

RISK ASSESSMENT OF TIME AND COST OVERRUN FACTORS
THROUGHOUT CONSTRUCTION PROJECT LIFECYCLE

ISMAAINI BINTI ISMAIL

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Faculty of Civil and Environmental Engineering
Universiti Tun Hussein Onn Malaysia

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This thesis is dedicated to my parents,
Ismail Hj.Salleh and Hazimah Hussein,
for their love, endless support and encouragement.



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ABSTRACT

Construction industry is a very important industry for the economic development of the country. However, this industry has been facing serious problems i.e. failure to complete projects within stipulated time and cost. Hence, the aim of this study is to assess the risk of various factors that cause time and cost overruns throughout the life cycle of construction projects in Malaysia. A total of 35 factors were identified from previous studies. The data collections were carried out using structured questionnaire survey. A pilot study was conducted to determine the level of occurrence and severity of each factor with respect to various phases of project life cycle. Then, the actual survey was conducted in two rounds of Delphi. Delphi round 1 was conducted to assess the probability of occurrence and level of severity of each factor in the life cycle phases. Based on the survey, construction phase was found as the phase that had significantly contributed to time and cost overrun compared to other phases. Then, Delphi round 2 was conducted to seek agreeability from respondents regarding the results obtained from the Delphi round 1. The result showed that majority of respondents had agreed with the results from Delphi round 1. This study found that there were 12 high risk factors on time overrun, namely: *poor site management and supervision, incompetent subcontractors, inadequate planning and scheduling, frequent design changes, mistakes and errors in design, change in the scope of the project, delay preparation and approval of drawings, lack of coordination between parties, slow information flow between parties, lack of communication between parties, shortages of materials, and late delivery of materials and equipment*. While, there were 9 high risk factors on cost overrun, namely: *poor site management and supervision, incompetent subcontractors, schedule delay, inaccurate time and cost estimates, mistakes during construction, incomplete design at the time of tender, poor design and delays in design, contractual claims, such as, extension of time with cost claims, and poor financial control on site*.

ABSTRAK

Industri pembinaan merupakan industri yang sangat penting untuk pembangunan ekonomi negara. Walau bagaimanapun, industri ini telah menghadapi masalah yang serius iaitu kegagalan dalam menyiapkan projek dalam masa dan kos yang ditetapkan. Oleh itu, tujuan kajian ini dijalankan adalah untuk menilai tahap risiko pelbagai faktor yang menyebabkan lebih masa dan kos di sepanjang kitaran hayat projek pembinaan di Malaysia. Sebanyak 35 faktor telah dikenal pasti daripada kajian-kajian terdahulu. Pengumpulan data dilakukan dengan menggunakan soal selidik berstruktur. Kajian rintis telah dijalankan untuk menentukan kemungkinan berlakunya faktor-faktor tersebut dan tahap keterukan setiap faktor dalam setiap fasa kitaran hayat projek. Kemudian, kajian sebenar dijalankan melalui dua pusingan Delphi. Delphi pusingan pertama telah dijalankan untuk menilai kemungkinan berlakunya faktor tersebut dan tahap keterukan setiap faktor yang berlaku dalam fasa kitaran hayat projek. Berdasarkan soal selidik, fasa pembinaan didapati sebagai fasa penting yang menyumbang kepada lebih masa dan kos berbanding fasa lain. Kemudian, Delphi pusingan kedua telah dijalankan untuk mendapatkan persetujuan dari responden mengenai keputusan yang diperoleh daripada Delphi pusingan pertama. Ia dapat disimpulkan bahawa majoriti responden bersetuju dengan hasil daripada Delphi pusingan pertama. Hasil kajian ini mendapati bahawa terdapat 12 faktor berisiko tinggi dalam menyebabkan lebih masa iaitu *kelemahan pengurusan dan pengawalan tapak, subkontraktor yang tidak berkelayakan, perancangan dan penjadualan yang tidak mencukupi, kekerapan perubahan reka bentuk, kesilapan dalam reka bentuk, perubahan skop projek, kelewatan penyediaan dan pengesahan lukisan, kekurangan koordinasi antara pihak, aliran maklumat perlahan antara pihak, kekurangan komunikasi antara pihak, bekalan bahan, kelewatan penghantaran bahan dan peralatan*. Manakala, 9 faktor yang berisiko tinggi yang menyebabkan lebih kos terdiri daripada *kelemahan pengurusan dan pengawalan*

