

**THE KEY CRITICAL FACTORS
TOWARDS TIME DELAY DURING THE
CONSTRUCTION OF BUILDING AND
INFRASTRUCTURE PROJECTS
IN SARAWAK**

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**SCHOOL OF CIVIL ENGINEERING
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BUILDING AND INFRASTRUCTURE PROJECTS
IN SARAWAK

by

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ABSTRAK

Kini, industri pembinaan terdedah kepada banyak risiko, terutamanya penangguhan. Penangguhan projek pembinaan akan menyebabkan penundaan masa dan kenaikan kos. Badget projek akan dibelanjakan secara berlebihan, masa tambahan diperlukan untuk memperbaiki isu akibat kelewatan, dan akhirnya kegagalan projek jika masalah ini tidak ditangani dengan baik. Oleh sebab itu, penyelidikan ini bertujuan untuk mengenal pasti faktor kunci dan juga faktor kelewatan kritikal utama terhadap penundaan masa semasa pembinaan projek di Malaysia. Melalui pemahaman terhadap faktor penundaan kritikal utama, semua pihak akan mempunyai tahap kesediaan yang tinggi dan langkah-langkah yang lebih baik dapat disediakan dengan lebih awal berdasarkan faktor-faktor kritikal tersebut. Penyelidikan ini akan difokuskan pada projek pembinaan bangunan dan infrastruktur di Sarawak, Malaysia. 25 faktor penundaan dikumpulkan daripada kajian sastera dan dikategorikan di bawah faktor pemilik, kontraktor, perunding, bahan, tenaga kerja, dan faktor luaran. Soal selidik disediakan berdasarkan faktor-faktor tersebut dan tinjauan rintis dilakukan untuk memeriksa kesahan soal selidik. Selepas tinjauan rintis, temu bual soal selidik dilakukan bersama 10 responden kontraktor yang berbeza. Data yang dikumpulkan dianalisis melalui perisian Analytical Hierarchy Process (AHP), Expert Choice 11 untuk memeriksa kepentingan keutamaan faktor penundaan melalui perbandingan berpasangan. Akhirnya, kedudukan dihasilkan berdasarkan skor global bagi setiap faktor penangguhan yang dibandingkan. Daripada kedudukan tersebut, faktor penundaan yang paling kritikal ialah produktiviti pekerja yang rendah dan pekerja yang tidak berkelayakan di mana kedua-duanya dikategorikan di bawah faktor tenaga kerja. Berdasarkan responden, prestasi pekerja sangat penting untuk menyiapkan projek pembinaan tepat pada waktunya. Hasil kajian ini berguna dalam memberikan panduan yang lebih baik kepada komuniti pembinaan untuk

mencadangkan strategi yang lebih baik berdasarkan faktor penanguhan kritikal. Pengurus projek dapat mengenal pasti masalah dengan lebih awal dan mengurangkan penundaan masa dan kenaikan kos.

ABSTRACT

Nowadays, construction industry has been exposed to lots of risks, especially delay. Construction project delay will lead to time overrun and cost overrun. Project budget will be overspent, extra time are needed to repair the damage due to delay, and finally project failure if this issue is not handled properly. Therefore, this research aims to identify the major factors as well as the key critical delay factors towards time delay during project construction in Malaysia. By acknowledging key critical delay factors, all parties will have high level of preparedness and better measures can be prepared earlier based on those critical factors. The research will be focusing on the building and infrastructure construction projects in Sarawak, Malaysia. 25 delay factors are collected from literature reviews in which they are categorized under owner, contractor, consultant, material, labor, and external factors. Questionnaire is prepared based on those factors and pilot survey is done to check the validity of questionnaire. After pilot survey, questionnaire interviews are conducted with 10 different contractor respondents. The collected data is then analyzed through Analytical Hierarchy Process (AHP) software, Expert Choice 11 to check for the priority importance of delay factors through pairwise comparisons. Finally, a sequential ranking is generated based on the global score for every compared delay factors. From the ranking, the most critical delay factors are low productivity of labors and unskilled workers which are both categorized under labor-related factor. Based on respondents, labor performance is crucial in delivering a construction project on time. These findings are helpful in providing a better guidance for construction communities to propose better mitigations based on the critical delay factors. Project managers can identify the problems earlier, thus minimizing time and cost overruns.

