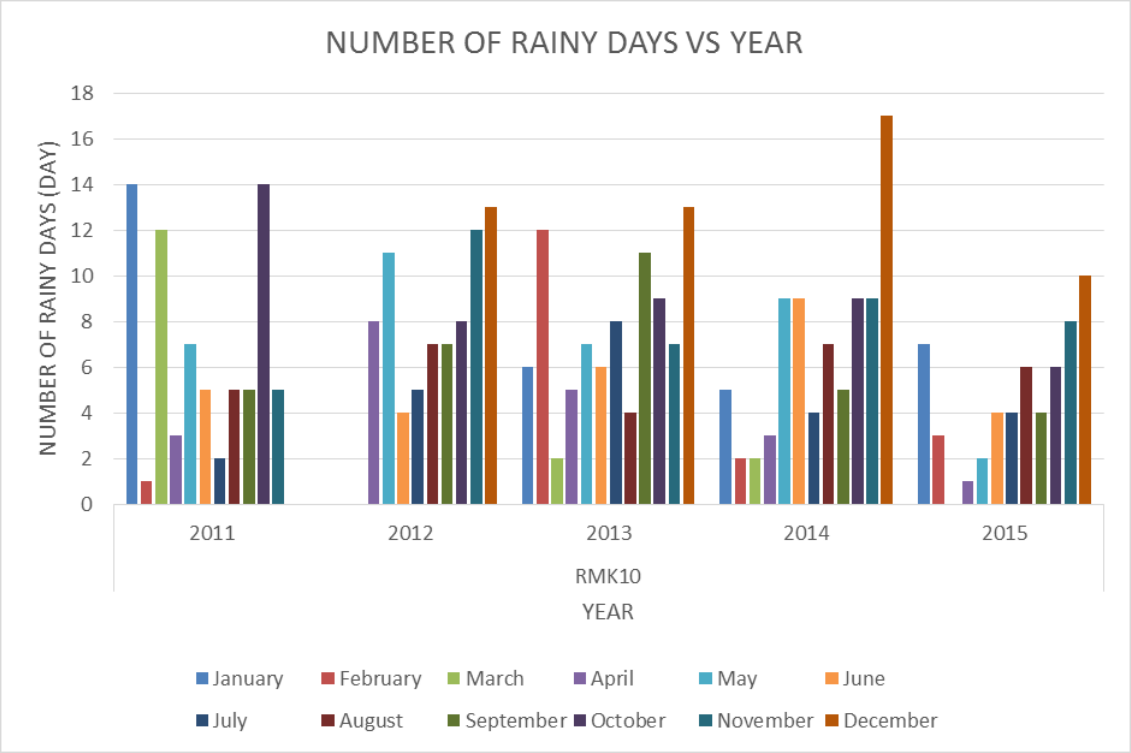


Figure 1.4 Number of Rainy Days vs. Year

Managing bad weather is one of the most difficult, yet important aspects of good civil construction practices. Properly handling the effect of bad weather on construction project is the key to protect worker safety, complete the project on exact time and on budget and most importantly ensuring the quality of the project is not compromised. Generally speaking, there is a shared sense that weather condition is some of contributors to residential construction delays in Malaysia. Based on the figure below, we can see that the numbers of rainy days in Malaysia are quite high. So in doing construction planning, we need to consider the rainy days to avoid from delay.

On top of that, the other reasons that can cause project delay are government regulations and laws. In order to start a project in certain area, the contractor must get the permit approval from the parties concerned such as Jabatan Kerja Raya (JKR), Tenaga Nasional Berhad (TNB) or TELEKOM. Before requesting for permit, contractor must identify the location of the project because it might affect the time taken to obtain the permit. The area of location can be divide into two types which is Greenfield area and Brownfield area. Greenfield area is a land that undeveloped in rural or in city area. These areas are usually agricultural or amenity properties that will be considered for future development. Besides, Brownfield area is lands that have been

used previously or have been built before. It is usually occupied with existing building or any structure before getting demolished or renovated.

As for this project is about to maintaining piping system at Bukit Sekilau area, contractor still need to apply for permit before start the maintenance process as it is located at Kuantan City which is also known as Brownfield area. Brownfield area usually will facing problem as it often encounter difficulties in carrying out the maintenance process due to interruption to obtain approval from certain parties take a long time. This condition is due to the Brownfield area having a lot of existing structure and building belonging to different parties. So, the contractor needs to apply for each existing structure. This led to the process of obtaining permit approval taking a while. Hence, the project will also be affected because of this and cause project delay.

1.2 Problem Statement

Planning and scheduling techniques are indispensable in delivering successful projects. Successful projects also are tied with profit making and in consequence survival in the construction industry. Unfortunately, planning and scheduling can be very difficult, arduous and time-consuming. The planning obviously requires competent and experienced personnel (Illingworth, 2000). Unfortunately, the emerging trends suggest a skill shortage in the area of construction planning (Heesom and Mahdjoubi, 2004).

The objective of this research is to improve the planning and scheduling process by determining the factors that might contribute in construction project. So, before producing the schedule planning, all the related factors must be considered. Hence, optimum planning can be produced.

Therefore, this research is carried out to produce optimum planning in construction by identifying the factors that can affect the planning and scheduling of construction work progress.

1.3 Objective

The study was focused on assessment of construction planning of new project. In order to ensure the objectives are achieved, other objectives were created as a guideline to complete the studies. The objectives of the studies are:

a) To establish the effective number of days in construction planning

b) To identify effective day to deal with government regulations and laws at construction site.

c) To produce an effective planning in construction project.

1.4 Scope of Study

In order to achieve the objectives for this study, the scope of the study were focusing on:

a) The study was focused about maintenance of piping system at Bukit Sekilau project.

b) The study was focused on establishing the effective planning in construction considering the important factor which is number of rainy days and public holidays.

c) The study was carried out by dealing with the government regulations and laws that might occur at construction site.

d) The study was carried out by comparing the existing planning of maintenance of piping system at Bukit Sekilau project with the new planning and obtaining the more optimist work execution.

1.5 Significant Of Study

Based on the other research and the related issues, the major aim of this research is to establish a system which will help to enhance the performance of building construction projects in developing countries and also the performance in any maintenance or renovation projects without cost and time exceeding the initial plan while achieving optimal quality. In order to achieve the optimal project, the contractor must considering the risk that may occur to produce the good quality product that meets the client's expectation and satisfaction.

In getting an effective number of days in making construction planning is by considering two factors which are the weather and the unknown risk that might happen in the construction site. Bad weather is the most difficult to handle, yet important aspects of good civil construction practices. Properly handling the effect of bad weather on construction project is important in order to complete the project on exact time and on budget and most importantly ensuring the quality of the project is not compromised.

Besides, it is also important to identify the unknown risk that might happen at the construction site. As in this project, the maintenance of piping is located at brownfield area. So the unknown risk is to identify the existing structure or building because usually the in drawing planning does not state the exact existing structure which is there. Brownfield area usually will facing problem as it often encounter difficulties in carrying out the maintenance process due to interruption to obtain approval from certain parties take a long time. This condition is due to the brownfield area having a lot of existing structure and building belonging to different parties. So, the contractor needs to apply for each existing structure. This led to the process of obtaining permit approval taking a while. Hence, the project will also be affected because of this and cause project delay. From the interviews, case-studies and an analysis of hypothetical development situations, it has been found that brownfield redevelopment is less cost-effective and causes greater risks than Greenfield development.

It is essential to make sure any progress of project follow the construction planning schedule as to produce the good quality product that meets the client's expectation and satisfaction. In conclusion, it is also important to produce an effective

construction planning by considering all the related factors to ensure the project is successfully completed.

1.6 Thesis Structure

This research comprises of five chapters. The first chapter consists of introduction section. It stated the background, problem statements, and objectives of study, scope of study and lastly the significant of study. For chapter two, the key terms in purpose for this research are described and also the literature review that related with this research. Chapter three, explained the research methodology for research data collected and the, method of data analysis t be employed. For chapter four, the results obtained from the study area and year of study were presented and the analysis from the result was discussed. Last but not least, chapter five comprised the conclusion from the overall chapter and some related recommendations for future work on research field.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In today's world of globalization, the construction industry plays an important and integral role to enhance the nation's competitiveness. Malaysian Government has moved forward under the 10th Malaysia Plan (2011-2015), which has been formulated with various new approaches towards becoming a high income and high productivity economy. As Malaysia moves from developing country status towards a developed and industrialized nation as envisaged in Vision 2020, her construction industry needs to respond to the changes in construction demand. This has resulted in rapid implementation of several large-scale infrastructure and building projects. However, Malaysian construction industry also faced many problems which affect this industry in terms of manpower, quality of productivity, time, payment issues especially during the closing of final accounts in the construction projects and the unknown risk that might happen during the construction site

Delay gives rise to disruption of work and loss of productivity, late completion of project, increased time related cost, third party claims and abandonment or termination of contract. In many cases, construction projects suffer from delay will cause suspension, which means stoppage of works directed to the contractor by a formal form from the client. However, delay when slowing down of work does not mean entire stop to the project. There are many causes, which must be identified in order to control delay in the early stages of the project. Delay could be a result of low performance of contractor during construction, inadequacies or defaults in early planning and design, poor owner administration and involvement in construction, problem in supervision, restriction in government laws and regulations or obstructions at the site.

2.2 Project Life Cycle

The use of life cycles in project management is not a new concept to most project managers. Much has been written on the use of life cycle analysis and its impact on project management. Life cycles have been used to explain the impact of a variety of behavioural issues on the project organization. For example, studies have examined propensity toward conflict and effective conflict management styles at different phases in the life cycle. Other research has argued that leadership styles of the project manager must change at different phases in the project life cycle, These and other authors have presented a strong case for the inclusion of the project life cycle phase into investigations of the dynamics of the project implementation process.

In 2011,(Larson and Gray, 2011) illustrated four stages of the project life cycle which includes:

- Defining stage
- Planning stage
- Executing stage
- Closing stage

Larson and Gray merged the monitoring and controlling stage with the executing stage. Whereas, (PMBOK, 2004) and (OIT, 2005) separated them and presented the project lifecycle in five major stages:

- Initiation
- Planning and design
- Execution
- Monitoring and controlling
- Closing

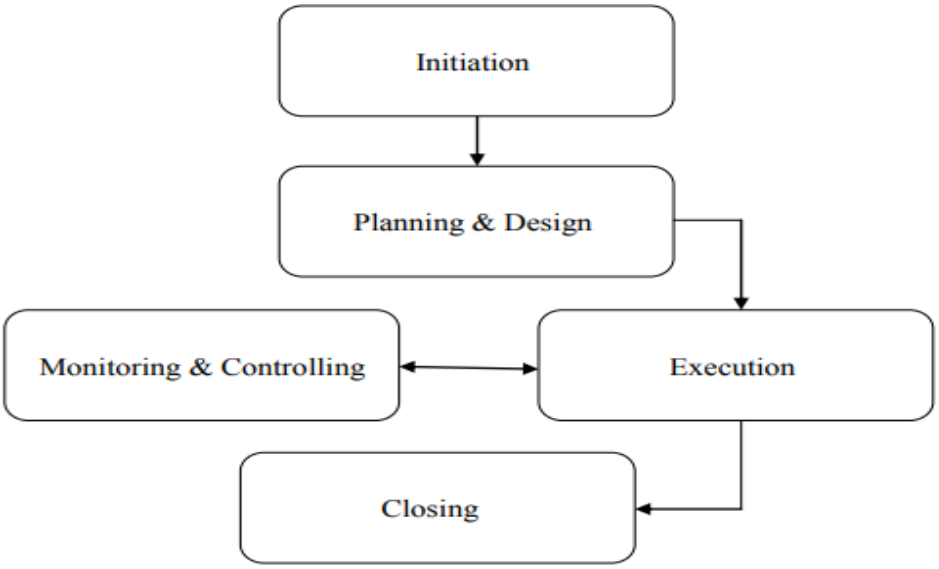


Figure 2.1 Construction project lifecycle

2.2.1 Initiation

The initiation stage establishes the preliminary scope of the project by understating the project environment and incorporates all the required resources in the project by developing a preliminary scope statement. It should include an organised plan that covers contracting, equipment and budget requirements, in addition to costs, tasks and the time schedule (PMBOK, 2004).

2.2.2 Planning and Design

The purpose of the planning and design stage is to show how the project will be managed during the executing, monitoring and controlling processes. In this stage, activities are grouped together by defining tasks and their sequences, in addition to their resources. It should ensure that the project satisfies the end-user and can be achieved within the constraints of time and budget (PMBOK, 2004).

2.2.3 Execution

The execution stage is the phase in which the activities defined in the project management plan (PMP) are performed in order to achieve the project's aims. Furthermore, it involves coordinating people and resources, in addition to integrating activities, in order to produce the final result identified in the project management plan (PMP), (PMBOK, 2004).

2.2.4 Monitoring and Controlling

The monitoring and controlling stage involves observation of the project execution phase to identify difficulties and to take actions to correct problems. The monitoring and controlling stage includes the on-going activities, in addition to monitoring the actual cost, time and effort expended against the project management plan (PMP). Moreover, it involves monitoring the project performance baseline, addressing risks and taking actions (PMBOK, 2004).

2.2.5 Closing

The closing stage is the period in which the construction project is handed over to the end user with formal acceptance. It has two phases: the project closure stage, where all 48 activities across the project are finalized, and the contract closure stage, where each contract related to the project is completed and closed (PMBOK, 2004)

2.3 Risk Management

The construction industry is one of the most dynamic, risky, and challenging businesses. However, the industry has a very poor reputation for managing risk, with many major projects failing to meet deadlines and cost targets. This is influenced greatly by variations in weather, productivity of labour and plant, and quality of material. All too often, risks are either ignored, or dealt with in a completely arbitrary way simply adding 10 per cent contingency onto the estimated cost of a project is typical. In a business as complex as construction, such an approach is often inadequate, resulting in expensive delays, litigation, and even bankruptcy (Hayes et al., 1986). Risk management is an important part of the decision-making process of all construction companies. Risk and uncertainty can potentially have damaging consequences for some

construction projects. Risk can affect productivity, performance, quality, and the budget of a project. Risk cannot be eliminated, but it can be minimized, transferred or retained (Burchett, 1999).

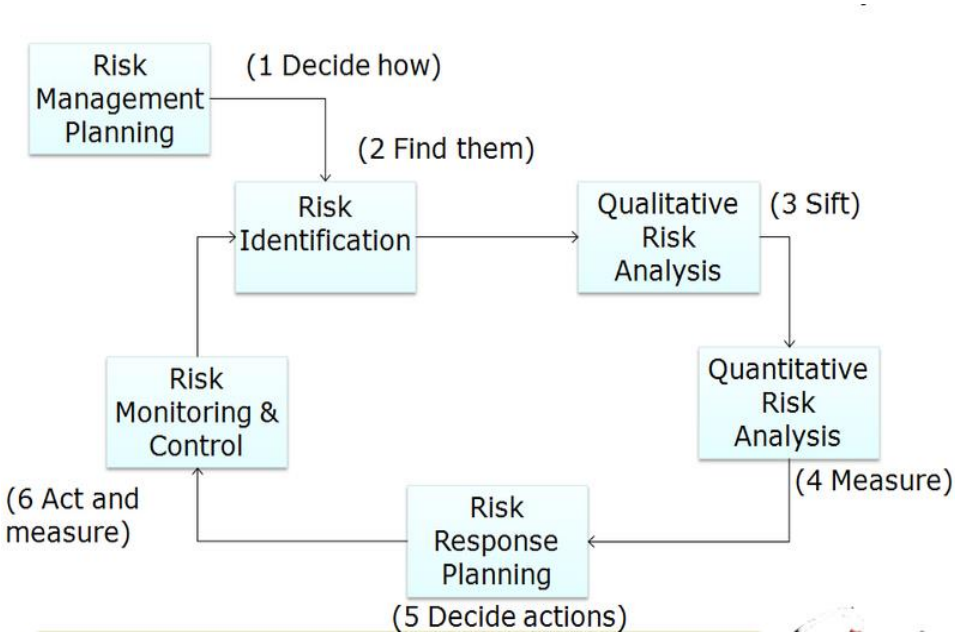


Figure 2.2 Risk Management Planning Process

2.4 Risk Identification

According to Tchankova (2002), the process of risk management begins with risk identification which develops the basis for the next steps of analysis, assessment and control. If this is done correctly it ensures risk management effectiveness. Consequently, it illustrates that risk identification must be seen in a broader way and not just be seen as what can be insured or mitigated (Tchankova, 2002).