tapak, subkontraktor yang tidak berkelayakan, kelewatan jadual, anggaran masa dan kos tidak tepat, kesilapan semasa pembinaan, reka bentuk tidak lengkap semasa tender, tuntutan secara kontrak seperti penambahan masa dengan tuntutan kos, dan kelemahan kawalan kewangan di tapak.



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PT TAAUTHM
PERPUSTAKAAN TUNKU TUN AMINAH

CHAPTER 1

INTRODUCTION

1.1 Background

In the construction industry, the aim of project control is to ensure that projects finish on time, within cost and achieve other project objectives. Unfortunately, time overrun is a very frequent phenomenon and is associated with nearly all projects in the construction industry (Le Hoai *et al.*, 2008). Similarly, cost overrun is a major problem in project development and is a regular feature in construction industry. The situation of a construction project in which budgetary estimate exceeds estimation, budget exceeds budgetary estimate, and settlement exceeds budget is a universal phenomenon (Ali & Kamaruzzaman, 2010). This trend is more severe in developing countries where time and cost overruns sometimes exceed 100% of the anticipated cost of the project (Kaming *et al.*, 1997; Abd El-Razek *et al.*, 2008). The projects that had faced time and cost overruns problem were reported in numerous countries.

According to Moura *et al.*, (2007), time and cost overruns were major problem in the construction industry of Portugal where the project had experienced time overrun of around 40% of the contract time. While, average cost overrun was recorded as 12% of the contract cost. In Nigeria, Omoregie & Radford 2006) found that average escalation for the time and cost overruns were 188% and 14% respectively. Similarly in Malaysia, several studies have been carried out to

investigate the performance and factors of time and cost overruns in construction industry. As reported by Sambasivan & Soon (2007), about 17.3% of 417 government contract projects in Malaysia were considered sick and abandoned in the year 2005. Besides that, a study conducted in Klang Valley found that most of construction projects were affected by cost overrun due to inaccurate or poor estimation of original cost (Ali & Kamaruzzaman, 2010). Thus, it is very important to address the issues of time and cost overruns to ensure the success of construction projects.

1.2 Problem Statement

A success of any project can be assessed based on the performance of cost, time, quality and safety of the project (Atkinson, 1999; Memon *et al.*, 2013). A project can be classified as successful if it is completed within the stipulated time and cost (Ejaz, Ali, & Tahir, 2013). Besides that, the success of a project is also assessed on the ability in achieving the objectives of the project. However, it is rare for a construction project be completed within contractual time and cost where commonly a huge amount of time and cost overruns occur.

Time and cost overruns are critical issues frequently faced by the construction project worldwide (Le-Hoi *et al.*, 2008; Murray & Seif, 2013; Sweis *et al.*, 2013). This problem is considered as the recurring problem in construction project and gives negative impact to the projects (Sweis, 2013). Similarly, it is also a severe problem in Malaysian construction industry as reported by (Endut *et al.*, 2009; Rahman *et al.*, 2012). A study on 308 public and 51 private sectors construction projects found that only 20.5% of the public sector projects were completed within stipulated time and 46.8% of projects completed within the budget. On the other hand, only 33.35% and 37.2% of private sector projects were completed within the estimated time and cost respectively (Endut *et al.*, 2009). Another study on MARA construction projects also found that 90% of the projects have experienced delay (Abdullah *et al.*, 2011). More recently, the problem of time and cost overruns issue also happened in the construction of Kuala Lumpur International Airport 2 (known as KLIA2). The targeted opening was in September 2011 but was postponed until

May 2014. Its initial budget of RM1.6 billion has since ballooned to RM4 billion. These time and cost overruns were caused by various factors. For example: time and cost overruns in KLIA2 project occurred due to “frequent design change in construction” (Nie, 2014).