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CHAPTER 1

INTRODUCTION

1.1 Background of Study

Nowadays, construction industry has been exposed to lot of risks, such as accidents, quality issues and project delay. According to Rachid et al. (2019), delay is the most serious risk in all construction projects. For contractor, delay will increase the overall cost due to extended work schedule, elevated construction material and labour costs. Due to delay, client will need to bear the consequence of losing profit from project deliverables. If the project result does not fulfil owners' requirements, or the completion time exceeds the deadline and there is cost overrun, it shows that the project has failed (Khlaifat et al., 2019). Moreover, the probability in which a construction project can be completed within schedule is very low.

Delay problem in construction industries is still unavoidable regardless of high professional planning and understanding towards project management and building techniques. There are many factors causing project delays, and it is critical to realize the key causes of delays in construction projects. Examples of key delaying factors are client, consultant, and contractor-related issues. By having knowledge regarding these issues, a project can be finished efficiently with success (Adeleke et al., 2020). Besides, based on the researches by Olanrewaju et al. (2017), most construction delay problems are caused by communication issues such as insufficient communication among parties.

Although lots of time and resources are spent, the chance of project delay is still high. This phenomenon reflects the lack of understanding of the real project delay factors. With the rise of complexity and uncertainties of construction projects, difficulty level of handling the projects will be increased (Chan, 2012). Therefore, a comprehensive

understanding of reasons behind project delay at construction stage should be performed so that the construction project can be completed punctually.

Thus, this study is conducted to determine the major delay factors for construction projects. In order to identify the ranking of key and sub delay factors during construction stage of a project, Sarawak contractors' opinions are collected through questionnaire survey. This is because contractor plays as the most critical character in construction stage, ensuring all projects to be running smoothly by reducing the delay risk (Hasmori et al., 2018).

1.2 Problem Statement

Delays in construction projects are usually inevitable regardless of the planning done before construction phase. Project delay may lead to lots of consequences, and eventually project failure. Therefore, the importance of ensuring construction project finished on time is very critical for all parties, especially contractors. If the key delay factors are not highlighted, the project performance will become poorer.

Moreover, project parties such as clients, consultants and contractors fail to understand their roles and responsibilities in succeeding a construction project. Most of them do not realize the key problems leading to project delay during construction stage. Measures and solutions are not provided as soon as the problems emerge, causing project delay and budget loss. Poor management of these project issues may cause time overrun, cost overrun, and finally project failure (Gamil & Rahman, 2017). The construction project is not able to be completed within the schedule, leading to financial loss, litigation, and other social problems.

Delay in construction projects can lead to losses in time, quality and cost. More resources will be wasted to repair the damage due to project delay, causing budget deficit.

Hence, by identifying the major delay factors and their significances, most construction projects' performance can be improved. This is because better delay mitigations can be proposed based on the critical delay factors from the ranking.

1.3 Objectives

There are few objectives required to complete this study. The objectives of the study are:

- i) To identify the major factors towards construction project delay in Sarawak.
- ii) To determine the priority importance of key and sub delay factors for construction projects in Sarawak.
- iii) To analyse the sequential ranking of critical delay factors for construction projects in Sarawak.

1.4 Scope of Work

This study is focusing on the determination of the key critical delay factors towards time delay in construction project during construction stage. The study area is emphasized on the construction of building and infrastructure projects in Sarawak, Malaysia. The chosen respondents for questionnaire surveys only consist of those involving in Sarawak contractor companies, such as site engineers, site supervisors, and project coordinators. However, this study is surely impossible to list out all the delay risks because all construction projects have their own specialties and complexities. By identifying all major delay factors, priority importance of the key and sub delay factors are obtained based on comprehensive data collected from questionnaire surveys. Finally, a sequential ranking is generated, and the most critical delay factor during project construction stage will be determined.

