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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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

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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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-Hoai 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 & Papadopoulo (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
budgeted cost. It was considered as time and cost overrun (Azhar et al., 2008; González et al., 2013). A detailed empirical analysis of time and cost overrun performance for various types of projects from various countries is summarized in Table 2.1.

Table 2.1: Time and cost overrun scenario

<table>
<thead>
<tr>
<th>Country</th>
<th>Type of Project</th>
<th>Time &amp; Cost Overrun</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hong Kong</td>
<td>Civil engineering projects</td>
<td>85% of the projects faced time overrun</td>
<td>(Yogeswaran et al., 1998)</td>
</tr>
<tr>
<td>Jordan</td>
<td>Public projects</td>
<td>81.5% of projects were delayed</td>
<td>(Al-Momani, 2000)</td>
</tr>
<tr>
<td>Australia</td>
<td>Construction projects</td>
<td>The mean of time overrun was 20.7%. The mean of cost overrun was 12.6%.</td>
<td>(Love et al., 2005)</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>Large construction projects</td>
<td>70% of projects experienced time overrun</td>
<td>(Assaf &amp; Al-Hejji, 2006)</td>
</tr>
<tr>
<td>Nigeria</td>
<td>Infrastructure Projects</td>
<td>The percentage of project delay was 188%. The average percentage of over budget was 14%.</td>
<td>(Omoregie &amp; Radford, 2006)</td>
</tr>
<tr>
<td>Portugal</td>
<td>Construction projects</td>
<td>The average of time overrun was 201 days (40%) from expected time. The average of cost overrun was €2.054.280 (12%) of the initial average cost.</td>
<td>(Moura et al., 2007)</td>
</tr>
<tr>
<td>Malaysia</td>
<td>Construction projects</td>
<td>17.3% of 417 government contract projects were considered sick More than 3 months of delay or abandoned</td>
<td>(Sambasivan &amp; Soon, 2007)</td>
</tr>
<tr>
<td>Bosnia and Herzegovina</td>
<td>Building construction structure</td>
<td>Average of time overrun was 11.55%. Average of cost overrun was 6.84%.</td>
<td>(Žujo et al., 2010)</td>
</tr>
<tr>
<td>India</td>
<td>Highway construction project</td>
<td>90% of projects exceeded the planned construction duration. 57% of projects exceeded the estimated cost.</td>
<td>(Bhargava et al., 2010)</td>
</tr>
<tr>
<td>Nigeria</td>
<td>Civil engineering project</td>
<td>46.1% of projects were delayed , and 53.2% abandoned</td>
<td>(Amu &amp; Adesanya, 2011)</td>
</tr>
<tr>
<td>Malaysia</td>
<td>Construction projects</td>
<td>More than 90% of large MARA construction projects experienced delay</td>
<td>(Abdullah et al., 2011)</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>Building projects (housing, schools, offices, hospitals and super-markets)</td>
<td>35.6% of projects were delayed and the extent of time delays ranged from 1-12 month. 25.2% of projects were overspent and the extent of cost overruns ranged from 0.03 million to 14 million pounds.</td>
<td>(Meng, 2012)</td>
</tr>
<tr>
<td>Ghana</td>
<td>Telecom tower construction projects</td>
<td>35% - 55% of the projects executed experienced 82% time overruns</td>
<td>(Danso &amp; Antwi, 2012)</td>
</tr>
<tr>
<td>Australia</td>
<td>Construction projects (banks, hospitals and hotels)</td>
<td>For construction projects the maximum cost overrun was 244% For the civil engineering projects</td>
<td>(Love et al., 2013)</td>
</tr>
</tbody>
</table>
Thus, from Table 2.1 it can be concluded that time and cost are the two common concerns in construction project, and this was reported by many researchers in different countries, types of project, locations, sizes, and scopes. This conclusion is in agreement with Le-Hoai et al., (2008) that studied to find the causes of delay and cost overruns during the construction phase of projects in Vietnam. It has been proven that the total time and cost overruns faced by each project mostly exceed 50% as shown in table above. This problem is more critical in Nigeria, India, Australia and Malaysia as reported by researchers. It was revealed that projects in these countries had experienced almost or exceeds 100% of time and cost overrun.