The identification process at start enables a good basis for the implementation of the project and does not put up any barrier about the type of risk that would be identified or the resources that can be influenced (Tchankova, 2002). Risk identification reveals and determines the possible project risk as well as conditions (Williams et al, 1998). Risk identification enables the project managers to study activities and places

where resources are exposed to risk. According Tchankova (2002), risk identification can be described based on these elements:

Table 2.1 Element of Risk Identification

ELEMENT	DESCRIPTION
Sources of risk	There are the elements of the project environment that can bring some positive or negative outcome.
Hazard	It is a condition or a circumstance that increases the chances of losses or gains and their severity
Peril	This is a circumstance that is close to risk and has negative, non-profitable results. Peril can happen at any time and cause unknown, predictable losses. Peril is the cause of losses
Exposure to risk	This is an object facing possible loss or gain. They will be affected if the risk occurs.

Risk identification is a continuous process. It is not possible to identify risk as a one off activity (Tchankova, 2002). Practically, the techniques used to thoroughly capture the critical risks affecting a building construction project include but is not limited to;

i. Brainstorming: This is the commonly used method (APM, 2004). The technique involves bringing together all interested and relevant parties or personnel to identify and assess risk in a building construction project. This purpose is to generate a large quantity of potential risks affecting a project. Consequently, this process encourages the

identification of risk concerns in a non-critical way and not ascribing blame to the identified risk (Banes, 2000). In order to gain an effective brainstorming session, it must include individuals of knowledge, experience and expertise in risk management with an optimum size of twelve members (Chapman, 1997; Smith and Bohn, 1999).

ii. The Delphi Technique: This process involves a process where qualified people are consulted and asked to identify risks or estimate the impact and probability of previously identified specific risks through questionnaires. Opinions are given anonymously (this allows the technique to be carried out remotely). The risk coordinator summarises the responses and elicits estimates based on the results. This information is re-circulated for a repeat session. The process will continue until a stable opinion is reached (Banes, 2000). This technique is more time consuming and expensive compared to the brainstorming technique (Chapman 1998). An added shortage of this technique is the lack of interaction and communication, the respondents may encounter difficulties in interpreting the questions and results.

iii. Interviews: Interviews may be used as a follow-up to the group-oriented techniques previously described. Individuals with expertise relevant to a particular risk issue may be interviewed to assess risk parameters, identify possible mitigation and contingency measures and to elicit data. This is a precursor to any quantitative analysis that maybe required (Banes, 2000). This technique is time consuming. Due to time limitations, the questions must be properly structured in order to effectively gather the required information. Vague and confusing questions should be avoided so that the feedback gained from the interviewees is not misleading (Chapman, 2001). Another concern about this technique is that the information acquired is based on expert' subjective judgement which may not be free from bias.

iv. Experiential knowledge: this is a process where individuals obtain information through their experience in the construction industry (Clear

Risk, 2015). It is important to note that in this kind of process, knowledge based information acquired must be relevant and applicable to the existing building construction project.

v. Outputs from Risk-oriented Analysis: According to Clear Risk report (2015), there are various types of risk oriented analysis. Examples are the fault tree analysis and event tree analysis. These approaches are top down analysis approach that intends to determine what event, conditions or faults that could lead to an undesirable or unacceptable event. These events can be associated to a risk in a construction project.

vi. Risk Register: Risk register contains a standard format in which to record risk information gathered using the risk identification techniques previously described. It records various data for each individual risk issue, including a description, potential causes, ownership, probability, impacts, mitigation and fall-back plans and status (Banes, 2000). In its detailed form it may even include an identification of secondary risks, contingency plans and quantitative parameters (Banes, 2000). Nevertheless, the use of checklists to initiate the risk identification process is not advisable since they may constrain the identification of new risks (ICE et al., 2005).

2.5 Risk Analysis & Assessment

A direct relationship between effective risk management and project success is acknowledged since risks are assessed by their potential impact on the project objectives (Balio and price, 2003). Hence, engaging effective risk management techniques to manage risk associated with variable construction activities has never been more important for the successful delivery of projects (Zou et al. 2007). In managerial practice, different definitions and classifications can be used in managerial practice. Tchankova (2002), states that general classification may use physical, social and economic sources. However, an in-depth investigation of the problem of risk identification may need classification that can cover all types of risk in more detail (Tchankova, 2002). Thus, depending on the construction environment, the sources of risk can be represented.

2.5.1 Qualitative Risk Analysis

Qualitative risk analysis is regarded as the most useful part of the risk management process as the results gained from the analysis will be used extensively in the subsequent stages (Smith, 1999). Important information about risks such as the likelihood of occurrence, the risk severity, and risk ownership is required at this stage. Risks are often qualitatively assessed using Probability-Impact (P-I) Grids. I. Probability-Impact (P-I) Grids - are a tabular format for assessing and ranking risks. The advantage of using probability-impact grids is their simplicity, and risks can be assessed conveniently without precisely specifying their impacts and probabilities of occurrence (Ward, 1999)

Impact	V High					
	High					
	Med					
	Low					
	V Low					
		V Low	Low	Med	High	V High
		Probability				

Figure 2.3 Probability-impact grid

For each risk characteristics, the estimates of likelihood of events and consequence of events can be assigned qualitatively, for example: High; Medium; and Low etc. as shown in Figure 2.3 and each of these verbal scales can be related to a scale value. The P-I score for each cell in the grid can be determined as the result of the multiplication of probability and impact scale values; an arbitrary value; or an alphabet (Ward, 1999). Consequently, it is necessary to achieve a consistent quantification of risk likelihood of occurrence and the magnitude of the risk by using a common language in describing them as been suggested by Tah and Carr (2001).

2.5.2 Risk Exposure

Fraser and Simkins (2010), describes risk exposures as the extent to which one is exposed to risk (or a portfolio of risks). It is a function of the potential impact of a risk event and its probability of occurrence. These potential risk events however can impact on a construction organization in achieving its goals (Fraser and Simkins, 2010). Consequently, if more than two events may occur, risk exposure is used to quantify and compare and decide how to respond to them. Lock (2013), demonstrates the use of four main quadrants for risk exposure which are:

- High chance – High impact
- High chance - Low impact
- Low chance – High impact
- Low chance – Low impact

The least important type of risk is the low chance-low impact, and the most important type of risk is the high chance-high impact. Consequently while describing risk assessed qualitatively to determine their likelihood and potential effect on project objectives, Hillson (2002) reports that the Probability–Impact Matrix is useful, involving rotating the opportunity half as shown in Figure 2.5 This allows key threats and opportunities to be visualised by focusing on the so-called ‘‘Arrow of Attention’’. The size of this wedge can be increased if the organisation is more risk-adverse or if more effort is available for risk management.

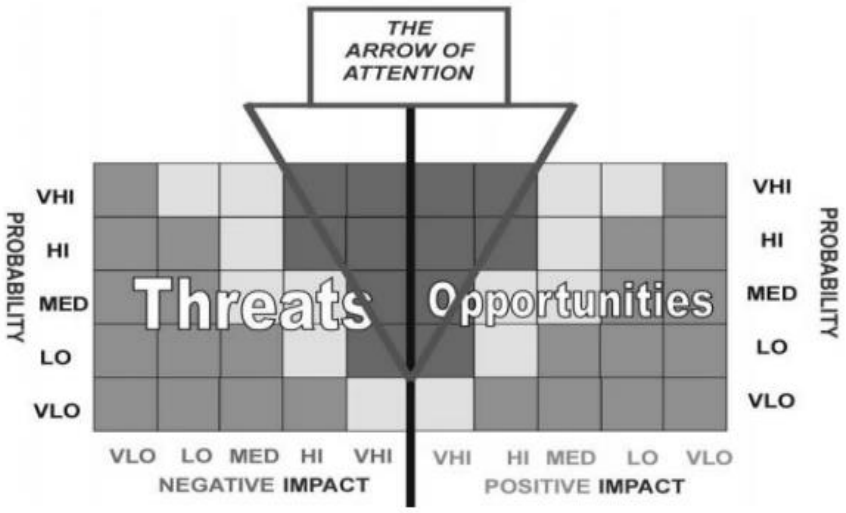


Figure 2.4 Probability and Impacts of Risk

From Figure, the probability and impacts of each risk are assessed against defined scales, and plotted on a two-dimensional grid. Position on the matrix represents the relative significance of the risk, and high/ medium/low zones may be defined, allowing risks to be ranked.

2.5.2.1 Risk Acceptability

Depending on the amount of risks an organization might be facing, individual risk can be classified as unacceptable (intolerable must be eliminated or transferred), undesirable (To be avoided if reasonably practical, detailed investigation of cost justification is required, top level approval is needed, monitoring is essential), acceptable (can be accepted provided that the risk is managed) and negligible (No further consideration needed) as suggested by Godfrey (1996).

2.5.2.2 Quantitative Risk Analysis

This process is made easier with the creation of a model, which represents the project being studied (Banes, 2000). The model may then be modified to quantify impacts on the project of the specific risks identified using qualitative techniques (Banes, 2000). It also explains the effect of general uncertainty on the project (Banes, 2000). The model may be constructed based on an activity network, spread sheet, or a

diagrammatic tool. Whichever modelling method is used, it will include all those elements comprising the undertaking (tasks, costs, durations etc.), which are relevant to the risk analysis (Eaton, 2010). Against these elements, uncertainty variables can be entered rather than deterministic values, in order to reflect areas of significant uncertainty (Eaton, 2010). A range of techniques for quantifying risk has been recognized but for the purpose of this study, the following are examined as they contain valuable logic that may lead to explaining and reasoning as part of a quantitative model.

i. Decision trees: A decision tree is a graphical method of modelling a project, showing the possible effects of individual risks requiring project decisions and immediate-planned courses of action to the overall outcome (Eaton, 2010). Each outcome is assigned a probability of occurrence allowing the most probable outcome to be determined. Alternative actions can be explored within the model in order to identify the most beneficial expected outcome of the project or activity (Banes, 2000).

ii. Influence Diagrams: The influence diagram was first defined as an aid to formulating problems prior to decision-making (Banes, 2000). Influence diagrams allow the construction of models representing the influences upon a project goal or target. The model exposes the key influences and allows the effect of uncertainty to be determined. These models can become very complex, leading to the need for effective graphical presentation as well as computational efficiency (PRAM, 2004)

iii. Probabilistic Analysis: This is a statistical method, which calculates the impact of every single risk factor, or the impacts of all risk factors on the project (Boothroyd and Emmett, 1996). In this technique, Optimistic, Most Probable, and Pessimistic time and cost estimates are given for each activity, or for the project as whole (Eaton, 2010).

iv. Sensitivity Analysis: this technique seeks to examine the sensitivity of a risk model to individual risk (Banes, 2000). This is done by repetitive

calculation of the effect on the project outcome of a range of values of the variables. The project outcome is usually considered in terms of time of construction, or the final cost of a project (Eaton, 2010).

v. Monte Carlo Simulation: this is a technique where single value estimates (of duration, resource, cost, and logic) are replaced by a distribution to reflect the perceived uncertainty of those estimates (Banes, 2000). A random number is then generated and a corresponding value sampled from the distribution. Once samples have been taken from all variables in the model, a single value is calculated for each target (e. g. time and cost overruns). The process is repeated a large number of times (iterations) to give a distribution of possible outcomes (a simulation).

vi. Simple Assessment: This is a relatively simple mathematical method that investigates the significant risks separately by inspecting their probable effect on total project time/cost (Boothroyd and Emmett, 1996). The evaluation is based on calculating the expected impact of every significant risk. The impacts are added up and the total impact is used as foundation for a contingency plan.

vii. Simple Assessment: This is a relatively simple mathematical method that investigates the significant risks separately by inspecting their probable effect on total project time/cost (Boothroyd and Emmett, 1996). The evaluation is based on calculating the expected impact of every significant risk. The impacts are added up and the total impact is used as foundation for a contingency plan. being effectively managed, and also indicates the subcritical paths which could be monitored alongside the main project critical path. Particular attention should be paid to tasks with a high criticality index, especially if they also have significant risks associated with them (Banes, 2000).

In the quantitative risk analysis phase, Sodhi and Tang (2012), identified expected outcomes for risk analysis in construction risk so that they can be used to define the expectations to be supported by risk model as to:

- Understand the nature of threats and other risks to help counter these better
- Support risk measures for informing their stakeholders,
- Help management focus on specific areas and
- Support allocation of risk management efforts and budget to different risk mitigations such as to answer the question of who should make such an investment (contractors, subcontractors or its clients) in construction industries.

The selected model should be able to provide the outcomes which can fulfil the defined purposes of the building construction risk analysis.

2.6 Risk Response

After risks are identified and analyzed, they are not left unattended in the implementation phase of construction projects. The outcome of risk analysis enables responsible parties to understand the risk impacts, and subsequently plan and undertake effective risk mitigation actions to curb the effect before or when they occur. Some organizations prepare to cope with uncertainty by different strategies and this can affect the building construction process system. How much the effects of adverse events can disrupt the building project performance depends on how well the current mitigating actions are implemented. The interaction of risk mitigating policies for different aspects has also been shown through the concept of risk-reward relationship (e.g. Chopra and Sodhi, 2004). The understanding of possible risk mitigating actions should thus be defined as a key concept for systemic risk modellers. General risk mitigating actions have been clearly explained by Vose (2008) especially in terms of implementing different risk mitigating strategies in different situations (Figure 2.5)

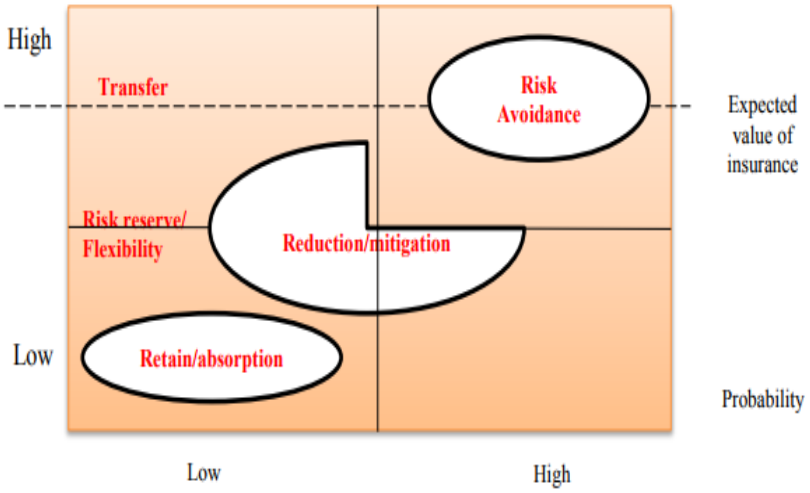


Figure 2.5 General Risk Mitigating Actions

According to Vose (2008) the responses for threats are:

i. Risk avoidance changing some aspect of the project so that the threat either cannot have an impact anymore or can no longer happen.

ii. Risk transfer is another form of "reduce" response for reducing the impact only, and it is mostly only the financial impacts (a third party takes this responsibility). Common practice in risk transfer is to sign contracts that guarantee a certain level of performance and set penalties for when the contractor fails to meet it. Insurance is an attractive option when the adverse event that will happen is above the expected cost of insurance.

iii. Risk reduction is a proactive action taken to either reduce the probability of the event occurring or to reduce the impact of it. However, this needs to be done at the strategic level because relevant high level of cost is involved. This option is suitable for any level of risk that is not severe (high probability and high impact) by trading off between benefits and costs.

iv. Risk reserve/flexibility aims to increase responsiveness by adding some reserve (buffer) to cover risks or using redundancy policy. This risk reserved option is suitable for small or medium impact risks.

v. Risk retention/absorption/acceptance can be called self-insurance, because some risks are not critical so the cost of insuring against those risks may be higher than the cost of the loss if the adverse event happens. In other words, it is a conscious decision taken for retaining the threats. This option is suitable for risks that are not significant because they have both low likelihood and impact, compared with the cost of control.