1.5 Significant of Study

Construction industry is the most important sector in every country. Any delay in construction industry can lead to great economic loss to a country. Therefore, the critical delay risk factors need to be determined in the first hand. The analysis of delay factors and their outcomes can be relevant and applicable to most construction projects. The data collection from questionnaire surveys with real construction personnel will provide a wide view for this study. After that, better mitigation measures can be generated based on those critical factors. This study provides an opportunity for local and global construction project managers to have a better insight into key causes of project delay and other possible risks. Through this study, all construction teams will have high level of preparedness and responses during project involvement. Project managers can identify the problems earlier, thus reducing time and cost overruns due to project delay.

1.6 Dissertation Outline

This study report consists of five chapters. Chapter 1 is the introduction including study background, problem statements, objectives, and work scopes. Chapter 2 is literature review focusing on the project delay cases and the major factors causing project delays. Chapter 3 is the methodology part that explains the procedures for data collection and analysis. Chapter 4 is result and discussion section that presents the data analysis through questionnaire interviews. The data is analysed, coming out with the most critical delay factor through ranking of overall key and sub delay factors. Finally, Chapter 5 is concluding the findings and recommendations from this study. This research is expected to eliminate the delay issue in Malaysia construction project. Identification of the most severe delay factor is therefore a good start in tackling the project delay.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter reviews the key literature concerned with the factors causing delays in construction projects. There are many problems during construction stage, and this will lead to various consequences such as project delay. Hence, the types of problems need to be identified, and the reasons leading to delays in constructions should be determined.

Numerous articles and scholars have conducted comprehensive research in an attempt to determine the factors causing the delaying in constructions and the factors behind them. Reviewing of these literatures and previous research can aid in developing our understanding and knowledge on how to actually minimize the risks of project delay or failure. Online resources, journal, thesis, conference papers or books are the resources that can provide us with useful information about this topic. The reviews mainly include the examples of project delay cases in various countries all over the world, including Malaysia. Moreover, the causes behind the delays will be further investigated, coming out with the critical factors causing the delays in construction projects. Then, suitable solutions to tackle those delaying factors can be proposed.

2.2 Project Delay Cases

King Abdulaziz International Airport (KAIA) in Jeddah is one of the biggest airports in the world, sitting as gateway to Medina and Mecca for religious tourism. According to Al Hudhaif (2021), this project was supposed to have completed in 3 years, but it is still not fully completed after a decade. KAIA airport will be expanded in three phases, in which the final phase should be completed in 2017. However,

currently the first phase of project is just completed in 2020 and there are two more phases behind the schedule. Time delay and cost overruns seems to be the key reasons leading to delay in KAIA airport expansion project (Baghdadi & Kishk, 2015).

Having a height of 1 km, Jeddah Tower will become the highest building on Earth upon completion. The construction of this skyscraper project had not yet finished since 2013 and there is no updated completion date until now. Jeddah Tower is supposed to be fully completed in 2020, but this project is delayed due to some issues. In 2018, Jeddah Economic Company (JEC) stopped the construction due to labour issues and country's anti-corruption purges. Later in 2020, JEC announced that the construction will be resumed, and the date of completion is still an unknown.

Kuala Lumpur International Airport 2 (KLIA 2) is the largest airport terminal for low-cost carrier in Malaysia. Starting the operation on 2 May 2014, it is built to replace to previous Low-Cost Carrier Terminal (LCCT) by AirAsia. It is designed to accommodate 45 million passengers annually. Based on the review by Novitasari (2013), this KLIA 2 project was delayed for 2 years. The original starting date is 15 July 2010, and the project should be finished on 15 April 2012. However, the final completion date was falling on April 30, 2014, and the airport was opened to public on 2 May 2014. The reasons behind the delays are the incoordination between contractors, and redesign of airport capacity in last minute. Due to delaying, the main contractor was fined for RM 199445.40 per day as Liquidated Ascertained Damages (LAD).

Merdeka 118 is a 644 m skyscraper currently under construction in Kuala Lumpur with lots of innovative technologies involved. This tower will be the tallest building in Malaysia, and the second tallest building in the world upon completion. Initially, Merdeka 118 is expected to complete at the end of year 2021, but it was delayed until the range within April and June (Q2) in 2022. This is mainly due to the

Movement Control Order (MCO) on March 2020, and the original schedule is delayed by more than half year. According to Permodalan Nasional Berhad (PNB), currently in February 2021, the tower is 70 % completed and the contractors are catching up with the schedule to meet the latest completion date in 2022.