2.5 Factors Affecting Time and Cost Overruns

The problems of time and cost overrun occur due to various risk factors such as accidents, price fluctuation, inadequate materials and unfavorable weather condition as cited by (Zaini et al. 2010). Thus, the process of identification of major factors that cause time and cost overrun in construction projects is discussed as below:

i. In order to identify the major factors that cause time and cost overrun in construction projects, 80 journals were reviewed. From different countries, a total of 69 time and cost overrun factors were identified as shown in Appendix D.

ii. Based on frequency (min 1), 35 of the 69 significant factors that cause time and cost overrun were identified. These factors were summarized as shown in Appendix E.

iii. These factors were grouped into seven main categories namely: Contractor’s Site Management Related Factors (CSM), Design and Documentation Related Factors (DDF), Financial Management Related Factors (FIN), Information and Communication Technology Related Factors (ICT), Labour Management Related Factors (LAB), Material and Machinery Related
Factors (MMF), Project Management and Contract Administration Related Factors (PMCA).

iv. These 35 factors were applied in a pilot study to get the confirmation from the expert panel regarding the suitability of these factors in Malaysian construction projects.

In recent years, there have been numerous studies on the identification of influencing factors of project’s time and cost overruns worldwide (Olawale & Sun, 2010). It is summarized as below:

**Malaysia:** Sambasivan & Soon (2007) investigated the time overrun factors and their impact on project completion in Malaysian construction industry. The finding of this study indicated that the ten most important causes were contractor’s improper planning, contractor’s poor site management, inadequate contractor experience, inadequate 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, and mistakes during the construction stage. While, Abdullah *et al.,* (2011) studied the causes and effects of delay in large MARA construction project based on the perception of Project Management Consultants (PMC) in Malaysia. The study found that the 5 most significant causes of construction delay were cash flow and financial difficulties faced by contractors, contractor’s poor site management, inadequate contractor experience, shortage of site workers, and ineffective planning and scheduling by contractors. Besides that, Rahman *et al.,* (2013) identified 20 resource factors in construction industry in Malaysia that caused cost overrun and they also assessed the relationship between these factors. The results showed that the 3 most significant factors were fluctuation of prices of materials, cash flow and financial difficulties faced by contractors and shortages of materials.

**Pakistan:** Azhar *et al.,* (2008) investigated the main factor that caused cost overrun in Pakistan construction sector and the results indicated that the top ten cost overrun factors were fluctuation in prices of raw materials, unstable cost of manufactured materials, high cost of machineries, lowest bidding procurement procedures, poor project (site) management/ poor cost control, delays between design and
procurement phases, incorrect/ inappropriate methods of cost estimation, additional work, improper planning, and unsupportive government policies. While, Nawaz et al., (2013) studied the cost overrun causes which affect the cost performance in construction projects of Pakistan. The result showed the top ten significant causes were corruption and bribery, political interests, poor site management, delay in site mobilization, rigid attitude by consultants, extra work without approvals, frequent changes during execution, gold platting, safety and health and limited access to job sites.

**Egypt**: Aziz (2013) conducted questionnaire survey to identify the factors perceived to cause a delay in the Egyptian construction project. A total of 99 factors that caused time overrun were identified and these factors were categorized into 9 major groups. As a result, the most 3 significant factors for each group was found. They were: (1) Contractor category: ineffective project planning and scheduling, poor site management and supervision, poor financial control on site, (2) Equipment category: shortage of equipment, frequent equipment breakdowns, equipment allocation problem, (3) Owner category: delay in progress payments, selecting inappropriate contractors, inadequate planning, (4) Project category: complexity of project, legal disputes between project participants, ineffective delay penalties, (5) Design category: design changes by owner, misunderstanding of owner’s requirements by design engineer, design errors and omissions made by designers, (6) Consultant category: delay in approving major changes in scope of work by consultant, lack of consultant experience in construction projects, poor communication and coordination between owner and contractor, (7) External category: different tactics patterns for bribes, sudden failures actions, global financial crisis, (8) Material category: shortage of construction materials, late delivery of materials, delay in manufacturing materials, (9) Labour category: unqualified/inadequate experienced labour, shortage of labour, and low productivity of labour. While, Marzouk & El-Rasas (2013) outlined the top ten causes of delay in Egyptian construction projects. It comprised finance and payments of completed work by owner, variation orders/changes of scope by owner during construction, effects of subsurface conditions, low productivity level of labour, ineffective planning and scheduling of project, difficulties in financing project by contractor, type of
project bidding and award, shortage of construction materials in market, late in revising and approving design documents by owner, and unqualified workforce.