The responses for opportunities are:

Table 2.2 Responses for opportunities

RESPONSES	EXPLANATION
Exploit	Grasping an opportunity to make sure it will happen and its impact will be realized
Enhance	A proactive action taken to enhance the probability of the event occurring or to enhance the impact of it.
Reject	A deliberate decision taken for not exploiting or enhancing the opportunity.
Share	Parties sharing the gain (within pre-agreed limits), normally when the cost is less than the cost plan. In practice, decision maker may be satisfied with their current level of risk with respect to the risk-reward trade-off. In other words some decision makers may think that they have spent too much on resources (money, time, etc.) for managing risks which may not necessarily happen, so they may want to reduce their level of risk protection (Vose, 2008). However, this option can lower the public credibility of the construction organisation, which may adversely affect the organisation's reputation and image. Another option is gathering more data to reduce uncertainties of unknown (epistemic uncertainties) in order to make

	a robust decision (Ellegaard, 2008; Vose, 2008). Besides the direct strategy to manage risks, knowledge creation is useful as it can help to reduce either probability or the effects of risk effectively (see more discussion in Ellegaard, 2008).

2.7 Risk Factor

Risk management is the systematic process of identifying, analysing, and responding to project risk and it includes maximizing the probability and consequences of positive attributes and minimizing the probability and consequences of attributes adverse to project objectives. Project risk is an uncertain event or condition that, if occurs, has a positive or negative effect on a project's objectives. Components of risk are an event that may or may not happen, the probability of the occurrence of that event and the impact of the occurrence of that event.

There are many sources of uncertainty in construction projects, which include the performance of construction parties, resources availability, environmental conditions, involvement of other parties, contractual relations, etc. As a result of these sources, construction projects may face problems that cause delay in the project completion time. The key success indicators of construction management system include completing the project with cost and time, within the planned budget and duration, and within the required quality, safety, and environmental limits. These goals are interrelated where each of them is affecting and affected by the others. An accurate cost estimating and scheduling should be sought in order to meet the overall budget and time deadline of a project.

As a conclusion, it is important to identify what risk factors that will be faced during the construction work. This is to ensure that the work at site runs smoothly and is well-timed, quality and cost agreed upon by the client. In this study, there are three risk factors that have been identified.

2.7.1 Rainy days

Managing bad weather is one of the most difficult, yet important aspects of good civil construction practices. Properly handling the effect of bad weather on construction project is the key to complete the project on exact time and on budget and most importantly ensuring the quality of the project is not compromised. Wet weather can be a problem for a number of different types of construction jobs, roofing, excavating, and even concrete (Ida May, 2017).

Throughout the year, the climate in Malaysia is quite hot and humid with heavy rainfall. Malaysia's weather and climate also feature monsoon season (monsoon season varies by location). Monsoon winds greatly affect the Malaysian weather and it varies along the coast of Peninsular Malaysia. Monsoon winds blowing from South to West throughout May to September, and it struck in the north to the east from November to March.

This project is located in Kuantan Pahang which is Malaysia’s East Coast area. Malaysia's East Coast is famous for its hot and sunny weather all year round with its warm-tempered waters in the South China Sea. However, travelers are advised to avoid visiting the islands during the Northeast Monsoon season that struck between November and February. This is because heavy rain can interfere with the journey and safety of the boat. Outside the months of the Northeast Monsoon, the East Coast is usually dryer than all over Malaysia.

Thus, in order to do schedule planning, contractor must consider number of rainy days in Kuantan to avoid from delay to happen. Based on the number of rainy days in Kuantan, mostly rainy days are in January, April, May, September, October, November and December. On average, November is the rainiest and June has the least rainy days. The average annual amount of rainy days is 179 days.

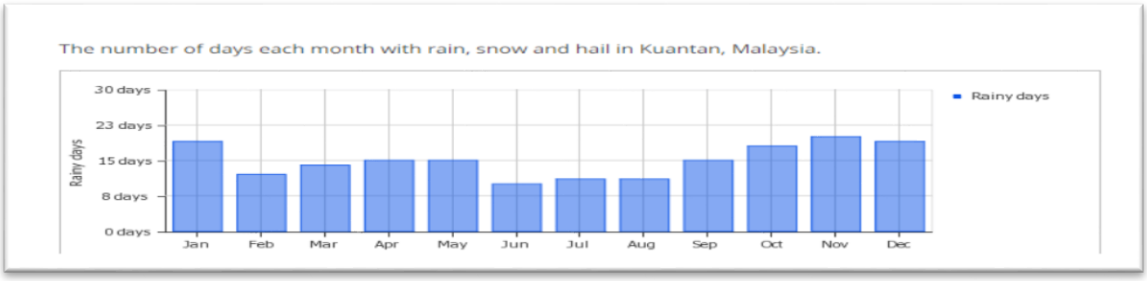


Figure 2.6 The average number of rainy days in Kuantan

2.7.2 Public Holidays

Every country allocates a number of days as a public holiday for employees to enjoy. Public holidays are not just the expectations of the workers, but they are closely intertwined with the well-being of the community in a country, the performance improvement, excellence, and the social and economic development of an organization.

In Malaysia, basically public holidays can be classified at the national level, complied with by all government institutions and most private companies, while public holidays are only adhered to in the state. The provision of public holidays in Malaysia is governed by various federal and state laws in accordance with the Holiday Act 1961 and the Labor Ordinance or the State Public Holiday Ordinance.

Apart from Malaysia, some other countries in the world also allocate public holidays from 11 days to 20 days a year. In reality, public holidays are welcomed by all parties, including employers. However, there is no difference in opinion because long leave will affect the company's operations, especially if the employer is forced to bear large costs.

Hence, in order to do planning in construction, contractor must allocate the number of public holiday in Malaysia in the schedule so that the project can run smoothly. This is because; all delivery from factory will be delayed on the public holiday. Besides, workers will also be on leave during the public holiday. So, work at site will also be delayed. In conclusion, to avoid delay in construction, the contractor should consider the number of holidays to be included in schedule planning.

2.7.3 Greenfield Area

According to Jim Heid (2004), Greenfield defined as land that has not been Built Rural land or land low density. The example of the land is:

i. Natural resources, culture, and significant agriculture

ii. The location is beyond the boundaries urban.

Greenfield developments are a vacant site whereas brownfield sites will have some existing buildings that may be refurbished. Each option has advantages and disadvantages and you will need to assess these according to individual circumstances. One factor becomes obvious: Greenfield gives maximum flexibility for the design, and therefore operation of a new facility. Brownfield developments will require some compromises and, in some cases, these constraints may significantly outweigh the higher initial capital investment required in Greenfield sites.

By 2050, the world population is expected to increase by 2.5 billion, passing from 6.7 billion in 2008 to 9.2 billion. At the same time, the population living in urban areas is projected to increase from 3.3 billion in 2008 to 6.4 billion in 2050. Thus, the urban areas of the world are expected to absorb all the population growth expected over the next four decades while at the same time drawing in some of the rural population (OECD, 2005).

2.7.3.1 Advantages of Greenfield Area

Greenfield advantages:

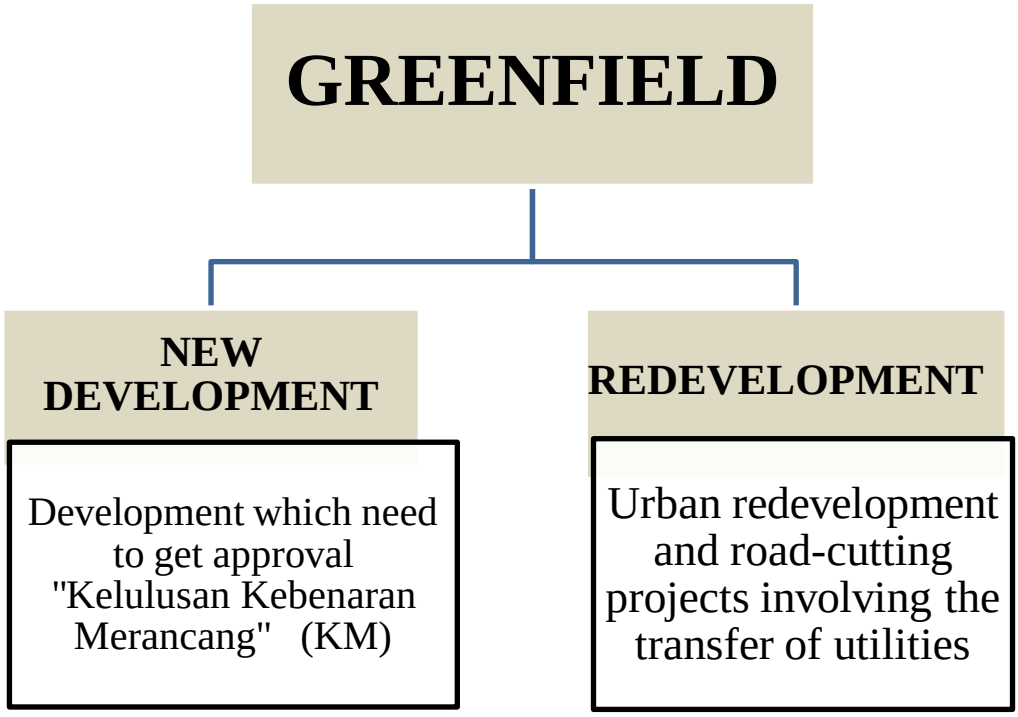
- Provides maximum design flexibility to meet project requirements
- New facility will reduce required maintenance
- Can be designed to meet current and future needs
- Opportunity to improve corporate image
- Suitable for either lease or own option

2.7.3.2 Disadvantages of Greenfield Area

Greenfield disadvantages:

- Some sites are not fully developed and have additional development costs such as headwork's costs for sewer and water
- Council approval time frames may be longer for new sites
- High demand of industrial sites may mean that sites available have difficulties (Slope, ground conditions)

2.7.3.3 Implementation of Provision of Utilities Route Reserves in New Development (Greenfield)



2.7.4 Brownfield Area

According to Jonathan Barnett (2003), brownfield can be interpreted as a site or location in a city already contaminated by industrial pollution, however now brownfield is defined as a land in an empty city or hollow, which is the opposite of its meaning with rural Greenfield. Brownfield development: an international perspective There have been continuous debates/discussions on the issue of industrial activities, contamination and brownfields in mature markets worldwide. Dixon (2006, p. 241) defines brownfield in a broader sense as ‘‘any land, which has been previously developed, including derelict and vacant land, which may or may not be contaminated’’. Alker et al. (2000) proposed a robust definition of the term from a multidisciplinary perspective, stating that a brownfield site is ‘‘any land or premise which has previously been used or developed and is not currently fully in use, although it may be partially occupied or utilised. It may also be vacant, derelict or contaminated’’. The Hazardous Substance Research Centre defines brownfields as ‘‘abandoned or underused industrial and commercial facilities available for re-use’’ (HSRC, 2006). The expansion or redevelopment of such a facility may be complicated by real or perceived environmental contaminations. The term brownfield also refers to previously developed land as defined by the Department of Environment, Transport and Regions the UK (Adams and Watkins, 2002, p. 18; Syms, 2004). In more recent years, it has become apparent that major cities in the former planned economies such as Malaysia have started to face urban brownfield development issues, especially in the inner city areas. In this context, existing definitions will need to be confined to reflect the unique forces that drive inner-city brownfield development in Malaysia.

2.7.4.1 Advantages of Brownfield Area

Brownfield advantages:

- May include existing environmental licenses and council approvals
- Existing infrastructure may already be in place

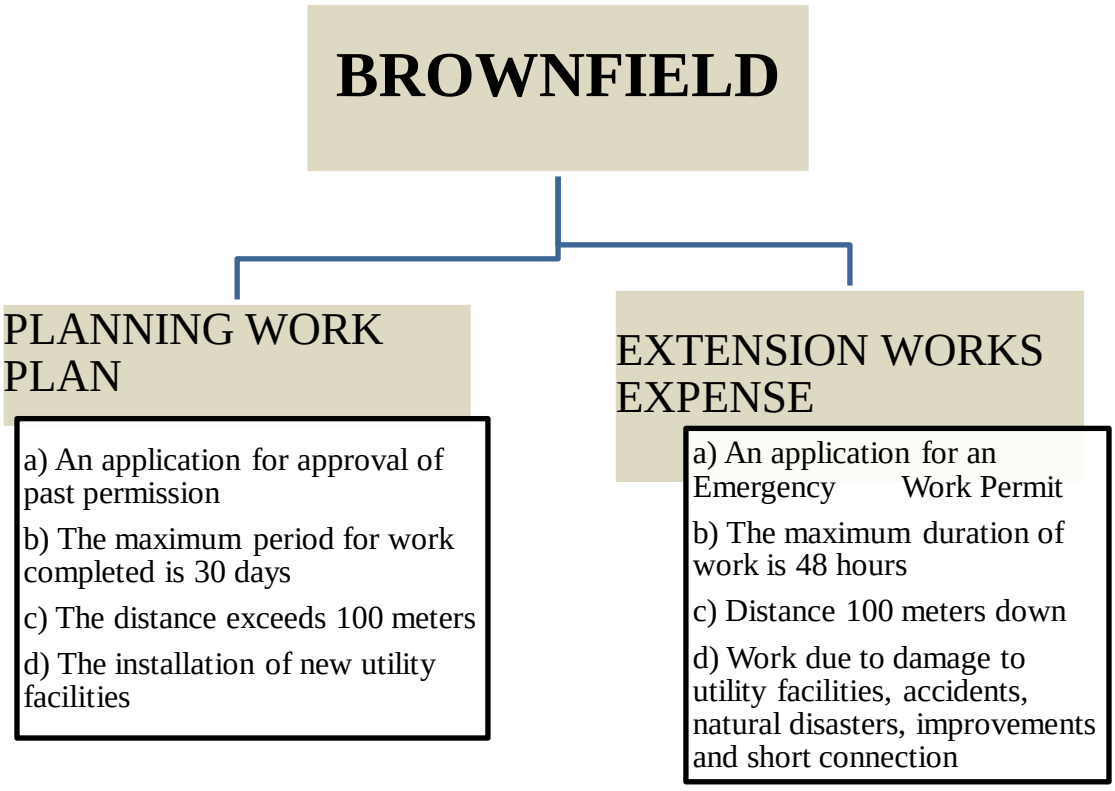
- Total project may cost less, but depends on how extensive the fit-out or modifications are, and whether existing structures and services can be utilised without major upgrades (ie electrical, drainage)
- Occupancy may be faster depending on amount of alterations

2.7.4.2 Disadvantages of Brownfield Area

Brownfield disadvantages:

- Design and operation efficiency is often compromised to suit existing constraints
- Site location may be inner-city and therefore pose operating difficulties in future (traffic congestion, noise if residential close)
- Older structures can be lightweight design and not meet structural requirements for more advanced fit-out to current standards
- Fire services often will not comply with regulations and building codes
- Higher risk of cost blow-outs for unforeseen situations
- Site/buildings may have contamination issues
- Existing buildings will often have lower roof heights
- Extensions may be difficult due to older structure and services
- Often difficult to find the ideal site
- Higher maintenance cost