These problems were caused by various factors that had affected the progress of works from beginning until the final stage of construction. Therefore, many studies have been conducted to identify the factors that cause time and cost overruns in Malaysian construction projects. Potty *et al.*, (2011) conducted a case study to identify the risk of time and cost overrun factors for multiple Design and Build (D&B) projects in Malaysia. They pointed out that the major factors that led to time and cost overruns were; *shortage and lack in quality materials and appropriate equipment in the local market, no material delivery schedule prepared by the contractor, delay in materials, drawing and proposal approvals by consultant and bad weather conditions*. While, Rahman *et al.*, (2013) studied on factors that had caused cost overrun in large construction projects and found three significant factors of cost overrun were *fluctuation of prices of material, cash flow and financial difficulties faced by contractors and poor site management and supervision*. Karim *et al.*, (2012) focused on investigating risk factors from the perspectives of the contractors that involved in construction projects within Batu Pahat and Muar districts. Results found that the three most important risk factors in construction project were *shortage of material, late deliveries of material, and shortage of equipment*. A study conducted by Alaghbari *et al.*, (2007) identified the most important factors that had caused the delay in construction projects in Malaysia were *financial problems and coordination problems*. Memon *et al.*, (2010) studied the causes affecting the construction cost in Majlis Amanah Rakyat (MARA) large projects. It showed that *cash flow and financial difficulties faced by contractors, contractor's poor site management and supervision, inadequate contractor experience, shortage of site workers, incorrect planning and scheduling by contractors* were the most severe factors.

The previous studies had only focused on identifying time and cost overrun factors. There was a lack of investigation on the risk factors and their relative occurrence throughout the construction project life cycle (CPLC). It is necessary to consider CPLC in this study since the completion of projects involves a few phases such as planning, design, construction and finishing. Since each phase has different

activities, it also has its own risk which is caused by parties that involve in each phase. Hence, it is very important to recognize the risk factors of time and cost overruns in each phase. This will be very helpful in considering the appropriate actions to overcome these problems.

1.3 Aim and Objectives

The aim of this study is to assess the risk of various factors that cause time and cost overruns throughout the life cycle of construction projects in Malaysia. In order to achieve this aim, the following objectives are set as follow:

- i. Identifying time and cost overrun factors throughout the project life cycle.
- ii. Determining the occurrence of the factors throughout the project life cycle.
- iii. Assessing the risk level of the factors of time and cost overruns.

1.4 Scope of the Research

This study involves quantitative approach using structured questionnaire survey in identifying and assessing the risk level of the factors that cause time and cost overruns in construction. However, the scope of this research is limited to the construction companies located in the peninsular Malaysia. Targeted respondents for data collection are clients, consultants and contractors who are registered with the CIDB under Grade 5 until Grade 7.

1.5 Thesis Layout

This study focuses on assessing the risk of the various factors of time and cost overruns. The thesis for this study has been structured into five chapters as follows:

- i. Chapter 1 presents the background of the research issues to provide a broader understanding of the issues and justifying the relevance of the research issues. Following which, the aim and objectives of the research are proposed. The scope of the research then was narrowed to the areas of study.
- ii. Chapter 2 describes the scenario of construction projects in Malaysia, the risk management, concept of time and cost overrun, discussion of time and cost overrun factors, and lastly, this chapter reviews the CPLC phases. All these information are gathered to provide an understanding on the time and cost overrun issues in the context of construction projects.
- iii. Chapter 3 presents the research process to achieve its objectives, to select the appropriate method of data collection and data analysis, and to explain the reason for the selection and how it relates to the research objectives.
- iv. Chapter 4 discusses the data collection, analyzes and discusses the results of the survey to determine whether the research objectives are valid by reflecting the responses from the industry.
- v. Chapter 5 concludes the results of this research by reflecting upon the limitation and weaknesses of the research and also by providing the suggestion for further research.