2.3 Causes of Delays

Ghulam Abbas Niazai and Kassim Gidado (2012) had carried out a research to investigate the causes of delays in construction sectors in Afghanistan. From the results, the major delaying factors are corruption, poor qualification, poor site management, and payment delay.

Susanti (2020) identified the reasons behind delay of projects in Indonesia from the perspective of clients and contractors. Her research revealed that site location, sudden design changes, delay in work approval, subcontractors performance, price instability of materials, government rules, and bad weather are causing time delay in construction projects.

Moreover, Edison & Singla (2020) analysed the delay causes in India's infrastructure projects. Questionnaires were distributed to respondents to obtain their feedbacks. The result of study showed that poor communication between parties, improper construction methods, low productivity of labors, unskilled workers, transportation issues, shortage of construction materials, complexity of project, insufficient field inspection are contributing to delays in a project.

Besides, additional requirements, final design errors, rework, and cultural issues are the root causes of delay in Victoria-based pipeline projects in Australia (Orangi et al., 2011).

Bhavsar et al. (2020) had carried out a study on key factors affecting construction of airports in India. Delay in decision-making and information privacy are causing the delay in airport construction projects.

Table 2.1 Summary of Literature Review from various authors for Causes of Delays in Construction Projects

Authors	Causes of delays in construction projects
Ghulam Abbas Niazai and Kassim Gidado (2012)	Corruption
	Poor qualification
	Poor site management
	Payment delay
Susanti (2020)	Site location
	Sudden design changes
	Delay in work approval
	Subcontractors performance
	Price instability of materials
	Government rules
	Bad weather
Edison & Singla (2020)	Poor communication between parties
	Improper construction methods
	Low productivity of labors
	Unskilled workers
	Transportation issues
	Shortage of construction materials
	Complexity of project
	Insufficient field inspection
Orangi et al. (2011)	Additional requirements
	Final design errors
	Rework
	Cultural issues
Bhavsar et al. (2020)	Delay in decision-making
	Information privacy

All sub-factors are collected and categorized under few key factors. Lists of factors are shown below:

Table 2.2 List of Delay Factors

Factors causing Delay at Construction Stage
Owner-Related Factor
• Payment delay
• Poor communication between parties
• Delay in decision making
• Delay in work approval
• Information privacy
• Additional requirements
Contractor-Related Factor
• Poor site management
• Subcontractors performance
• Improper construction methods
• Rework
• Poor qualification
Consultant-Related Factor
• Insufficient field inspection
• Final design errors
• Sudden design changes
Material-Related Factor
• Price instability of materials
• Transportation issues
• Shortage of construction materials
Labor-Related Factor
• Low productivity of labors
• Unskilled workers
External Factor
• Corruption
• Site location
• Government rules
• Bad weather
• Complexity of project
• Cultural issues

2.3.1 Owner-Related Factor

Owner-related factors refer to any behaviors from owners that will cause project delay. Examples of owner-related factors are payment delay, poor communication between parties, delay in decision making, delay in work approval, information privacy and additional requirements.

2.3.1(a) Payment Delay

Questionnaires were distributed to contractors and subcontractors in Selangor, Malaysia, coming out with the result showing that majority contractors do not receive the payment in time when the given tasks are finished. The top three impacts of delayed payment are fatalistic chain effect on other parties, delay in project schedule, and finally bankruptcy. So, the practice of punctual payment should be emphasized to make the project succeed (Raman et al., 2016).

2.3.1(b) Poor Communication between Parties

Weak communication can lead to time overrun and cost overrun. Poor communication can happen in large scale (client, consultant, contractor), and small scale (personnel in same organization). Communication problem can also lead to accidents at site. Lacking of effective communication among parties seems to be the key factor towards poor communication (Gamil & Rahman, 2017). Poor professionalism among stakeholders, low transparency of available budget, and poor responsibility will severely influence the communication process. Awareness campaigns are introduced to make all people understand the importance of communication in constructions (Gamil et al., 2019). Training programs and workshops

can be conducted to improve the managing skills of involved construction parties (Alhomidan, 2013). By having improved communication skills, the project budget and schedule will be more stable.