2.7.4.3 Implementation of the Provision of Utilities Route Reserves in Brownfield Area



2.7.4.4 The Role of the Utility Supervisor

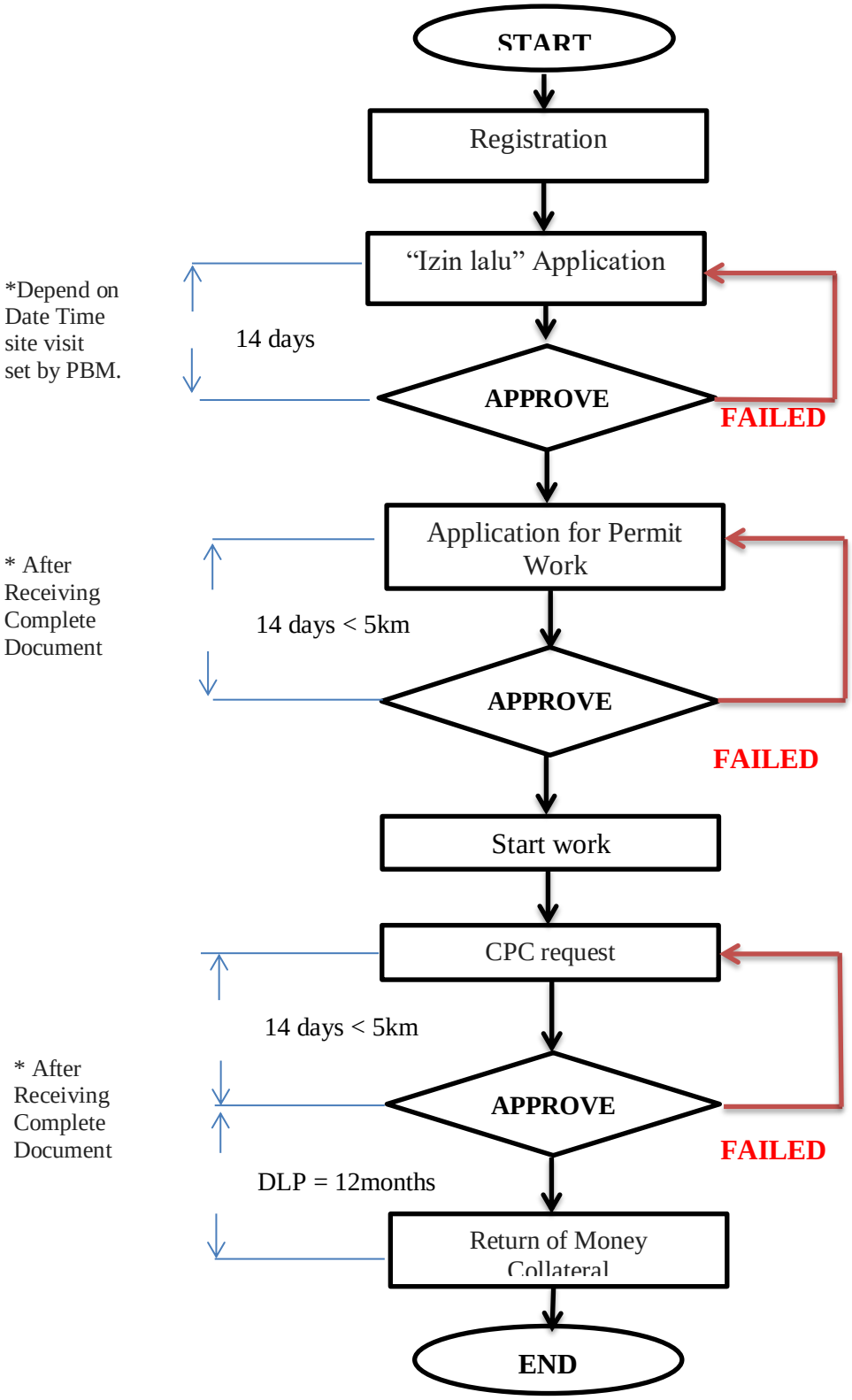


Figure 2.7 Flow Chart of Application for Planning Work

2.7.4.5 Application Registration

- Registration form
- Registration Charge (RM 53 including GST)

2.7.4.6 Conditions of the Application of "Izinlalu"

- Letter of Approval for Licensing
- Last Permit Approval Checklist
- Last Permit Approval Form (BKIL)
- Technical Proposal (3 sets)

2.7.4.7 Permit Application Requirements

- Employee Permit Application Letter
- Work Permit Approval Checklist
- Work Permit Approval Form (BKPK)
- Key Plan, Location Plan, Site Plan, Road Reserves
- Underground Utility Mapboards (UDM) plan (4 sets)
- Traffic Management Plan (4 sets)
- Boundary Marking Work Report (ROW and Pegging) (4 sets)
- Affected Street Image
- Method of Work "Method of Statement"
- Validation of Appointment of Civil Engineer Consultant (Form JKR / P-03/2016)

- Submission of Utilization Utilization Plans (Form JKR / P-04/2016)
- Letter of Appointment (Form JKR / P-05/2016)
- Insurance Documents (CAR, PL and WC)
- Security Deposit Payments
- Work Schedule Proposal (Work Program)

** Notice of Work Start Confirmation shall be given to KUP at least 7 days before work starts.

2.7.4.8 Requirements for Applicable Trade Code (CPC)

- Ready-Made Certificate Application Checklist (CPC)
- Ready Confirmation Notice
- Utilization Installation Report (Previous Picture, Current & After Image Report Work)
- Built-in Plan (As-Built)
- LiDAR Topography Plan
- Project Manager Review / Support Letter
- Letter of Visit / PBM Visit Support
- Construction Reports of Non - Compliance Construction (NCR) Repairs and Reports
- Certified by Civil Engineering Consultants (if any)

2.7.4.9 Conditions for Money Revenue

- Letter of Refund Application
- Refund Checklist
- Perfect Work Report
- CPC certificates
- CMGD certificate (if any)
- Original Deposit Payout Receipt
- Copy of Bank Statement / Bank Account Verification

CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter represents the methodology used to identify how the duration estimation as done and to develop planning and scheduling. Methodology and procedures will be discussed in details to apply in order to obtain all the data needed for this case study.all the collected data will be explained orderly on from where the sources of data obtained, how the data were collected and lastly do the data management process and representing the result.

Methodology or research design is a plan, framework and as a guideline to complete research.during this section study, it would focus on the method of study to be carried out to achieve the objectives of this study. Besides, this chapter consists of three parts which are data collection techniques and data analysis. Therefore, every measure taken must be appropiate and relevant to the related topic of study. In order to gather all the reliable and relevant data, literature review are used into this study. Figure 3.1 below shows the methodology flow chart.

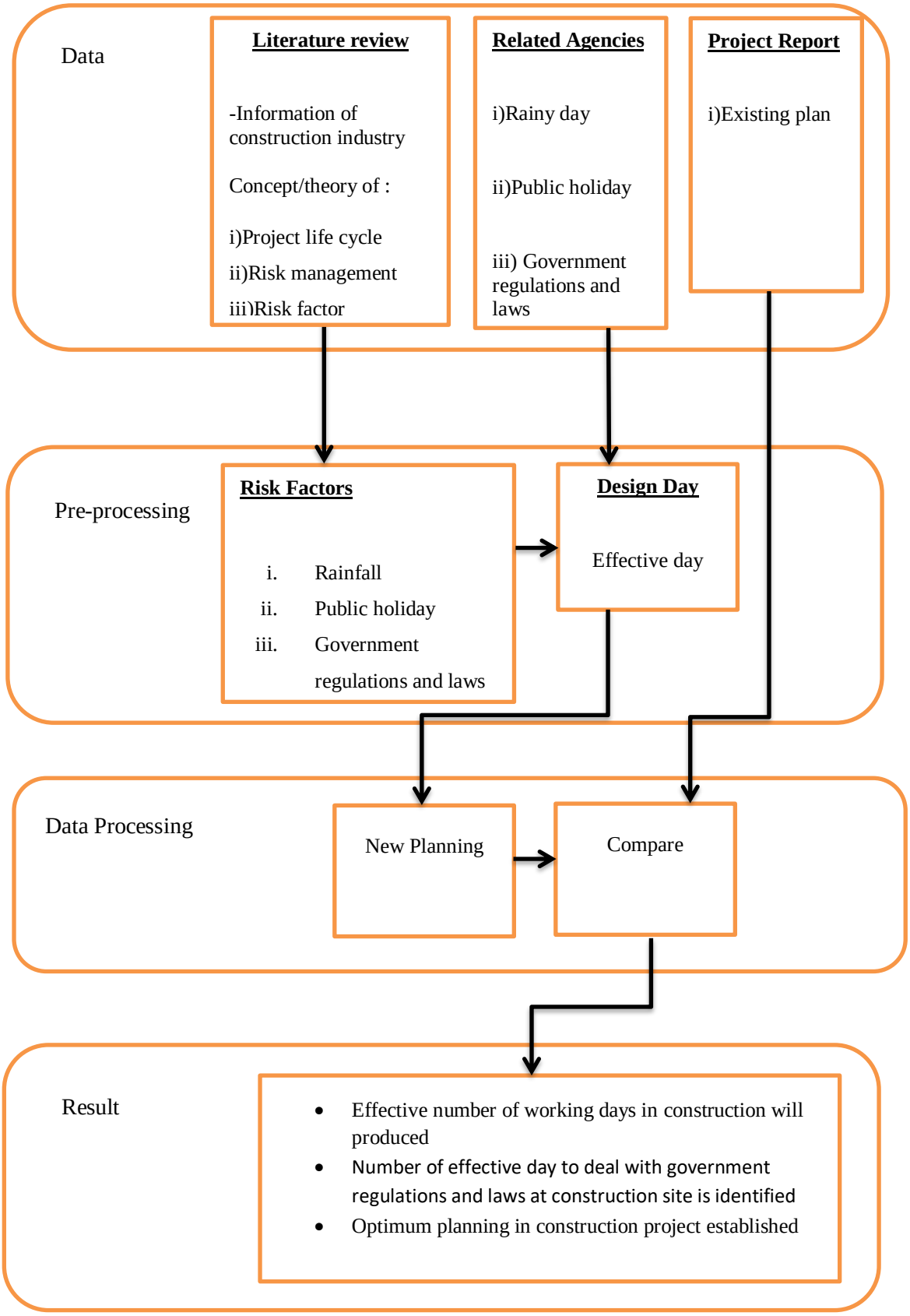


Figure 3.1 Flowchart of Methodology

3.2 Methods of data collection

Data collection is the important stage in obtaining all required information from the fundamental in achieves objectives of the research. All related data have been collected in accordance with the objectives which are to identify the high risk factor that will affect the construction work which is the number of rainy days, the number of public holidays and also the government regulations and laws.

3.2.1 Primary Data Collection

Primary data are collected from the literature review. Data collections for this research are all regarding to planning and scheduling process generally and in particularly to duration estimation process for a construction project. All data obtained from the previous study need to be taken into considerations.

The primary data in this study were gathered through literature review of journals, thesis, and textbook regarding the implementation of planning scheduling in construction industry. A lot of information on the subject of planning and scheduling process is successfully gathered.

3.3 Literature Review

Literature review was carried out in order to collect information for the research topic. The literature review was obtained from published books, textbooks, articles, journal papers and previous constructions records. In additional, there also effort on searching and browsing through internet web pages, internet websites, online articles, and journals to seek for supplementary information. The purpose of literature review is to gather important information related to the topic and deepen the understanding in the local construction reporting system such as:

i. Planning and scheduling process in construction project

ii. The duration estimation process in construction project

iii. Planning and scheduling in construction project using Microsoft Project

3.3.1 Secondary Data Collection

Secondary data are based on the data that have been collected from related agencies to determine the number of rainy days in Kuantan. Secondary data are important in order to obtain the optimum planning for construction project. After the secondary data are collected, planning and scheduling can be processed by using the effective number of days obtained from the secondary data.

3.3.2 Related Agencies

The number of rainy days, public holidays and duration to obtain permit from parties concerned are required for this research to achieve the optimum working days of this project which is maintenance of piping system at Bukit Sekilau Kuantan. The number of rainy days is attained from the Wunderground website. Thus, the working day estimation could be produced along with the existence of data of public holidays in Malaysia by taking the data from calendar. Last but not least, data from Koridor Utiliti Pahang (KUP) is obtained regarding the duration needed to get permit approval before starting the construction work.

3.3.3 Project Report

For the case study, "Tawaran Semula Membekal Dan Memasang Paip Air Jenis Keluli Lembut Bersaiz 500mm, 300mm, 250mm Dan 150mm Dia Serta Kerja-Kerja Berkaitan di Bukit Sekilau, Kuantan" is selected in order to achieve the objectives of the research. This study focused on maintaining the piping system in Bukit Sekilau area by changing the old pipes to new pipes. All data that need to gathered are such as the planning and scheduling of the project, tender, duration estimation of the project and date of completion. The construction progress of this maintaining project has been studied in order to identify on how the project activities is planned and scheduling, involving activities for the whole project and the factors that will affect the duration of the work completion. By observing the scheduling of this project report, the deficient and imperfectness of the scheduling prepared in the reports are analysed. For this research, we are focusing on the number of rainy days, public holidays and the duration needed to obtain permit. The project reports covered for all the maintenance works that have been constructed in Bukit Sekilau and the cost for the project.

3.4 Pre-processing

Data gathered explain the steps that include in the duration estimation process in order to meet the objectives. The risk factor that affected the construction work is identified. Number of rainy days, the public holidays and the duration of obtaining the permit approval is considered as the risk factors in this construction project. These factors that obtained from the literature review process then continue with getting the effective days that the maintenance project must produce in order to obtain the optimum planning.

3.5 Data Processing

The data processing which also known as analysis is the process where the reschedules planning are produced based on the data collected from the previous process. This data processing could be done after the design day is produced. After rescheduling the existing planning, comparison between them is done in order to determine the most optimum planning of construction work.

3.6 Result

After data processing or analysis is concluded, the result could be obtained where the number of rainy days and public holidays are determined. The duration of obtaining the permit approval also has been identified. Hence, suggestion for the proposed preliminary guidelines is suggested to improve the better performance of the building construction projects without delay of time.

3.7 Summary of the Chapter

As a conclusion, every research will have different methodologies that will be used to make the research successful and working well. Generally, methodology of this research consists of four parts which are data collection, pre- processing, data analysis and result. Therefore, every measure taken must be appropriate and relevant to the related topic of study.

The primary data in this study were gathered through literature review of journals; thesis and textbook regarding the implementation of planning and scheduling process are gathered. Furthermore, primary data also were gathered through related agencies and project report. This primary data also functioned as a guideline for next process. From the literature review, problem can be identified and objectives of this research can be developed.

Finally, in analysis phase this research will come out with the results and will be analysed. With appropriate methodology, all process and procedures of completing this research can be managed wisely. Hence, with a good methodology this research finding will be excellent as desired.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Introduction

The success of construction projects is a fundamental issue for most governments, users and communities. In the literature that deals with construction project success and causes of time and cost overruns in the construction industry. In an attempt to understand and investigate this impact, a case study of maintenance project by Pengurusan Air Pahang Berhad which is ‘ Installing New Piping System at Bukit Sekilau Kuantan Pahang” is conducted. This project is carried out to upgrade the old pipe (Asbestos Cement) to the new pipe (Mild Steel) in order to ensure the quality of water supply to users is assured and the piping system around Bukit Sekilau area is functioning well.

From the study, the duration estimation process and the factors that contribute duration estimation process data are gathered. All data are obtained from the existing planning and scheduling in Microsoft project. With the purpose of gaining data from Project Manager from Pengurusan Air Pahang Berhad, all data will be analysed in order to produce two new schedules planning considering all the factors affected the duration estimation process. Finally the result came out in a line with determined objectives. In this chapter, all data will be explained in details. The backgrounds of this case study project are shown as below.

Case Study

- **Project Title**: Tawaran Semula Membekal Dan Memasang Paip Air Jenis Keluli Lembut Bersaiz 500mm , 300mm , 250mm Dan 150mm Dia Serta Kerja-Kerja Berkaitan di Bukit Sekilau , Kuantan , Pahang Darul makmur
- **Client** : Pengurusan Air Pahang Berhad
- **Main Contractor**: Agamekar Sdn. Bhd
- **Start Date**: 19/1/2015
- **End Date**: 23/2/2017

4.2 Factors Affecting Duration of Work Completion

Construction planning is a very complex process. Every detail related to the construction work need to be considered very equally in order to propose a good planning. Thus, many variables and factors that might affect the planning progress must be take account so that effective planning can be produce with good performance of work. There are many factors which affected the construction duration estimation and causing on project duration to delay and have been charged of extension of time. There are three factors affecting construction duration as shown are the most significant factors. These factors were listed and explained as follows:

i. Number of rainy days

ii. Number of public holidays

iii. Duration of getting permit from authorities

4.2.1 Number of Rainy days

Throughout the year, the climate in Malaysia is quite hot and humid with heavy rainfall. Malaysia's weather and climate also feature monsoon season (monsoon season varies by location). Monsoon winds greatly affect the Malaysian weather and it varies along the coast of Peninsular Malaysia. Monsoon winds blowing from South to West throughout May to September, and it struck in the north to the east from November to March.

This project is located in Kuantan Pahang which is Malaysia's East Coast area. Malaysia's East Coast is famous for its hot and sunny weather all year round with its warm-tempered waters in the South China Sea. However, travellers are advised to avoid visiting the islands during the Northeast Monsoon season that struck between November and February. This is because heavy rain can interfere with the journey and safety of the boat. Outside the months of the Northeast Monsoon, the East Coast is usually dryer than all over Malaysia.

As for this project, most of the tasks are run from May to January which this is where Kuantan is having monsoon season. One of the reasons why the project is delayed is because the work cannot be made during this period as the bad weather had affecting the project to be run. Hence, in order to do schedule planning, contractor must consider number of rainy days in Kuantan to avoid from delay to happen

Based on the number of rainy days in Kuantan, mostly rainy days are in January, April, May, September, October, November and December. On average, November is the rainiest and June has the least rainy days. The average annual amount of rainy days is 179 days. Figure above shows the average number of rainy days in Kuantan.