India: Pai & Bharath (2013) studied the causes of delay in Indian infrastructure projects. This study found 73 causes and has classified them into nine groups. Three critical causes of delay were identified for each group which were (1) Project group: original contract duration is too short, legal dispute between various parties, and type of construction contract, (2) Owner group: delay in progress payment by owner, late revision and approval by owner, and delay in giving site to contractor, (3) Contractor group: ineffective planning and scheduling, difficulty in financing by contractor, and delay in subcontractor work, (4) Consultant group: late revision and approval by consultant, poor communication, and inflexibility of consultant, (5) Design group: mistakes and discrepancies in design document, unclear and inadequate details in drawings, and complexity of the project design, (6) Material group: delay in material delivery, shortage of material in market, and changes in material type and specification, (7) Equipment group: equipment breakdown, shortage of equipment on site, and low level skill of operator, (8) Labour group: Shortage of labour, unqualified work force, and low productivity, (9) External group: effects of subsurface condition, delay in getting permit from municipality, and rain effect on site.

Nigeria: Ameh, Soyingbe, & Odusami (2010) investigated the significant factors that caused cost overruns in the development of telecommunication projects in Nigeria. This study involved 53 telecommunication projects scattered over the six geopolitical zones. The result indicated that the three major causes of cost overruns were lack of experience of contractors on telecommunication projects, high cost of imported materials, and fluctuation in the prices of materials. While, Amu & Adesanya (2011) studied the factors that contributed to time overrun in Nigerian construction project. The result showed that funding and payment, contractor and client factors were the major factors that contributed to the delay of projects.

Turkey: Gündüz et al., (2013) conducted a survey on Turkey construction projects to identify the delay factors. 83 delay factors were identified and categorized into 9 major categories. Results of their study indicated that the most significant factors
were inadequate contractor experience, ineffective project planning and scheduling, poor site management and supervision, design change by owner, late delivery of materials, unreliable subcontractors, delay in performing inspection and testing, unqualified workers, change orders, delay in site delivery, delay in approving design documents, delay in progress payments, slowness in decision making, poor communication and coordination with other parties, and unexpected surface and subsurface conditions.

**Ghana:** Fugar & Agyakwah-Baah (2010) conducted a study to investigate the causes of delay in building construction projects in Ghana through interviews and questionnaires survey. A total of 32 causes of delay were analyzed and the top ten influencing factors in causing delay were delay in honoring certificates, underestimation of the costs of projects, underestimation of the complexity of projects, difficulty in accessing bank credit, poor supervision, underestimation of time for completion of projects by contractors, shortage of materials, poor professional management, fluctuation of prices, and poor site management.

**Bahrain:** Hasan *et al.*, (2014) identified the delays in road projects in Bahrain. A total of 47 causes were identified and the result indicated that main causes of delay related to contractors, owners and consultants were improper planning and scheduling, delay in decision making, and lack of experience respectively. While, time and cost overruns were found as the most frequent effects of delay.

Therefore, the similarities and differences of time and cost overrun factors in Malaysian construction projects to other mentioned countries are shown in Table 2.2.
Table 2.2: Mapping Previous Studies (Causative Factors of Time and Cost Overrun)