2.3.1(c) Delay in Decision Making

Slow decision-making by clients will affect the overall project schedule. For example, delay in decision-making is happening in rural area due to far distance among each other that are involved in construction project. Without site meeting, project teams can only use mobile phones to communicate, which in turn slowing down the decision-making process (M Z Ramli et al, 2018). Lacking of knowledge also causes delay in decision-making. Clients have less confidence to make their decision based on current situation. Delay occurs, as there is no instruction given by owners. A deadline should be set so that decision must be made within that period in order to avoid delay (Nasir et al., 2016).

2.3.1(d) Delay in Work Approval

Delay in work approval will result in cost overrun, based on the research on road construction projects in Saudi Arabia. Late work approval by clients may delay the project schedule. More labour costs will be required to cover the expenses due to late approval (Alhomidan, 2013). Slow decision making by clients has negative effect on delay of construction projects in Pakistan. All parties should undergo essential training programmes in time, cost, quality control and project management (Rachid et al., 2019).

Moreover, contractors cannot move on to the next tasks without work approval from owners. Clients should check and approve the work punctually. They should monitor the work closely by conducting site inspections during the execution of the

project to ensure that all work is done based on design requirements. Clients should also define the project scope carefully so that there will be no variation order (Rachid et al., 2019).

2.3.1(e) Information Privacy

Information privacy is one of the issues that will affect the project progress. Based on the case study in India, construction of airport involves high safety considerations, thus having strong national security sensitivity. There will be limitation on the sharing of the construction data among project teams. Due to information privacy, the decision-making process will be affected, as the available information is insufficient (Bhavsar et al., 2020). Improved communication and coordination between parties is critical in minimizing the delay risks. Important construction information should be well distributed to all members to understand the project scope clearly. All project members must recognize the whole construction process by understanding their own responsibilities (Tafazzoli & Shrestha, 2017).

2.3.1(f) Additional Requirements

Some clients will come out with extra requirements during construction phase. For example, clients may suddenly demand for the usage of different construction materials rather than using the original materials agreed previously. Varying of Bill of Quantities (BOQ) will occur as the actual performed work is totally different from the BOQ provided during tendering. BOQ is created to show the items of works for tendering, and to create an agreement among parties involved for contracting. BOQ is important for all parties to have a clearer view about the work scope and cost in a construction project. Due to additional requirements, contractors or consultants need to

perform extra work, causing time and cost overruns. Therefore, clients and the project teams should examine all drawings and inspect the design carefully to ensure that all items are listed in BOQ. The item quantities need to be measured accurately to come out with the nearest possible construction cost. By having a standard BOQ, project delay risk can be lowered (Razali et al., 2016).

2.3.2 Contractor-Related Factor

Contractor-related factors refer to any behaviors from contractors that will cause project delay. Examples of contractor-related factors are payment delay, poor communication between parties, delay in decision making, delay in work approval, information privacy and additional requirements.

2.3.2(a) Poor Site Management

Poor site management is the key challenge for construction site in Swaziland. Bad site management will cause administration, technical and communication issues. Eventually, the time and budget may be affected. From the survey, contractors need to be responsible for this problem. All parties should be well trained to deal with unforeseen risks. All problems should be reported to top management to come out with solutions as soon as possible (Dube, N.N.F., Aigbavboa, C.O., Thwala, 2015).

2.3.2(b) Subcontractor Performance

Non-performance of subcontractors will obstruct time and cost control in constructions. This problem may be due to insufficient communication between main

contractors with subcontractors. There is no healthy working relationship among contractors and subcontractors. Therefore, subcontractors may not fully understand the project scope. Contractors should guide the subcontractors to let them know the project goals and targets that should be achieved (Olawale & Sun, 2010).