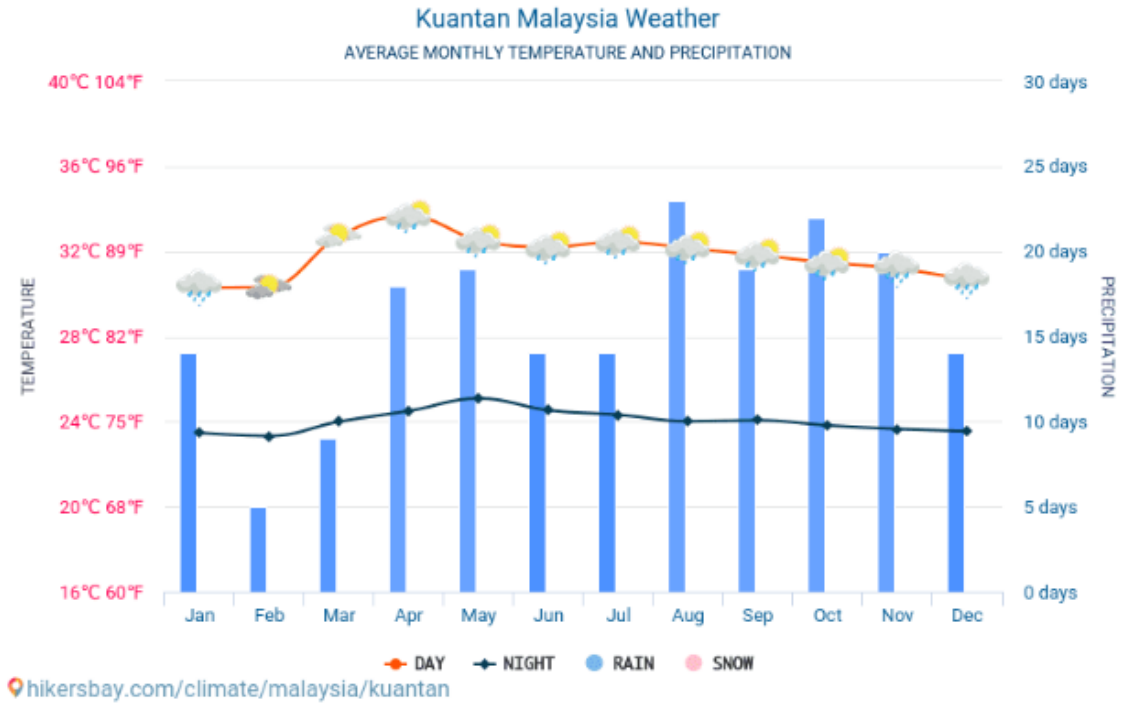


Figure 4.0 Kuantan Malaysia Weather

4.2.2 Number of Public Holidays

Every country allocates a number of days as a public holiday for employees to enjoy. Public holidays are not just the expectations of the workers, but they are closely intertwined with the well-being of the community in a country, the performance improvement, excellence, and the social and economic development of an organization.

The number of public holidays must be considered in the construction industry because some of the issues of delay that happens in construct project are caused by the public holidays. This is because the number of public holidays is not allocated during the scheduling phase and hence causing extension of time in construction work. Public holidays should be considered in project planning because the work cannot be run due to unavailability of workers during public holidays.

Hence, in order to do planning in construction, contractor must allocate the number of public holiday in Malaysia in the schedule so that the project can run smoothly. This is because all delivery from factory will be delayed on the public holiday. Besides, workers will also be on leave during the public holiday. So, work at

site will also be delayed. In conclusion, to avoid delay in construction, the contractor should consider the number of holidays to be included in schedule planning in order to ensure the project can be done according to the time, cost and quality required.

The list of holidays in Pahang for 2015 and 2016 are showed as in table below:

Table 4.1 Public Federal Holidays and State Holidays in Pahang (2015)
Source: Holiday Tracker.

DATE	HOLIDAY	TYPE
Jan-1	New Year's Day	State
February-3	Chinese New Year	Federal
February-19	2nd Day of Chinese New Year	Federal
May-1	Labor Day	Federal
May-7	Hol day	State
May-21	Wesak Day	Federal
June-6	Birthday of His Majesty the Yang di-Pertuan Agong	State
June-4	Nuzul Al-Quran	State
July-17	Hari Raya	Federal
July-18	2nd day of Hari Raya	Federal
August-31	National Day	Federal
September-16	Hari Raya Qurban	Federal

September-24	Malaysia Day	Federal
October-14	Awal Muharam	State
October-24	Birthday of Sultan Pahang	Federal
November-10	Deepavali	
December-24	Birthday of Prophet Muhammad	Federal
December-25	Days of Christmas	Federal

Table 4.2 Public Federal Holidays and State Holidays in Pahang (2016)
Source: Holiday Tracker.

DATE	**HOLIDAY**	**TYPE**
Jan-1	New Year's Day	State
February-8	Chinese New Year	Federal
February-9	2nd Day of Chinese New Year	Federal
May-1	Labor Day	Federal
May-7	Hol day	State
May-21	Wesak Day	Federal
June-4	Birthday of His Majesty the Yang di-Pertuan Agong	State
June-22	Nuzul Al-Quran	State

July-6	Hari Raya	Federal
July-7	2nd day of Hari Raya	Federal
August-31	National Day	Federal
September-12	Hari Raya Qurban	Federal
September-16	Malaysia Day	Federal
October-2	Awal Muharam	State
October-24	Birthday of Sultan Pahang	Federal
October-29	Deepavali	
December-12	Birthday of Prophet Muhammad	Federal
December-25	Days of Christmas	Federal

4.2.3 Duration of Getting Permit from Authorities

Koridor Utiliti Pahang (KUP) is a coordinator of utility maintenance work to be more organized, efficient and effective, for the well-being of the people. They are also responsible for developing the state's utility infrastructure database. Pahang as a state that is moving towards advanced state status, the challenge is that in the best case management of utilities management which fails, it can contribute to various problems such as public infrastructure damage. For example, road surface, drainage system and landscape as well as traffic disruption especially during installation work or damage repair work to existing utility infrastructure (such as broken pipe and broken cable).

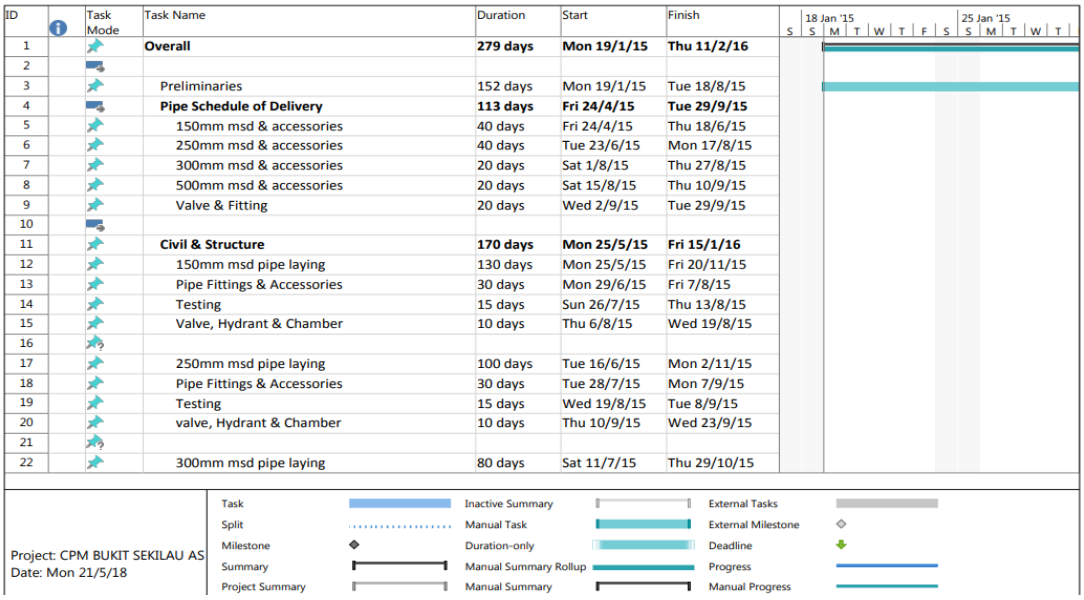
In order to get the permit, there is a lot of procedure to go through. Each process has certain duration. The shortest duration to get the permit approval are 30 days which a month. If there is problem regarding uncompleted documents or failed to prepare the deposit fees, the duration in gaining the permit approval will be longer. Hence, contractor must consider the duration of getting the permit in schedule planning as it

will influence the duration to complete the project. If this thing does not be highlighted during the planning process, the project being run will be delayed.

4.3 Duration of Estimation of Work Completion

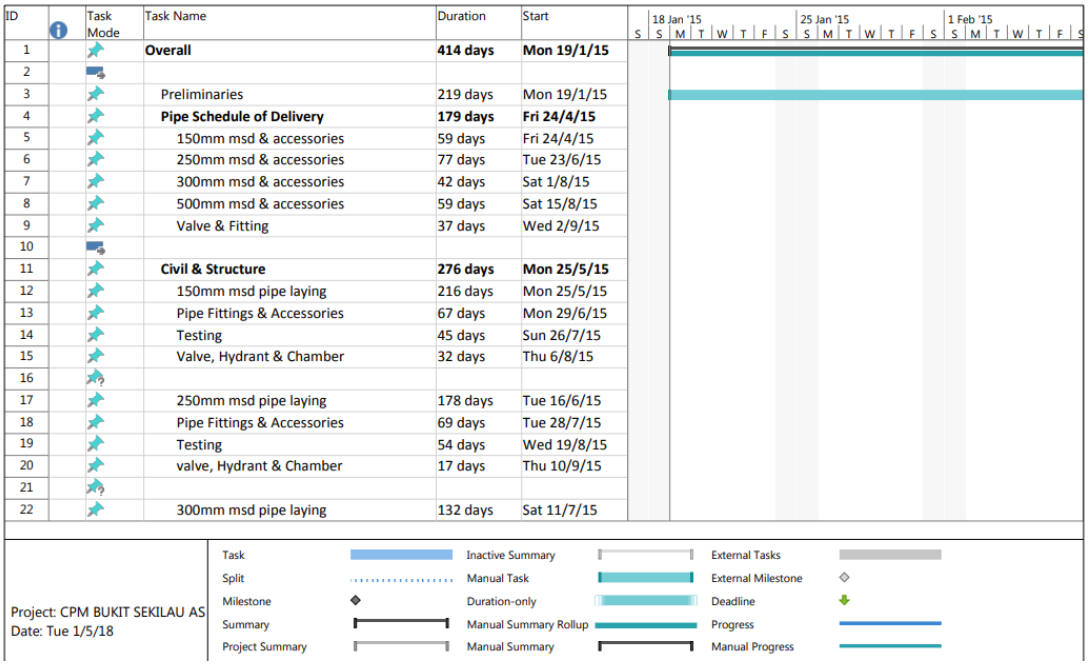
The duration estimation of work completion is the process duration estimating of time that is required for the work to complete. The duration estimation process is need to be finished before the project takes place and the right duration estimation is important hence there is no extension of time to finish up the project. So, estimating activity's duration accurately is required to have a good construction planning.

4.3.1 Preliminary Work



ID	Task Mode	Task Name	Duration	Start	Finish
1		**Overall**	**279 days**	**Mon 19/1/15**	**Thu 11/2/16**
2					
3		Preliminaries	152 days	Mon 19/1/15	Tue 18/8/15
4		**Pipe Schedule of Delivery**	**113 days**	**Fri 24/4/15**	**Tue 29/9/15**
5		150mm msd & accessories	40 days	Fri 24/4/15	Thu 18/6/15
6		250mm msd & accessories	40 days	Tue 23/6/15	Mon 17/8/15
7		300mm msd & accessories	20 days	Sat 1/8/15	Thu 27/8/15
8		500mm msd & accessories	20 days	Sat 15/8/15	Thu 10/9/15
9		Valve & Fitting	20 days	Wed 2/9/15	Tue 29/9/15
10					
11		**Civil & Structure**	**170 days**	**Mon 25/5/15**	**Fri 15/1/16**
12		150mm msd pipe laying	130 days	Mon 25/5/15	Fri 20/11/15
13		Pipe Fittings & Accessories	30 days	Mon 29/6/15	Fri 7/8/15
14		Testing	15 days	Sun 26/7/15	Thu 13/8/15
15		Valve, Hydrant & Chamber	10 days	Thu 6/8/15	Wed 19/8/15
16					
17		250mm msd pipe laying	100 days	Tue 16/6/15	Mon 2/11/15
18		Pipe Fittings & Accessories	30 days	Tue 28/7/15	Mon 7/9/15
19		Testing	15 days	Wed 19/8/15	Tue 8/9/15
20		valve, Hydrant & Chamber	10 days	Thu 10/9/15	Wed 23/9/15
21					
22		300mm msd pipe laying	80 days	Sat 11/7/15	Thu 29/10/15

Figure 4.1 Existing planning (Without EoT)

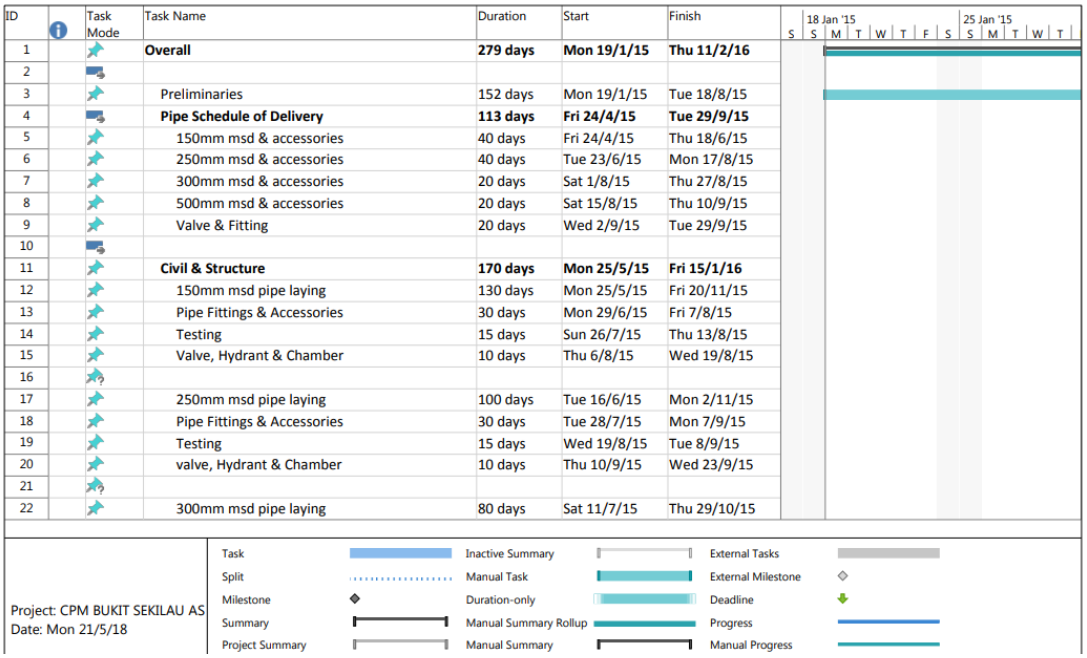


ID	Task Mode	Task Name	Duration	Start
1		**Overall**	**414 days**	**Mon 19/1/15**
2				
3		Preliminaries	219 days	Mon 19/1/15
4		**Pipe Schedule of Delivery**	**179 days**	**Fri 24/4/15**
5		150mm msd & accessories	59 days	Fri 24/4/15
6		250mm msd & accessories	77 days	Tue 23/6/15
7		300mm msd & accessories	42 days	Sat 1/8/15
8		500mm msd & accessories	59 days	Sat 15/8/15
9		Valve & Fitting	37 days	Wed 2/9/15
10				
11		**Civil & Structure**	**276 days**	**Mon 25/5/15**
12		150mm msd pipe laying	216 days	Mon 25/5/15
13		Pipe Fittings & Accessories	67 days	Mon 29/6/15
14		Testing	45 days	Sun 26/7/15
15		Valve, Hydrant & Chamber	32 days	Thu 6/8/15
16				
17		250mm msd pipe laying	178 days	Tue 16/6/15
18		Pipe Fittings & Accessories	69 days	Tue 28/7/15
19		Testing	54 days	Wed 19/8/15
20		valve, Hydrant & Chamber	17 days	Thu 10/9/15
21				
22		300mm msd pipe laying	132 days	Sat 11/7/15

Figure 4.2 Reschedule planning (Considering rainy days & public holiday)

Figure above showing the duration of preliminaries work of existing plan and reschedule plan. As in existing plan, the duration for preliminaries works is 152 days which start from 19/1/2015 to 18/8/2015. In order to improve and to have a better planning, a total of 67 days is added in the duration of preliminaries work. This is because the duration in existing plan is not enough to complete this task. The existing planning did not consider the number of holidays during this period as in this duration there is two big festival which is Chinese New Year and Hari Raya Aildilfitri. In February, there is a Chinese New Year celebration. During this festive period, all employees will be on vacation and work at the site cannot be run. To avoid delay happen, the holiday period for this festival is taken for 5 days (19/2/2015 – 23/2/2015) into account during rescheduling. In July, holiday period that has been taken into rescheduling is 6 days (17/7/2015 – 24/7/2015) because of Hari Raya Aidilfitri. Other than that, another 10 days added to consider the other public holidays such as Labor Day, Wesak Day, Nuzul Al- quran , Birthday of Yang di Pertuan Agung and National Day. Last but not least, 46 days are also considered as this is the average number of rainy days within this period. Thus, the total of number of day added during rescheduling is 67 days.