<table>
<thead>
<tr>
<th>No</th>
<th>Category</th>
<th>Causes of Time and Cost Overrun</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Jordan</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td>Inadequate planning and scheduling</td>
<td>Kuwait</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>Poor site management and supervision</td>
<td>Vietnam</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>Lack of experience</td>
<td>Nigeria</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>Incompetent subcontractors</td>
<td>Malaysia</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>Inaccurate Time and Cost estimates</td>
<td>Indonesia</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>Mistakes during construction</td>
<td>Vietnam</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>Inadequate monitoring and control</td>
<td>Egypt</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>Schedule Delay</td>
<td>Palestine</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td>Frequent design changes</td>
<td>Saudi Arabia</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>Delay Preparation and approval of drawings</td>
<td>Libya</td>
</tr>
<tr>
<td>11</td>
<td></td>
<td>Mistakes and Errors in design</td>
<td>Ghana</td>
</tr>
<tr>
<td>12</td>
<td></td>
<td>Poor design and delays in Design</td>
<td>Malaysia</td>
</tr>
<tr>
<td>13</td>
<td></td>
<td>Incomplete design at the time of tender</td>
<td>Malaysia</td>
</tr>
<tr>
<td>No.</td>
<td>Category</td>
<td>Issue Description</td>
<td></td>
</tr>
<tr>
<td>-----</td>
<td>----------</td>
<td>-----------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>FIN</td>
<td>Cash flow and financial difficulties faced by contractors</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>FIN</td>
<td>Delay in progress payment by owner</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>FIN</td>
<td>Financial difficulties of owner</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>FIN</td>
<td>Delay payment to supplier / subcontractor</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>FIN</td>
<td>Poor financial control on site</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>FIN</td>
<td>Contractual claims, such as, extension of time with cost claims</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>ICT</td>
<td>Lack of communication between parties</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>ICT</td>
<td>Lack of coordination between parties</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>ICT</td>
<td>Slow information flow between parties</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>LAB</td>
<td>Shortage of site workers</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>LAB</td>
<td>Labour productivity</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>LAB</td>
<td>Shortage of technical personnel (skilled labour)</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>LAB</td>
<td>Labour Absenteeism</td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>LAB</td>
<td>High cost of labour</td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>MMF</td>
<td>Shortages of materials</td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>MMF</td>
<td>Fluctuation of prices of materials</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>MMF</td>
<td>Late delivery of materials and equipment</td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>MMF</td>
<td>Equipment availability and failure</td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>PMCA</td>
<td>Delays in decisions making</td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>PMCA</td>
<td>Change in the scope of the project</td>
<td></td>
</tr>
<tr>
<td>34</td>
<td>PMCA</td>
<td>Poor project management</td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>PMCA</td>
<td>Inaccurate quantity take-off</td>
<td></td>
</tr>
</tbody>
</table>
2.6 Discussion of Factors Causing the Time and Cost Overrun

A total of 35 factors that caused construction time and cost overrun were identified and grouped into seven main categories as discussed below. The categories were adapted from Rahman et al., (2013).

2.6.1 Category 1: Contractor's Site Management Related Factor (CSM)

Contractor's Site Management Related Factor concerns problems or adverse factors caused by contractors. They include poor site management and supervision, incompetent subcontractors, schedule delay, inadequate planning and scheduling, lack of experience, inaccurate time and cost estimates, mistakes during construction, and inadequate monitoring and control. Usually, the factors in this category occur in a construction phase which is under contractor's responsibility as discussed below:

i. Poor site management and supervision

Poor site management and supervision represent the weakness of contractors in managing and controlling the site which affects the time and cost in construction projects. This is due to lack of professional construction managers and lack of knowledge regarding site management (Odeh & Battaineh, 2002). This problem will cause negative impact on progress work that will lead to reworks, change of project scope, poor quality, and frequent change orders by contractors (Murray & Seif, 2013; Nawaz et al., 2013; Sambasivan & Soon, 2007). Thus, the impact from this factor will cause overrun in time and cost of project. It was supported by Le-Hoai et al., (2008) who found that poor site management and supervision were the major problems in Vietnam construction projects. Furthermore, in Malaysia, Sambasivan & Soon (2007) revealed that these factors were the most significant causes of construction delays. While, Ali & Kamaruzzaman(2010) reported that this factor was one of the factors that contributed to cost overrun in construction projects of Klang Valley.
ii. Incompetent subcontractors
   Factor of incompetent subcontractor is related to the inadequate experience or capability of subcontractor in handling their works which leads to high risk of delays (Aziz, 2013; Sambasivan & Soon, 2007).

iii. Schedule delay
   To ensure the success of projects, one of the major considerations is to complete the project within the stipulated time. Unfortunately, schedule delay is a common thing in construction project which leads to time overrun and increase in cost of project (Luu et al., 2009). This problem happens due to fluctuations in the availability of construction materials, very long average waiting times and uncertainties about deliveries of ordered materials, shortages of funds to procure materials, and inadequacy in terms of transportation (Omoregie & Radford, 2006).