2.3.2(c) Improper Construction Methods

Correct selection of construction methods is the key to secure the time, cost, quality, and customers' fulfilment. However, many companies nowadays are still struggling with selection of the most suitable construction technique for their projects, eventually dragging the schedule (Ferrada & Serpell, 2014). Poor qualification and performance of contractors will yield inappropriate construction methods. Contractors have fewer experiences to perform the given tasks, causing them to use the wrong methodology to finish the job. Failure in completing the job will impact the final cost and affect the project timetable (M Z Ramli et al, 2018). Contractors need to be well trained in handling the projects either in rural or urban area so that the projects can be finished with the most appropriate construction technique. Modern techniques such as Industrialized Building System (IBS) and prefabricated construction can be adopted rather than insisting on using traditional conventional method.

2.3.2(d) Rework

Rework is conducted when there is any activity fails to fulfil customers' requirement or the completed work is not tally with what have stated in contracts. The major rework causes are deception, competition, weak management, schedule pressure and weak job security. Inexperienced workers also cause failures and rework.

Contractors need to pay attention on supervision and site management to ensure that all tasks are performed based on requirements (Enshassi et al., 2017).

2.3.2(e) Poor Qualification

The failure to generate strategic plans for future construction projects has caused many delay cases in the Saudi Arabia construction sector. Moreover, the level of involvement of each party in the construction process is relatively low. For example, the contractor is unaware of technical issues and simply passes the tasks to the workers. Contractor may not understand the design from consultants. These issues have resulted in miscommunication between project parties due to confusion. The projects are unable to be finished in time due to lacking of professionalism of involved parties. In order to solve this problem, Saudi government is suggested to encourage local contractors and consultants to collaborate with outside experienced companies to improve their experiences (Al-Kharashi & Skitmore, 2009).

2.3.3 Consultant-Related Factor

Consultant-related factors refer to any behaviors from consultants that will cause project delay. Examples of consultant-related factors are insufficient field inspection, final design errors, and sudden design changes.

2.3.3(a) Insufficient Field Inspection

Project nature and site location need to be considered carefully before starting of design. Insufficient field inspection at site can lead to design errors, leading to project

failure. Consultants do not consider the historical data of the site area during the design stage, especially in rural area. The final design may not suit the site conditions because not all construction site has a perfectly flat ground. Moreover, buildings of high resistance should be designed to deal with bad weather such as rain and snow (M Z Ramli et al, 2018). Effective communication between design teams, contractors and clients is required to ensure that all site data is collected, and better design can be produced.

2.3.3(b) Final Design Errors

Final design errors in construction projects may affect the cost, time, and safety. More time is wasted to redesign the building. Design errors occurs due to unclear project scope, weak coordination, and human mistakes. Based on result, design errors in structural and mechanical works are ranked top, following by structural and plumbing design mistakes, and finally structural and architecture parts. Engineers are advised to recognize the most severe design errors, and take immediate actions when such errors happen (Peansupap & Ly, 2015). Consultants should help in improving the skills of their staffs. Coordination between construction parties need to be enhanced to ensure that the shared information is correct. Through this method, all people can review the design, and possible errors can be identified earlier (Ghulam Abbas Niazai and Kassim Gidado, 2012).

2.3.3(c) Sudden Design Changes

Sudden changes in design during construction will have severe impact on the project cost. From studies, changes in design will increase the overall cost for 5 % to 40 %. Contractors need to redo the work, which in turn greatly delay the schedule.

Lacking of communication among parties is the most critical factor contributing to design changes. It is recommended that effective communication will tend to solve this problem (Aslam et al., 2019).

2.3.4 Material-Related Factor

Material-related factors refer to any construction material issues that will cause project delay. Examples of material-related factors are price instability of materials, transportation issues, and shortage of construction materials.

2.3.4(a) Price Instability of Materials

Contractors in Nepal are facing the problem of price instability, causing them to lose at least 52 % of their expected profit. Project delay seems to be the negative effect of price fluctuation. Price instability is due to changing of exchange rate, taxes, economic condition, availability of raw materials, energy and transportation fees, external shock, and finally disproportion between supply and demand. Contractors should practice good value engineering concept and human resource management. Clients can apply cost-reimbursement idea by providing extra fee to contractors in order to recover some profit due to price instability (Mishra & Regmi, 2017). Akanni et al. (2014) suggested that government should encourage research in production of local building materials instead of relying on imported materials.