4.3.2 Pipe Schedule of Delivery



ID	Task Mode	Task Name	Duration	Start	Finish
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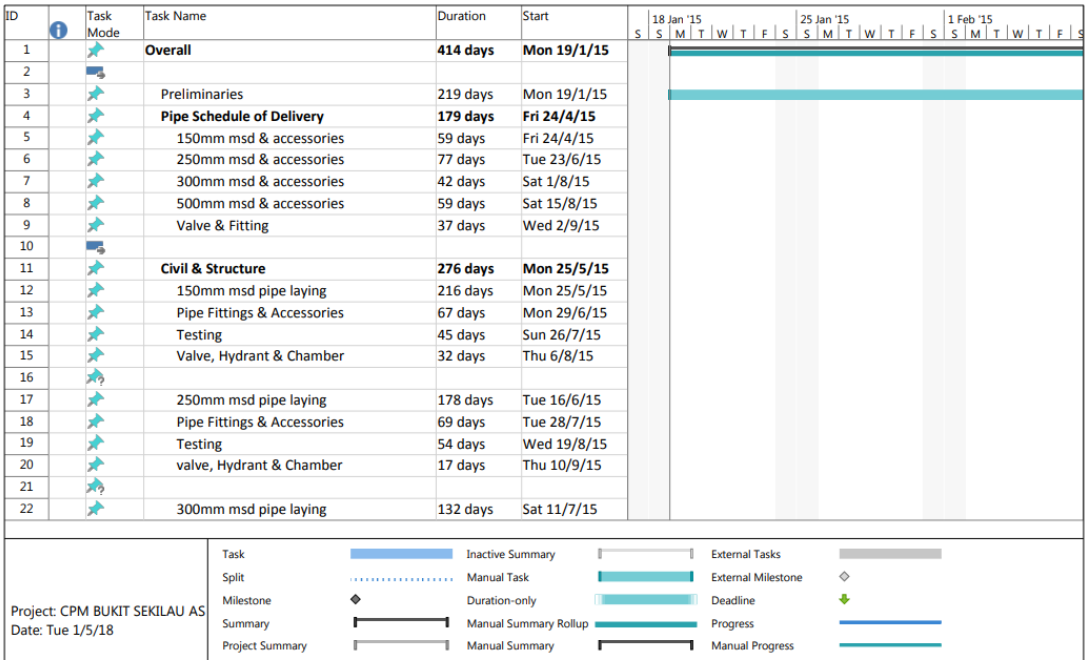
3		Preliminaries	152 days	Mon 19/1/15	Tue 18/8/15
4		**Pipe Schedule of Delivery**	**113 days**	**Fri 24/4/15**	**Tue 29/9/15**
5		150mm msd & accessories	40 days	Fri 24/4/15	Thu 18/6/15
6		250mm msd & accessories	40 days	Tue 23/6/15	Mon 17/8/15
7		300mm msd & accessories	20 days	Sat 1/8/15	Thu 27/8/15
8		500mm msd & accessories	20 days	Sat 15/8/15	Thu 10/9/15
9		Valve & Fitting	20 days	Wed 2/9/15	Tue 29/9/15
10					
11		**Civil & Structure**	**170 days**	**Mon 25/5/15**	**Fri 15/1/16**
12		150mm msd pipe laying	130 days	Mon 25/5/15	Fri 20/11/15
13		Pipe Fittings & Accessories	30 days	Mon 29/6/15	Fri 7/8/15
14		Testing	15 days	Sun 26/7/15	Thu 13/8/15
15		Valve, Hydrant & Chamber	10 days	Thu 6/8/15	Wed 19/8/15
16					
17		250mm msd pipe laying	100 days	Tue 16/6/15	Mon 2/11/15
18		Pipe Fittings & Accessories	30 days	Tue 28/7/15	Mon 7/9/15
19		Testing	15 days	Wed 19/8/15	Tue 8/9/15
20		valve, Hydrant & Chamber	10 days	Thu 10/9/15	Wed 23/9/15
21					
22		300mm msd pipe laying	80 days	Sat 11/7/15	Thu 29/10/15

Figure 4.3 Existing planning (Without EoT)



ID	Task Mode	Task Name	Duration	Start
1		**Overall**	**414 days**	**Mon 19/1/15**
2				
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8		500mm msd & accessories	59 days	Sat 15/8/15
9		Valve & Fitting	37 days	Wed 2/9/15
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12		150mm msd pipe laying	216 days	Mon 25/5/15
13		Pipe Fittings & Accessories	67 days	Mon 29/6/15
14		Testing	45 days	Sun 26/7/15
15		Valve, Hydrant & Chamber	32 days	Thu 6/8/15
16				
17		250mm msd pipe laying	178 days	Tue 16/6/15
18		Pipe Fittings & Accessories	69 days	Tue 28/7/15
19		Testing	54 days	Wed 19/8/15
20		valve, Hydrant & Chamber	17 days	Thu 10/9/15
21				
22		300mm msd pipe laying	132 days	Sat 11/7/15

Figure 4.4 Reschedule planning (Considering rainy days & public holiday)

Figure above shows the existing plan and reschedule plan for pipe schedule of delivery work. In existing plan, the duration to finish the work is 113 days but after reschedule 63 days are added in planning. This is because it considered the number of rainy days and also the number of public holidays lies within this period. During Hari Raya Aildilfitri festive period, all delivery of pipe will be shut down. So 6 days (17/7/15 – 24/7/15) holidays was added in the schedule. Also, there is Hari Raya Qurban in September so another 5 days (21/9/2015 – 25/9/2015) were added in the schedule. Other than that, another 22 days added to consider the other public holidays such as Labor Day, Wesak Day, Nuzul Al- quran , Birthday of Yang di Pertuan Agung, Holy Day, Malaysia Day and National Day. Last but not least, 44 days are also considered as this is the average number of rainy days within this period. From April to September, the highest number of rainy days is in August which is 12 days. Thus, the total of number of day added during rescheduling is 63 days.

4.3.3 Jacking Work and River Crossing Work

32	**Comunication Pipe**	**40 days**	**Wed 30/9/15**	**Tue 24/11/15**
33	Tapping	40 days	Wed 30/9/15	Tue 24/11/15
34				
35	**Jacking Works**	**150 days**	**Fri 17/7/15**	**Thu 11/2/16**
36	Jacking pipe 300mm dia	25 days	Fri 17/7/15	Thu 20/8/15
37	Jacking 500mm dia (no.1)	25 days	Tue 11/8/15	Mon 14/9/15
38	Jacking pipe 500mm dia (no.2)	100 days	Sat 12/9/15	Thu 28/1/16
39				
40	**River Crossing**	**30 days**	**Wed 20/5/15**	**Tue 30/6/15**
41	River Crossing Start	0 days	Wed 20/5/15	Wed 20/5/15
42	Pilling	6 days	Wed 20/5/15	Wed 27/5/15
43	Pier Construction	14 days	Wed 20/5/15	Mon 8/6/15
44	Steel Truss Installation	10 days	Thu 4/6/15	Wed 17/6/15

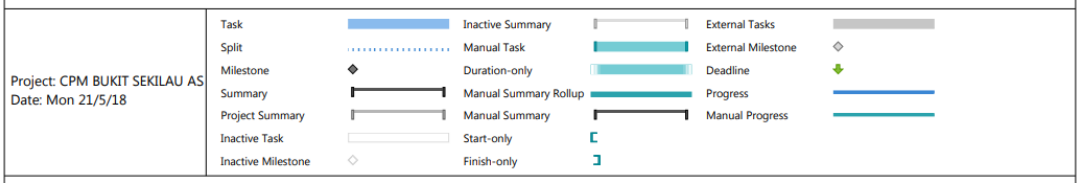

Figure 4.5 Existing planning (Without EoT)

32	**Comunication Pipe**	**81 days**	**Wed 30/9/15**	
33	Tapping	81 days	Wed 30/9/15	
34				
35	**Jacking Works**	**258 days**	**Fri 17/7/15**	
36	Jacking pipe 300mm dia	55 days	Fri 17/7/15	
37	Jacking 500mm dia (no.1)	64 days	Tue 11/8/15	
38	Jacking pipe 500mm dia (no.2)	161 days	Sat 12/9/15	
39				
40	**River Crossing**	**45 days**	**Wed 20/5/15**	
41	River Crossing Start	0 days	Wed 20/5/15	
42	Pilling	21 days	Wed 20/5/15	
43	Pier Construction	29 days	Wed 20/5/15	
44	Steel Truss Installation	17 days	Thu 4/6/15	

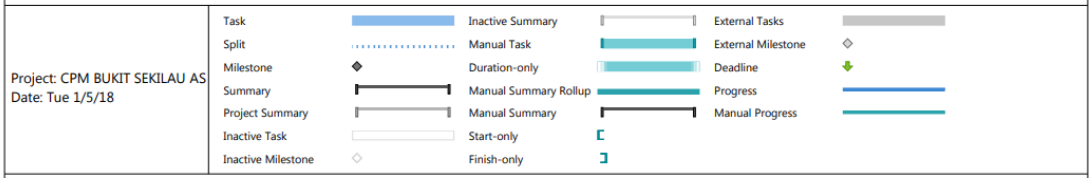

Figure 4.6 Reschedule planning (Considering rainy days & public holiday)

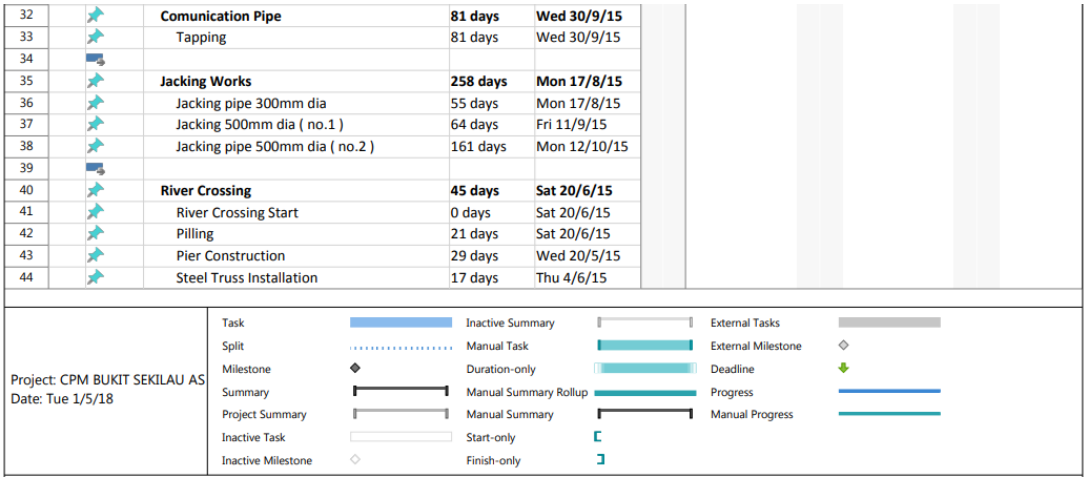

Figure 4.7 Reschedule planning (Considering rainy days, public holiday & permit)

Figure above show the existing planning and two reschedule planning by considering the factors affecting the planning duration. From the existing planning, the duration for working day is 40 days which is from 30/9/2015 to 24/11/2015.The reschedules planning which considering the factors that contribute the duration estimation to complete the project task took 81 days to complete the project task. During the reschedules planning, 59 days are also considered as this is the average number of rainy days within this period. During this duration, Kuantan is having rainy season from September to January and causing the work progress delayed. So, number of rainy days accounted in the planning is 46 days. Moreover, during this period there is a big festival which is Deepavali, so working progress is suspended for a week. Other than number of rainy days and public holidays that have been accounted, the duration of obtaining the permit from authority also is considered. Jacking work and river crossing work are considered to start 30days later than the existing schedule planning. This is because the duration needed to obtain the permit is at least 30 days. Hence, the effective number of working days can be obtained and most importantly, delays can be avoided.

4.4 Comparison between Existing Planning and Reschedules Planning

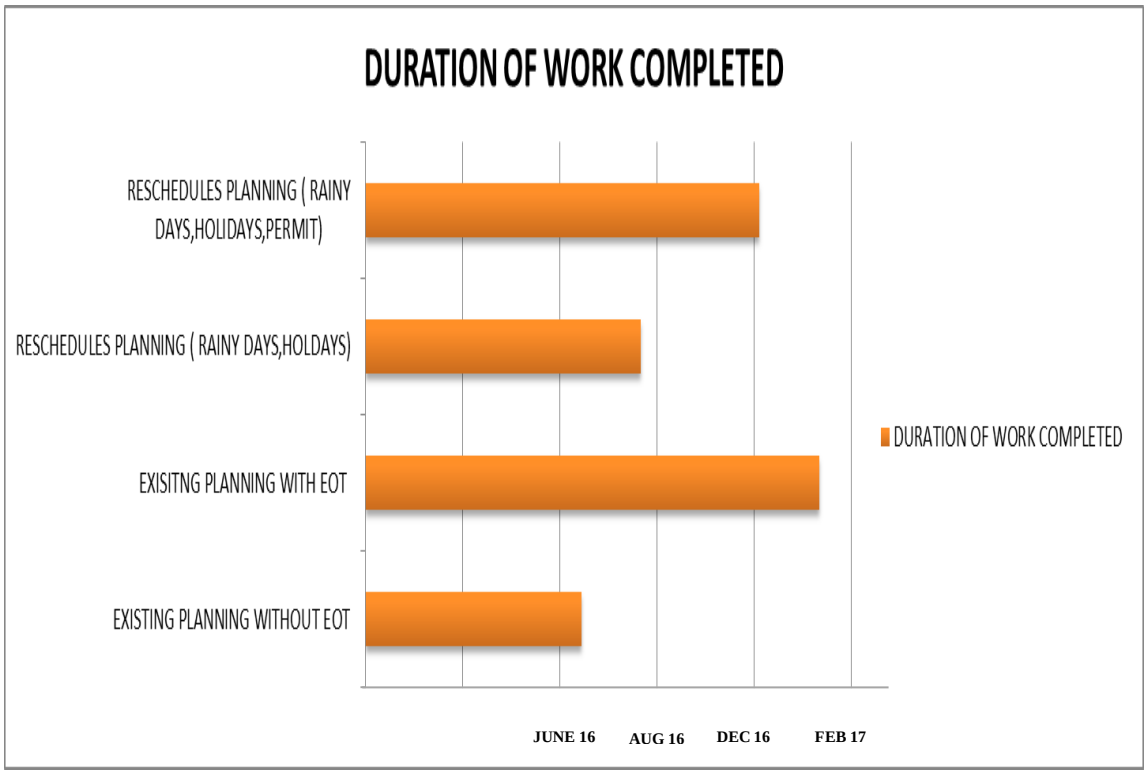

Figure 4.2 The duration of work completed between existing and reschedules planning

Bar chart above shows the duration taken to complete the work on site for existings and reschedules planning. From this chart, existing planning with EoT takes the longest period compared to reschedules planning in order to complete the project. This is because, during the process of completing the project, the contractor has been charged Extension of Time (EoT) twice and the project cannot be completed as it should be. After identifying the problems and factors affecting this delay, two new planning were produced to an effective planning. The first planning takes into consideration the number of rainy days and the number of public holidays while the second planning takes into account the number of rainy days and public holidays and also the period of obtaining permit approval prior to commencing work. Based on the first reschedule planning, the project can be completed 6 months earlier than the existing planning by considering the number of rainy days and public holidays. Moreover, project work also can be completed 2 months earlier than existing planning

after making second reschedule planning by considering the number of rainy days, number of public holidays and the duration of getting permit approval. Thus, this can be proven after making new planning by considering the factors because the period used by the new planning is shorter than the existing planning. Contractor can also be avoided by the charged of Extension of Time (EoT) and can result in more effective planning taking into account these factors.