iv. Inadequate planning and scheduling
   Planning and scheduling should be managed properly in the earlier part of the construction stage because it involves many works, starting from planning stage until the project complete. Without the proper planning and scheduling, it will cause delay at various stages (Murray & Seif, 2013). Usually, this factor is related to not having the right materials, the right tools, the right information, the right training, and the right people, all at the right place at the right time (Azhar et al., 2008). Due to this factor, project outcomes are likely to be low and an increase in project time and cost overrun will also occur (Long et al., 2004). In a study conducted by Abdullah et al., (2009), project management consultant (PMC) revealed that inadequate planning and scheduling by contractors was the significant cause of delay. The contractors were blamed for not being able to manage the works according to the planned schedule.

v. Lack of experience
   Clients and consultants blame the factor of lack of contractor's experience on site as one of the causes of delay in construction projects. However, contractors asserted that it happened due to the consultants’
(architects/engineers) lack of design experience in the early stage of construction (Chan & Kumaraswamy, 1997). Besides that, Odeh & Battaineh (2002) indicated that lack of experience describes the inability of contractors to plan. When the contractors are incapable of planning and managing their projects smoothly, it can lead to negative impacts on their projects, such as failure to complete the projects on time. This problem will be more severe when the contractors employ young employees and inexperienced management team in order for them to get high profit for their projects. Unfortunately, they cannot handle the project due to lack of experience related to the work (Abdullah et al., 2009; Memon et al., 2010). Indirectly, this factor can cause delay or waste of material and also has an effect on the cost of the project (Memon et al., 2011). For cost overrun problem, it can be observed in the aspect of financial management where most of the contractors did not have the experience to distribute the costs, and this caused the projects to be unable to be planned well (Ali & Kamaruzzaman, 2010).

vi. Inaccurate time and cost estimates

Usually, time and cost estimation are prepared by many parties, but the contractors are often blamed since they are the main party in producing the estimations. However, this happens due to the designs, which are prepared by the owners or consultants, that are not clear and do not consist enough information of the project. Thus, all parties are responsible for this problem (Long et al., 2004). This problem should be avoided because inaccurate time and cost estimates are the main factors that contribute to cost overrun of a project (Ali & Kamaruzzaman, 2010).

vii. Mistakes during construction

Mistakes during construction involve several aspects such as labours, equipment, and also communications. Mistakes caused by labour occur when the labours are careless in their works and do not follow the proper procedures that could result in accidents. While mistakes caused by equipment occur due to the lack of maintenance which leads to inefficiency of equipment. Besides that, miscommunication between the parties will also cause mistakes during the implementation of works. Thus, the right
information from professional managements will avoid the mistakes during construction (Murray & Seif, 2013; Sambasivan & Soon, 2007). However, when this problem happens, it will lead to reworks and indirectly will increase the time and cost of projects.

viii. Inadequate monitoring and control

In the study by Apolot, Alinaitwe, & Tindiwensi (2011), the results indicated that poor monitoring and control was ranked number three in contributing to the cost overruns. Furthermore, this factor will cause poor workmanship and schedule creep.

2.6.2 Category 2: Design and Documentation Related Factor (DDF)

Design and Documentation Related Factors are problems or adverse factors attributable to consultants/designers. Frequent design changes, mistakes and errors in design, incomplete design at the time of tender, poor design and delays in design, and delay preparation and approval of drawings are common factors for which consultants are held responsible. These factors are related to the design of project and occur during design and construction phase as discussed below:

i. Frequent design changes

Frequent design change is considered as the most important factor that inhibits the ability to control time and cost of projects. As a result, it will give negative effect to time as well as cost of project (Olawale & Sun, 2010). This problem happens due to inadequate site and environmental information (Ameh et al., 2010). According to a study conducted by Alwi & Hampson (2003), design changes mostly occurred based on owner’s demands to meet their requirements and preferences. Thus, any changes of design will affect the cost estimation for the project, the volume and type of materials, and also the labour. Furthermore, it also causes the rework of completed item, thus leads to extension of project time (Enshassi et al., 2009).
REFERENCES


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