CHAPTER 2

LITERATURE REVIEW

2.1 Construction Industry in Malaysia

In Malaysia, construction industry has been developed since the independence, and it was considered as a major productive sector in Malaysia (Ibrahim *et al.*, 2010). This industry is made up of many components including thousands of contractors, workers, developers, client organizations (government and private), management, engineering, architectural, and surveying consultants, manufacturers, material suppliers, plant hirers.

The Malaysian construction industry is divided into two areas that comprise general construction and special trade works. For general construction, it involves the residential construction, non-residential construction and civil engineering construction. Meanwhile, for special trade works, it consists of several activities like metal works, electrical works, plumbing, sewerage and sanitary work, refrigeration and air-conditioning work, painting work, carpentry, tiling and flooring work, and glass work (Ibrahim *et al.*, 2010).

The construction industry is a very important part of Malaysian economy and the performance of country's economy has increased almost every year. The 10th Malaysia Plan, which covers the period from 2011 to 2015, will potentially have high impacts on the Malaysian construction sector where it is expected that the

Construction Sector will grow at 3.7% per annum as compared to 6% per annum GDP growth for the country. Under the 10th Malaysian Plan, RM230 billion development funds and RM20 billion facilitation funds have been allocated. Both of these allocations aim to create a strong demand for the construction industry, in which 60% (RM138 billion) of the fund involve physical development. The RM20 billion facilitation fund aims to attract private sectors investment in the industry. As an initiative to strengthen the private sector investment in the industry, 52 projects in the 10th Malaysia Plan that worth RM63 billion are identified to be implemented under Public-Private Partnership (PPP) initiatives. Among the projects are 7 tolled highway at an estimated value of RM19 billion, 2 coal electricity generation plant (RM7 billion), Malaysian Rubber Board's Land Development (RM10 billion), Petronas LNG Melaka plant (RM3 billion), and 2 Aluminium Smelters in Sarawak (RM18 billion).

In the 10th Malaysia Plan, Dato' Shaziman Abu Mansor, Minister of Works Malaysia stated that the construction sector has a remarkable impact on the GDP of many countries including Malaysia. Construction Sector registered a strong growth of 5.8% in 2009, and subsequently 8.7% for the first quarter of 2010 as against the overall GDP growth of 10.1% during the first quarter of 2010.

It can be concluded that construction industry is a major industry that generates country's economic growth and development in providing public amenities which then help the people and increase their productivity which subsequently generates country's GDP.

However, construction industry in Malaysia is facing chronic problems including poor performance of time and cost, construction waste, poor productivity and over dependent on foreign workers. Of these challenges, poor time and cost performance are considered as critical issues (Rahman *et al.*, 2012).

In the past, some significant delay cases were reported by (Riazi *et al.*, 2011). For example, the Malaysia External Trade Development Corporation (MATRADE) project faced 9 years of time overrun and a 70% cost overrun due to inferior construction and abandonment of the project by the first contractor, resulting in the appointment of another contractor. Similarly, the construction of Pandan hospital was planned to complete within 2 years but it faced 4-year delay due to many extensions of time. While, the second Penang Bridge, which was built with the cost of RM4.5 billion, was initially scheduled to be completed in September but was

delayed to November 2013 after the ramp collapsed in June. Shah Alam Hospital also faced the same problem where the development had started on Nov 15, 2007, and was scheduled for completion on June 25, 2011. However, it had stalled twice due to problems with the contractors involved. These cases have caused the Malaysian construction industry to be inefficient and associated with low quality and productivity, leading to a comprehensively negative image and economic volatility (CIDB, 2004). Thus, it is very important to identify the causative factors of time and cost overrun in order to achieve a completion of project within the stipulated time and cost.

2.2 Risks in Construction Industry

A risk within the construction industry is generally perceived as an occurrence that impacts the major objectives of projects, namely cost, time and quality (Dai *et al.* 2009). The risks may be derived from two sources. The first consists of the environmental impacts, which are called external risks. The second consists of the uncertainties that exist in the project itself, which are called internal risks (He Zhi, 1995).