4.5 Summary of the Chapter

In this study, the duration estimation process was identified after finding the factors that contribute within the process. All the related factors have been analysed and all the result are presented in tables, figures and bar chart including the explanation. After taking into account all the factors, it is true that these factors are important to be taken care of as they help to get more effective planning as well as eliminate the problem of delaying the project to be completed.

The factors that have been considered in making the new planning is the number of public holidays, number of rainy days and also the duration needed in order to get permit approval. Since the existing planning did not consider all these factors, they have to face a lot of delayed process. For example, during the delivery if pipe there was a big festival which is Hari Raya Aildilfitri and they did not consider that as public holidays. Hence, the delivery process cannot be run as scheduled. Then, during the civil and structure process, they did not account the duration in getting the permit approval in schedule planning. Usually, the duration to obtain the permit is one month if only they follow the right procedure. If not, the duration to obtain it will be longer. Since they did not consider this, the progresses of work on site are left behind the schedule.

As a conclusion, it is important to take account into these factors before making a planning schedule. This is because by considering all these factors, an effective planning can be obtained and project delays can be avoided.

CHAPTER 5

CONCLUSION

5.1 Introduction

In this research with intention of obtaining all data related, there is literature studies and case study that involved. After all data has been obtained and been analysed, the assessment result can finally be made. The main target of this case study is to search the factors that contribute to duration estimation process at planning stage of the existing schedule planning on maintenance of piping system at Bukit Sekilau, Kuantan Pahang. Form the main target, there are three highlighted finding of duration estimation in construction according to the objectives. The objectives are:

i. To establish the effective number of days in construction planning

ii. To identify effective day to deal with government regulation and laws at construction site.

iii. To produce an effective planning in construction project.

In this study, the first thing that has been identified is the factors that contributed in estimation planning process. The duration estimation process was identified from the existing schedule planning that has been obtained from Project Manager in Pengurusan Air Pahang Berhad. After finding all the factors that contribute in the duration estimation process, all the data has been analysed in order to produce an effective planning in construction project and the results are presented in tables, figures and charts with further explanation. Last but not least, the recommendation for better future study also will be discuss in this chapter.

5.2 Conclusion

Formal project planning and scheduling involves the definition of activities, the relationships among these activities, the resources required by the activities and the activities durations. The estimation of activities duration is necessary in the preparation as the critical path method (CPM). With the proper planning and scheduling it will assist the project manager in completing the project within the time and meet the target and also the objective of the project.

Based on the objectives and aim for this research as explained in chapter 1, several conclusions have been made. From the first objectives, this research is aiming to establish the effective number of days in construction planning. So in order to get the effective number of working days, factors that have been contributed during schedule planning is identified. There are three factors are considered in the schedule planning. They are the number of rainy days, the number of public holidays and lastly the number of day in obtaining the permit from authorities before starting the work progress. By considering the third factors, the second objective is achieved because effective day to deal with authorities before starting the work progress is identified.

Hence, it is important to identify the factors that might contribute during the construction work. All these factors need to be considered during the scheduling planning because this is the most important phase which the work will run according to the planning. If the planning is failed, the work progress also will failed and causing problem in term of cost, time and quality. To avoid this to happen, the factors must be considered and thus will produce an effective planning of construction work.

5.3 Recommendation

In this study, it only specifically concentrated on the case study of a company's project. It is limited to this and not a representation of the entire construction industry or even the residential construction industry. Based on the findings, several recommendations can be made in order to obtain an effective planning in duration estimation that being practised nowadays. However, regarding to this research, there are some improvement that have been discovered. The first thing that needs to be observed is on the first phase of construction is the schedule planning. This is because the duration estimated is very important in order to make sure the project can be conducted according to the plan without having problem in time, cost money and quality. So, in order to make an improvement, the factors that might contribute the duration of estimation of construction work need to be identified to ensure the project planning has an effective schedule planning. As in this research, the factors are already been listed and considered during the reschedules.

For further study, it suggested that a few recommendations to improve the schedule planning process and produce an effective planning for construction work are:

i. Contractor's improper planning

ii. Inadequate contractor experience

iii. Client's finance and payments for completed work

iv. Problems with subcontractors

v. Shortage in material

vi. Labor supply

vii. Equipment availability and failure

viii. Lack of communication between parties

ix. Mistakes during the construction stage

	RANK		
FACTORS	**HIGH**	**MODERATE**	**LOW**
Contractor's improper planning	✓		
Inadequate contractor experience	✓		
Client's finance and payments for completed work	✓		
Problems with subcontractors		✓	
Shortage in material			✓
Labour supply			✓
Equipment availability and failure		✓	
Lack of communication between parties		✓	
Mistakes during the construction stage		✓	

A brief summary of each of the best practices found are presented in order of highest recommended to least recommended

1. Contractor's improper planning

Local contractors often fail to come out with a practical and workable ''work program'' at the initial planning stage. This failure is interrelated with lack of systematic site management and inadequate contractor's experience towards the projects. The consultant only checks and reviews the work program submitted by the contractors based on experience and intuitive judgment. Improper planning at the initial stages of a project manifests throughout the project and causes delays at various stages. Only a project that is well planned can be well executed.

2. Inadequate contractor experience

Odeh and Battaineh indicated that inadequate contractor experience was an important factor and this could be linked to the contract awarding procedure where most projects were awarded to the lowest bidder. A contractor with inadequate experience cannot plan and manage the projects properly and this can lead to disastrous consequences.

3. Client's finance and payments for completed work

Construction works involve huge amounts of money and most of the contractors find it very difficult to bear the heavy daily construction expenses when the payments are delayed. Work progress can be delayed due to the late payments from the clients because there is inadequate cash flow to support construction expenses especially for those contractors who are not financially sound.

4. Problems with subcontractors

Typically in huge projects, there are many subcontractors working under main contractors. If the subcontractor is capable, the project can be completed on time as planned. The project can be delayed if the subcontractor under performs because of inadequate experience or capability. High degree of

subcontracting in Malaysia leads to high risk of delays and this leads to inefficiencies in the Malaysian construction industry.

5. Shortage in material

Shortages in basic materials like sand, cement, stones, bricks, and iron can cause major delays in projects. Since Malaysia is a country that is developing very fast, often times demand exceeds the supply and this causes prices to increase. The contractors postpone the purchase activities until the prices decrease. Manavazhia and Adhikarib investigated material and equipment procurement delays in highway projects in Nepal and found these delays to cause cost overrun.

6. Labor supply

The quality and quantity of labor supply can have major impact on the projects. About 20% of the workers in the Malaysian construction industry are foreign workers, mainly from Indonesia and Vietnam (MALBEX). A few of them are illegal workers and their work quality is relatively low when compared to local labourers. The low quality and productivity of the foreign workers have impact on the project progress and efficiency. The illegal workers are frequently caught by the Malaysian immigrant officials and deported and this causes shortage of labor pool in the construction industry.

7. Equipment availability and failure

Many of the contractors do not own equipments that are required for the construction work. They rent the equipments when required. During the season when there are many construction projects, the equipments are in short supply and are poorly maintained. This leads to failure of the equipments causing the progress to be hampered.

8. . Lack of communication between parties

Since there are many parties involved in a project (client, consultant, contractor, sub-contractors), the communication between the parties is very crucial for the success of the project. Proper communication channels between

the various parties must be established during the planning stage. Any problem with communication can lead to severe misunderstanding and therefore, delays in the execution of the project.

9. Mistakes during the construction stage

The mistakes during the construction stage can be due to accidents, inadequate planning, or miscommunication between the parties. Whatever the reason, the mistakes can have impact on the progress of the project. While analyzing the effects of delays, all respondents were unanimous in ranking the effects. The time and cost overruns were ranked highly by the respondents. Any delay in a project can lead to cost and time overruns and these two are linked. Whenever there are delays, there are disputes as to who should bear the responsibility and the cost. These disputes often lead to an arbitration process by third parties and failure in this process leads to litigation where the disputes are settled by the court. In extreme cases, some projects might be totally abandoned. About 17% of the projects in Malaysia are abandoned (MALBEX).

Further research in identifying the factors that contribute in produce an effective planning would benefit our country construction industry. Hence, it can help the growth of GDP. These suggestions for further research would provide a better understanding of how to produce an effective planning in construction project. It also will provide the industry with an example of how a company is carrying out the schedule planning which related to duration estimation in handling a project. Thus, project also can be produce according to the time, cost, quality and meet the client's needs.

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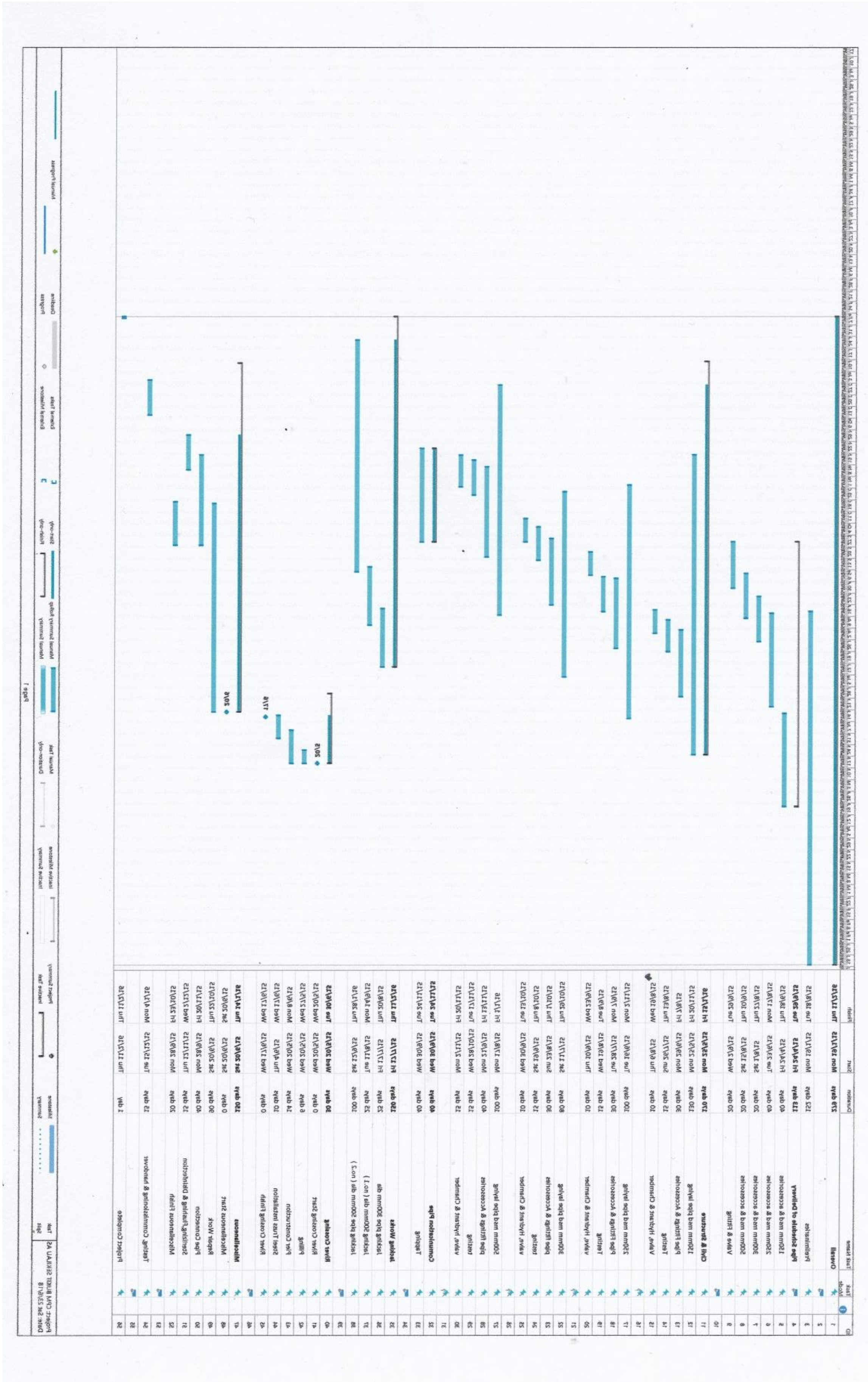
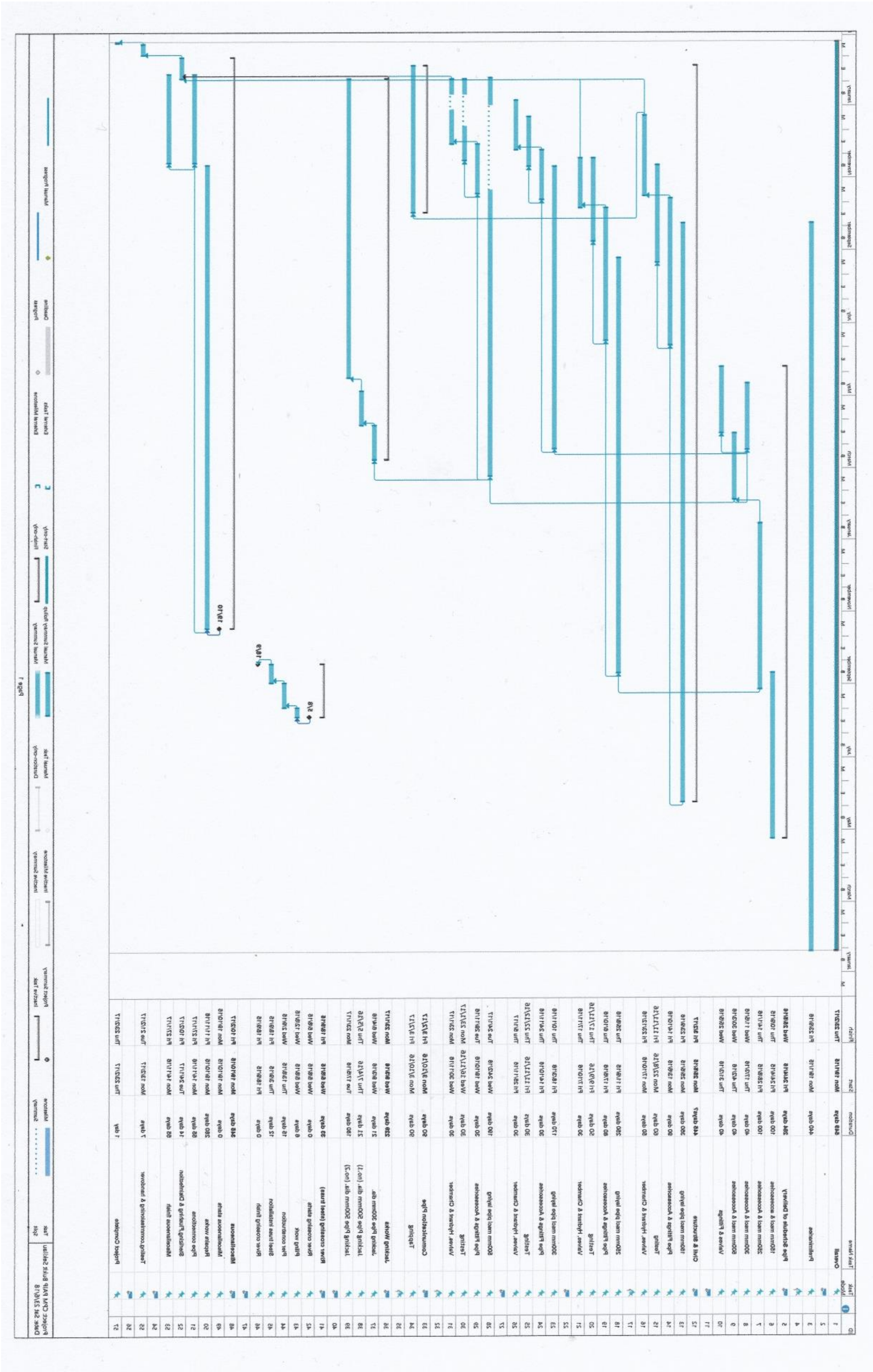
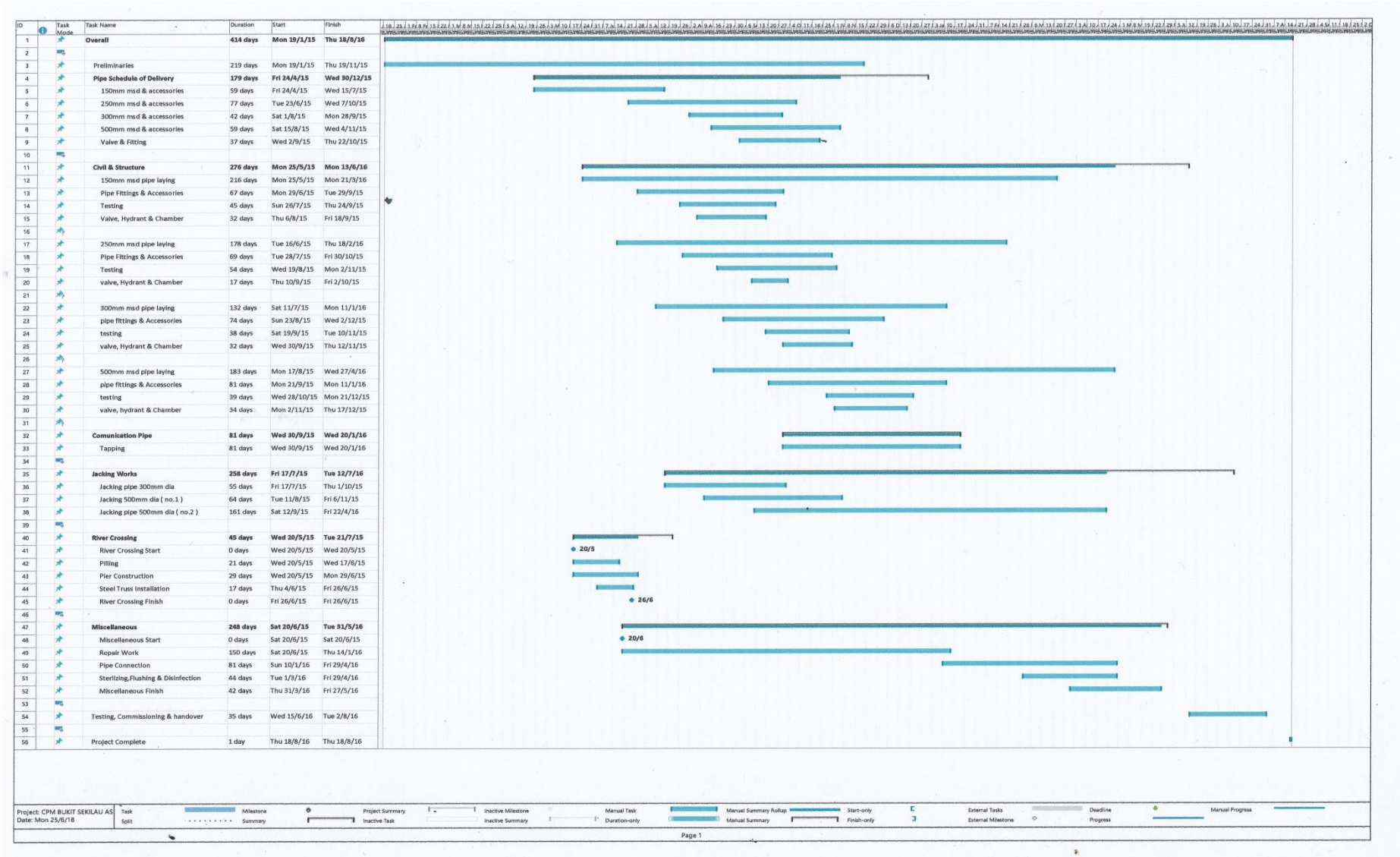
APPENDIX A
EXISTING PLANNING (WITHOUT EOT)