2.3.4(b) Transportation Issues

Material delivery is one of key factor causing delay in construction project. In rural area, it is hard to purchase materials if compared to urban area. Therefore, additional transportation fee is required to deliver those construction materials to the site. The time taken for the materials to reach the site will be longer due to low accessibility. The overall construction cost will increase, and the project schedule may delay, as the materials do not reach in time. Therefore, a comprehensive survey and preparation should be conducted before starting of project to avoid any possible problems especially when the site is located at rural area (M Z Ramli et al, 2018).

2.3.4(c) Shortage of Construction Materials

Based on research conducted at Kepulauan Anambass Regency, Indonesia, materials-related problems are dominating the reasons of development project delaying. Since Kepulauan Anambass Regency is surrounded by sea, it can only be accessed through sea and air transportations. Due to geographical conditions, the construction materials need to have high resistance towards corrosion and wind. This kind of construction materials are hard to be found in the local market. Therefore, contractors need to wait for materials importation from overseas, hence wasting a lot of time (Arumsari & Karim, 2020). Poor procurement method and delayed identification of category of materials required worsen the condition. Moreover, rework due to poor workmanship as a result of improper installation will also lead to shortage of available construction materials. Construction parties are advised to estimate the materials quantity accurately to meet the actual site demand. Type of materials used need to be specified to ensure that materials are procured correctly, and the amount is sufficient for construction (Rahman et al., 2017).

2.3.5 Labor-Related Factor

Labor-related factors refer to any behaviors from labors that will cause project delay. Examples of labor-related factors are low productivity of labors and unskilled workers.

2.3.5(a) Low Productivity of Labors

From the study, there are six factors contributing to project delays, and one of the factors is Labour Related Factors (LR). It is agreed that low productivity level of workers will cause heavy deviation in terms of time and cost for a construction project. This is because the workers could not finish the given tasks in time (Edison & Singla, 2020). Karthik & Kameswara Rao (2019) had conducted a study to determine the factors affecting the labor performance. Ranking is generated to come out with the significance of those factors. Lacking of workers' experiences, bad work arrangement, poor supervision, impractical scheduling, poor physical performance, and fatigue are in charge for weak productivity of workers in India's construction projects. Contractors should pay more attention on supervising the workers at site to make sure that the project progress is not behind the schedule.

2.3.5(b) Unskilled workers

Shortage of skilled construction workers is the main issue in Malaysia construction industry due to quick country development and poor involvement of local people. The provided salary is unattractive and unstable, causing local people to have negative thoughts about construction fields. Contractors will prefer foreign workers with low qualifications, as they are not selective and huge cost can be avoided.

Eventually, the projects cannot be finished punctually as workers do not have relevant experiences (Binti et al., 2012). Based on the research by Karthik & Kameswara Rao (2019), the contractors must hire skilled labor so that workers can conduct their tasks well.

2.3.6 External Factor

External factors refer to any uncontrollable factor others than common key factors which will cause project delay. Examples of external factors are corruption, site location, government rules, bad weather, complexity of project and cultural issues.

2.3.6(a) Corruption

Corruption is always happening in construction sectors, especially in developing countries. This is because there are no effective measures to tackle this problem. Corruption will result in cost overruns, poor work quality, weak productivity, and delays in scheduling. From the studies, law enforcement, constructive reporting channels and stricter audit systems seem to be better ways of removing corruption. High information transparency is also aid in reducing corruption in construction industries (Yap et al., 2020).

2.3.6(b) Site Location

Site location can affect the project progress due to uncertain geological conditions. For example, oil and gas industry projects in Middle East countries often encounter with delay issues due to lack of infrastructure as the sites are far away from town. Contractors

need to be ready and aware of the site condition before the construction so that the progress will be on schedule (Ramli et al., 2018).

2.3.6(c) Government Rules

Government plays an important role in construction industry by creating rules and regulations that all construction parties should obey. For example, clients need to obey government policies in procurements (Wijewardana et al., 2013). Due to Covid-19, government had restricted all construction companies to work from home and site works are prohibited. This had caused suspension in most projects. Projects' time and cost overrun will occur due to stricter government rules. (Gamil & Alhagar, 2020). Moreover, some regulations may rise confusion among clients, contractors, and consultants. Setting up a proper channel can aid in removing potential conflicts (Samarghandi et al., 2016).