Compared with many other industries, the construction industry is subject to more risks due to the unique features of construction activities, such as long period, complicated processes, abominable environment, financial intensity and dynamic organization structures (Flanagan & Norman, 1993; Akintoye & MacLeod, 1997). Hence, taking effective risk management techniques to manage risks associated with various construction activities has never been more important for the successful delivery of a project.

2.2.1 Systematic Approach to Risk Management

Risk management has become a main part of an organization's activities and its main aim is to help all other management activities to achieve the organization's aims

directly and efficiently. Risk management is a continuous process that depends directly on the changes in the internal and external environment of the organization. In reality, the changes in the environment require continuous attention for identification and control of risks (Tchankova, 2002).

Risk management may be described as “a systematic way of looking at areas of risk and consciously determines how each area should be treated. It is a management tool that aims at identifying sources of risk and uncertainty, determining their impact, and developing appropriate management responses” (Uher, 2003). The objective of project risk management is to identify and manage risks for successful completion of the project. Project risk management is the systematic and iterative process of identifying, analyzing, and responding to project risks. It includes maximizing the probability and consequences of positive events and minimizing the probability and consequences of adverse effects to project objectives (Kasap, 2007).

Different researchers have proposed different ways to implement risk management. There are studies that advocated the necessity of passing through three-stage (Zou *et al.*, 2007), four-stage (He Zhi, 1995; Fayda *et al.*, 2003) and six-stage (Ogunsanmi *et al.*, 2011) process to implement risk management effectively. Taking into account the simplicity and practicability of dealing with fewer stages for practitioners in the industry, this study considers implementing risk management in three consecutive stages as a widely acknowledged approach within the literature (Wang *et al.* 2004; Othman, 2008; Perera *et al.* 2014). Risk identification and risk analysis specify and predict the likelihood and the adverse impacts of risks, whereas risk response concerns the measures taken by project management to reduce the probability and effects of risks.

i. Risk identification

Risk identification is the first step of risk management process, in which potential risks associated with a construction project are identified (Zou *et al.*, 2007). It is of considerable importance since the process of risk analysis may only be performed on identified potential risks (Wang *et al.*, 2004). In this study, risk identification was accomplished through literature review and pilot study. A total of 69 common factors that contribute to time and cost overruns were identified from 80 journals worldwide. From that, 35 factors have been identified as the causes that lead to time and cost overruns on

construction projects in Malaysia. These factors have been confirmed by expert panels during the pilot study. Therefore, the 35 risk factors were used for data collection in this study. In the first round Delphi, expert panels were asked to identify and determine the phase of the listed factors.

ii. Risk analysis

The identified risks are analyzed to determine their severities and then to assign priorities to them (Fayda et al., 2003). Risk analysis is used to evaluate risks, and to ascertain the importance of each risk to the project, based on an assessment of the probability of occurrence (Likelihood) and the possible consequence (Severity) of its occurrence (Othman, 2008). In this study, the factors of time and cost overrun were analyzed using the average index and risk matrix. Based on the results, the risk factors were categorized into three zones: high risk, medium risk and low risk.

Thus, it can be concluded that risk assessment which involves risk identification and risk analysis is a systematic process of evaluating the potential of risks factors that may involve in a project activity.

2.3 Definition of Time and Cost Overrun

Time and cost overrun are common phenomena in projects worldwide (Le-Hoai *et al.*, 2008; Murray & Seif, 2013; Sweis, 2013). Based on previous studies, time and cost overruns have been defined in different ways. Time overrun is described as the additional times that a project takes to be completed compared to the original due date that has been set ahead of construction. The delay could be compensated or otherwise (Sorooshian, 2014). In the study by Pai & Bharath (2013), delay is defined as a slowing down of work without stopping it entirely. Delay will result in disruption of work, low productivity, delayed projects, cost increase, third parties' claims, and contract termination. It also refers to the long construction period due to the problems that occurred during the implementation of the project (Kikwasi, 2012). Lo, Fung & Tung (2006) and Assaf & Al-Hejji (2006) mentioned that delay as a time

overrun either beyond the contract date or beyond the date that the parties have agreed upon for the delivery of the project. It is a project that is not consistent with the plan and is considered as a common problem that occurs in a construction project. According to (Hasan, Suliman, & Malki, 2014), time overrun can be defined as postponing the project completion time due to predicted and unpredicted causes. Completion time is very essential in construction because “Time is Money”.