APPENDIX B
EXISTING PLANNING (WITH EOT)

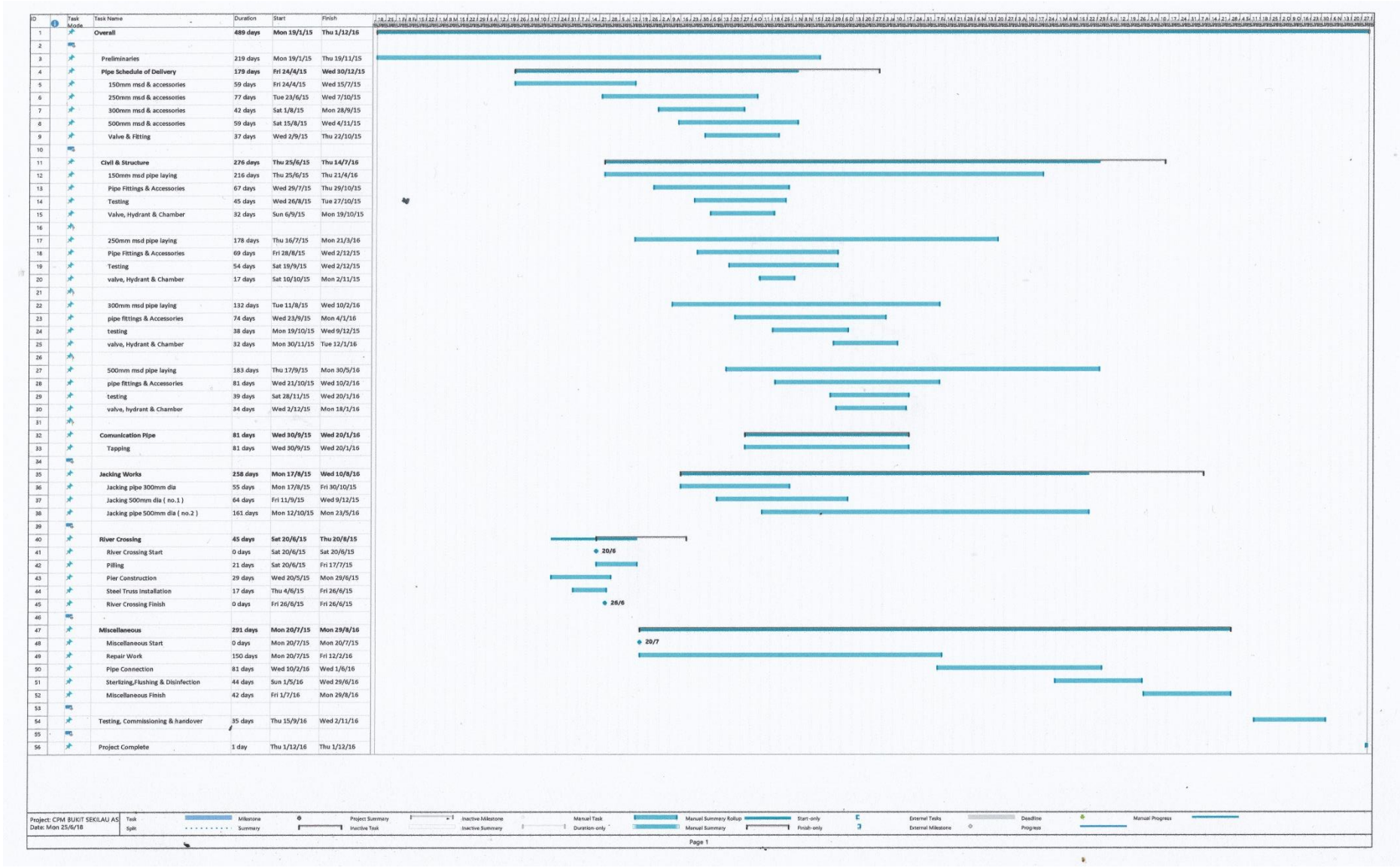


APPENDIX C
RESCHEDULE PLANNING (RAINY DAY, HOLIDAYS)



ID	Task Mode	Task Name	Duration	Start	Finish
1		**Overall**	**414 days**	**Mon 19/1/15**	**Thu 18/8/16**
2					
3		Preliminaries	219 days	Mon 19/1/15	Thu 19/11/15
4		**Pipe Schedule of Delivery**	**179 days**	**Fri 24/4/15**	**Wed 30/12/15**
5		150mm msd & accessories	59 days	Fri 24/4/15	Wed 15/7/15
6		250mm msd & accessories	77 days	Tue 23/6/15	Wed 7/10/15
7		300mm msd & accessories	42 days	Sat 1/8/15	Mon 28/9/15
8		500mm msd & accessories	59 days	Sat 15/8/15	Wed 4/11/15
9		Valve & Fitting	37 days	Wed 2/9/15	Thu 22/10/15
10					
11		**Civil & Structure**	**276 days**	**Mon 25/5/15**	**Mon 13/6/16**
12		150mm msd pipe laying	216 days	Mon 25/5/15	Mon 21/3/16
13		Pipe Fittings & Accessories	67 days	Mon 29/6/15	Tue 29/9/15
14		Testing	45 days	Sun 26/7/15	Thu 24/9/15
15		Valve, Hydrant & Chamber	32 days	Thu 6/8/15	Fri 18/9/15
16					
17		250mm msd pipe laying	178 days	Tue 16/6/15	Thu 18/2/16
18		Pipe Fittings & Accessories	69 days	Tue 28/7/15	Fri 30/10/15
19		Testing	54 days	Wed 19/8/15	Mon 2/11/15
20		valve, Hydrant & Chamber	17 days	Thu 10/9/15	Fri 2/10/15
21					
22		300mm msd pipe laying	132 days	Sat 11/7/15	Mon 11/1/16
23		pipe fittings & Accessories	74 days	Sun 23/8/15	Wed 2/12/15
24		testing	38 days	Sat 19/9/15	Tue 10/11/15
25		valve, Hydrant & Chamber	32 days	Wed 30/9/15	Thu 12/11/15
26					
27		500mm msd pipe laying	183 days	Mon 17/8/15	Wed 27/4/16
28		pipe fittings & Accessories	81 days	Mon 21/9/15	Mon 11/1/16
29		testing	39 days	Wed 28/10/15	Mon 21/12/15
30		valve, hydrant & Chamber	34 days	Mon 2/11/15	Thu 17/12/15
31					
32		**Comunication Pipe**	**81 days**	**Wed 30/9/15**	**Wed 20/1/16**
33		Tapping	81 days	Wed 30/9/15	Wed 20/1/16
34					
35		**Jacking Works**	**258 days**	**Fri 17/7/15**	**Tue 12/7/16**
36		Jacking pipe 300mm dia	55 days	Fri 17/7/15	Thu 1/10/15
37		Jacking 500mm dia (no.1)	64 days	Tue 11/8/15	Fri 6/11/15
38		Jacking pipe 500mm dia (no.2)	161 days	Sat 12/9/15	Fri 22/4/16
39					
40		**River Crossing**	**45 days**	**Wed 20/5/15**	**Tue 21/7/15**
41		River Crossing Start	0 days	Wed 20/5/15	Wed 20/5/15
42		Pilling	21 days	Wed 20/5/15	Wed 17/6/15
43		Pier Construction	29 days	Wed 20/5/15	Mon 29/6/15
44		Steel Truss Installation	17 days	Thu 4/6/15	Fri 26/6/15
45		River Crossing Finish	0 days	Fri 26/6/15	Fri 26/6/15
46					
47		**Miscellaneous**	**248 days**	**Sat 20/6/15**	**Tue 31/5/16**
48		Miscellaneous Start	0 days	Sat 20/6/15	Sat 20/6/15
49		Repair Work	150 days	Sat 20/6/15	Thu 14/1/16
50		Pipe Connection	81 days	Sun 10/1/16	Fri 29/4/16
51		Sterilizing,Flushing & Disinfection	44 days	Tue 1/3/16	Fri 29/4/16
52		Miscellaneous Finish	42 days	Thu 31/3/16	Fri 27/5/16
53					
54		Testing, Commissioning & handover	35 days	Wed 15/6/16	Tue 2/8/16
55					
56		Project Complete	1 day	Thu 18/8/16	Thu 18/8/16

APPENDIX D
RESCHEDULE PLANNING (RAINY DAYS, HOLIDAYS, PERMIT)



ID	Task Mode	Task Name	Duration	Start	Finish
1		**Overall**	**489 days**	**Mon 19/1/15**	**Thu 1/12/16**
2					
3		Preliminaries	219 days	Mon 19/1/15	Thu 19/11/15
4		**Pipe Schedule of Delivery**	**179 days**	**Fri 24/4/15**	**Wed 30/12/15**
5		150mm msd & accessories	59 days	Fri 24/4/15	Wed 15/7/15
6		250mm msd & accessories	77 days	Tue 23/6/15	Wed 7/10/15
7		300mm msd & accessories	42 days	Sat 1/8/15	Mon 28/9/15
8		500mm msd & accessories	59 days	Sat 15/8/15	Wed 4/11/15
9		Valve & Fitting	37 days	Wed 2/9/15	Thu 22/10/15
10					
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14		Testing	45 days	Wed 26/8/15	Tue 27/10/15
15		Valve, Hydrant & Chamber	32 days	Sun 6/9/15	Mon 19/10/15
16					
17		250mm msd pipe laying	178 days	Thu 16/7/15	Mon 21/3/16
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19		Testing	54 days	Sat 19/9/15	Wed 2/12/15
20		valve, Hydrant & Chamber	17 days	Sat 10/10/15	Mon 2/11/15
21					
22		300mm msd pipe laying	132 days	Tue 11/8/15	Wed 10/2/16
23		pipe fittings & Accessories	74 days	Wed 23/9/15	Mon 4/1/16
24		testing	38 days	Mon 19/10/15	Wed 9/12/15
25		valve, Hydrant & Chamber	32 days	Mon 30/11/15	Tue 12/1/16
26					
27		500mm msd pipe laying	183 days	Thu 17/9/15	Mon 30/5/16
28		pipe fittings & Accessories	81 days	Wed 21/10/15	Wed 10/2/16
29		testing	39 days	Sat 28/11/15	Wed 20/1/16
30		valve, hydrant & Chamber	34 days	Wed 2/12/15	Mon 18/1/16
31					
32		**Comunication Pipe**	**81 days**	**Wed 30/9/15**	**Wed 20/1/16**
33		Tapping	81 days	Wed 30/9/15	Wed 20/1/16
34					
35		**Jacking Works**	**258 days**	**Mon 17/8/15**	**Wed 10/8/16**
36		Jacking pipe 300mm dia	55 days	Mon 17/8/15	Fri 30/10/15
37		Jacking 500mm dia (no.1)	64 days	Fri 11/9/15	Wed 9/12/15
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39					
40		**River Crossing**	**45 days**	**Sat 20/6/15**	**Thu 20/8/15**
41		River Crossing Start	0 days	Sat 20/6/15	Sat 20/6/15
42		Piling	21 days	Sat 20/6/15	Fri 17/7/15
43		Pier Construction	29 days	Wed 20/5/15	Mon 29/6/15
44		Steel Truss Installation	17 days	Thu 4/6/15	Fri 26/6/15
45		River Crossing Finish	0 days	Fri 26/6/15	Fri 26/6/15
46					
47		**Miscellaneous**	**291 days**	**Mon 20/7/15**	**Mon 29/8/16**
48		Miscellaneous Start	0 days	Mon 20/7/15	Mon 20/7/15
49		Repair Work	150 days	Mon 20/7/15	Fri 12/2/16
50		Pipe Connection	81 days	Wed 10/2/16	Wed 1/6/16
51		Sterlizing,Flushing & Disinfection	44 days	Sun 1/5/16	Wed 29/6/16
52		Miscellaneous Finish	42 days	Fri 1/7/16	Mon 29/8/16
53					
54		Testing, Commissioning & handover	35 days	Thu 15/9/16	Wed 2/11/16
55					
56		Project Complete	1 day	Thu 1/12/16	Thu 1/12/16