2.3.6(d) Bad Weather

Bad weather condition such as heavy rain will cause delays and financial losses in construction projects. This is because most outdoor construction activities are sensitive to surrounding weather. Concrete casting process will be affected due to rainstorm. Alteration in temperature, rain and wind around may affect the construction progress. Through research, sine wave expression is introduced to simulate the probability of a day being workable for a series of activities. This method allows project manager to predict how long a project task will complete based on current weather condition. Suitable early preventive measures can be proposed to cope with the losses due to bad weather (Ballesteros-Pérez et al., 2018).

2.3.6(e) Complexity of Project

Project complexity can influence the project performance. The greater the project complexity, the lower the project performance. A project is defined as complex if it contains various organizations. Wide range of building type, harsh site condition, and convergence of construction and design stages will affect the project progress. Lacking of knowledge about project complexity framework leads to project delay (M et al., 2016). Therefore, effective communication is needed to reduce misinterpretation among various parties. Regular meetings and site visits are conducted frequently to discuss the current problems, coming out with suitable measures in time (Othuman Mydin et al., 2014).

2.3.6(f) Cultural Issues

Failure in managing cultural difference leads to project failure. Impact of cultural difference is more obvious in international construction projects. For example, engineers in western countries face the difficulty in working in Middle East countries due to religious difference and conservative lifestyle. Language barrier also inhibits the communication between parties, as translation is not always useful in knowledge sharing. This may create trust issues as team members have their own cultural backgrounds. Full attention should be given to cultural awareness by understanding the cultural differences among teams. Setting up a local office and hiring local workers for international construction is effective in making good relationship with the local government and people. All team members should respect each other regardless of cultural differences (Xiuli, 2015).

CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter describes the procedures adopted to collect and analyse the data, so that the study objectives can be achieved. The method used for data collection in this research is using questionnaire interview. The collected data were analysed and ranked through Analytical Hierarchy Process (AHP) to identify the top critical delay factor. Generally, the methodology can be defined as the process of reaching the objectives of this study.

3.2 Selected Research Methodology

Firstly, several literature reviews are used to have a full understanding on the major delay factors in construction industry. A questionnaire is developed to evaluate the relative importance of delay factors among each other. Data collection through questionnaire interview are conducted among the selected contractor respondents after pilot survey is conducted.

After conducting literature reviews and interviews with respondents, both qualitative and quantitative data will be used to achieve all stated objectives. The data obtained is analysed through AHP software in result and discussion sections. The ranking of those delay factors will be generated through the analysis. Finally, conclusion and recommendation are generated to finalize the results for this research.

3.2.1 Literature Review

Literature reviews are used to collect all possible delay factors from previous studies and understand the current condition of construction industry around the world.

Reviews on journals, articles, and papers from internet sources will help to gather information regarding the delay factors in the construction sector. Besides, literature reviews are conducted to have a better acknowledgement on the delay issue before looking into the factors towards time delay during construction of building and infrastructure projects in Sarawak.

All collected delay factors are then categorized under 6 key factors, which are owner-related factor, contractor-related factor, consultant-related factor, material-related factor, labor-related factor and external factor.

3.2.2 Preparation of Questionnaire

A sample questionnaire is constructed based on the collected delay factors from literature reviews. The questionnaire is designed into 2 parts, which consists of 1 key delay factor and 1 sub delay factor section. The target respondents are limited to those involving in building and infrastructure construction projects in Sarawak as contractors only.

For the key delay factor section, 6 key factors are listed for comparison, while there are 25 factors in sub delay factor section. Respondents are required to select the priority importance of key factors as well as the sub factors causing delay in construction fields based on their opinions and experiences. Priority importance scale from 1 until 9 is provided for comparison of each delay factor in questionnaire, where 1 shows the equal significance while 9 carries the highest priority, and vice versa.

For the questionnaire, the keywords, information, and instructions are kept as simple as possible so that respondents can understand the questionnaire easily without any obstacles. The contents inside questionnaire are ensured to be related to the research topic and objectives.