There are two types of delay: non-excusable delays and excusable delays (Tumi, Omran & Pakir, 2009; Hamzah *et al.*, 2011; Ibironke *et al.*, 2013). A non-excusable delay is delay caused by the contractor or its suppliers, through no fault by the owner. For example: *difficulties in financing project by contractor, poor site management and supervision by contractor, poor communication and coordination by contractor with other parties, and inadequate planning and scheduling* (Hamzah *et al.*, 2011). The contractor is generally not entitled to relief and must either make up the lost time through acceleration or compensate the owner. Therefore, non-excusable delays usually result in no additional money and no additional time being granted to the contractor. While, excusable delays are divided into two: compensable and non-compensable delays. Compensable delays are caused by the owner or the owner's agents. For example: *slowness in decision making process, change orders by owner during construction, late in revising and approving design documents by owner, financial problems (delayed payments, financial difficulties, and economic problems)*. While non-compensable delays are caused by third parties or incidents beyond the control of both the owner and the contractor. These delays are commonly called “acts of God” because they are not the responsibility or fault of any particular party (Alaghbari 2007; Tumi *et al.*, 2009). For example: *flood, wind damage, transportation delays, contract modifications, and labor dispute and strike*.

Thus, time overrun in this study takes into consideration these two types of delays because the identified factors involve in non-excusable delays and excusable delays. The factors that contribute to the non-excusable delay are: *poor site management and supervision, incompetent subcontractors, schedule delay, inadequate planning and scheduling, lack of experience, mistakes during construction, inadequate monitoring and control, cash flow and financial difficulties faced by contractors, poor financial control on site, delay payment to supplier /subcontractor, labour productivity, shortage of site workers, shortage of technical personnel (skilled labour), high cost of labour, labour absenteeism, fluctuation of*

prices of materials, shortages of materials, late delivery of materials and equipment, and equipment availability and failure. While the factors that contribute to the excusable delay are: inaccurate time and cost estimates, frequent design changes, mistakes and errors in design, incomplete design at the time of tender, poor design and delays in design, delay preparation and approval of drawings, financial difficulties of owner, delay in progress payment by owner, contractual claims such as extension of time with cost claims, poor project management, change in the scope of the project, delays in decisions making, inaccurate quantity take-off, lack of coordination between parties, slow information flow between parties, and lack of communication between parties.

Cost is one of the key drivers for construction projects and overrun in cost is a major concern within this industry (Sweis *et al.*, 2013). Cost overrun is also a frequent phenomenon and this problem is quite prominent with all projects of construction industry in Pakistan (Azhar *et al.*, 2008). In the study by Danso & Antwi (2012) and Park & Papadopoulou (2012), cost overrun is defined as the difference between the actual cost at completion and the contract amount agreed between client and contractor. In another study, cost overrun refers to as a budget increase, cost increase, or cost growth (Love *et al.*, 2013). While, Ali & Kamaruzzaman (2010) mentioned that the cost overrun in construction projects can be categorized in four situations in which budgetary estimate exceeds estimation, budget exceeds budgetary estimate, and settlement exceeds budget, and it is a universal phenomenon.

Therefore, the key definitions of time and cost overrun in this study are:

Time overrun: Late completion of activities to the planned schedule due to excusable and non-excusable delay.

Cost overrun: The increase in project cost exceeds the original estimation.

2.4 Time and Cost Overrun Scenario

In construction, time and cost are the most important parameters used to measure the performance and success of the projects. It is considered throughout the project lifecycle. However, most projects do not complete within the prescribed time and

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