QUANTIFICATION OF DELAY FACTORS USING THE RELATIVE IMPORTANCE INDEX METHOD FOR CONSTRUCTION PROJECT

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QUANTIFICATION OF DELAY FACTORS USING THE RELATIVE IMPORTANCE INDEX METHOD FOR CONSTRUCTION PROJECT

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23 JUNE 2016

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ABSTRACT

Construction known in general as an activity involve of clearing, dredging, excavating and grading of land and other activity associate with building, structure and other types of structure such as bridges, dams and roads. In the real situation, every project of construction will face a delay. Delay commonly happen in large project as it involved many parties. As a result, many major projects fail to meet schedule deadlines. The aim of this research is to identify the delay factors of construction projects on view of contractor and analyze these factors with the Relative Importance Index Method. For this purpose, 25 different delay factor were identify and categories in 5 major factor. The main major factor is contractor related factor, consultant related factor, design related factor, equipment related factor and external related factor. The Relative Importance Index (RII) is calculate for each factor and ranking it from the highest value to the lower value. The highest value of Relative Importance Index (RII) is known as a major factor of delay in construction project. Some of the recommendation and suggestion from the respondent are contractors should have experience before the bidding stage. Plus, project manager should preparing effective planning and scheduling to make sure the progress run smoothly.

ABSTRAK

Pembinaan dikenali secara umum sebagai satu aktiviti melibatkan penjelasan, pengorekan, penggalian, penggredan tanah dan aktiviti lain yang bersekutu dengan jenis struktur seperti bangunan, jambatan, empangan dan jalan raya. Dalam keadaan sebenar, setiap projek pembinaan akan menghadapi kelewatan. Kelewatan biasa berlaku dalam projek besar kerana ia melibatkan banyak pihak. Akibatnya, banyak projek-projek utama gagal memenuhi jadual tarikh akhir untuk menyiapkan projek. Tujuan kajian ini adalah untuk mengenal pasti faktor-faktor kelewatan projek pembinaan dari sudut kontraktor dan menganalisis faktor-faktor ini dengan mengunakan Kaedah Kepentingan Relatif Indeks. Bagi tujuan ini, 25 faktor kelewatan yang berbeza di kenal pasti dan di kategori dalam 5 faktor utama. Antara contoh faktor utama ialah faktor yang berkaitan kontraktor, faktor yang berkaitan perunding, faktor yang berkaitan reka bentuk, faktor yang berkaitan peralatan dan faktor yang berkaitan luaran. Kepentingan relatif Index di kira bagi setiap faktor dan kedudukan dari nilai tertinggi kepada nilai yang lebih rendah di catat. Nilai tertinggi Indeks Kepentingan relatif ialah faktor utama kelewatan dalam projek pembinaan. Antara syor dan cadangan daripada responden adalah kontraktor perlu mempunyai pengalaman sebelum peringkat pembidaan. Plus, pengurus projek perlu menyediakan perancangan yang berkesan dan penjadualan memastikan kemajuan berjalan lancar.

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INTRODUCTION

1.1 Back ground of study

Construction known in general as an activity involve of clearing, dredging, excavating and grading of land and other activity associate with building, structure and other types of structure such as bridges, dams and roads. The construction industry today is different to the construction industry of the past. Now days, construction must deliver the product in the shortest time with the high quality attainable. The construction product must cost-effectively.

In addition, the construction industry contributes to the Malaysian economy. It is important to generating wealth and improving the quality of life for the future generations. Plus, the construction industry provides job opportunities for approximately 800,000 people. The average construction sector growth from 2000 to 2006 is 0.7% (Bank Negara Annual Report 2006).

A construction project is commonly acknowledged as successful when it is completed on time, within budget, in accordance with the specifications, and so to stakeholders satisfaction (Majid, 2006). In construction industry, contractors tend to maximize their profit to increase market share (Murat et al., 2013). It is widely accepted that the schedule of construction project plays a key role in project management due to its influence on project success (Luu et al., 2009).

In the real situation, every project of construction will face a delay. Delay is common thing that will happen on large project because it is involve of many parties. As a result, many major projects fail to meet schedule deadlines (Duran 2006). The common factor delay are late completion of the project, increased cost, disruption of work, loss of productivity, third party claims, disputes and abandonment or termination of contracts (Murat et al., 2013).

1.2 Problem Statement

Now days, Malaysian construction industry faces a challenging compared than before. The project today more complicate because it is involving larger capital investment, straight quality standard and widely dispersed project participants. The construction growth rates in Malaysia fluctuates between extremities that varies from as high as 21.1 percent in 1995 to as low as -24 percent in 1998. Since the 1990's, the contribution of the construction sector to the GDP also fluctuated albeit at a more stable rate varying from a high of 4.8 percent in 1997 to an estimated low of 2.7 percent in 2005 (CIDB, 2008).

Plus, the demand from the clients is one of the problems that face in construction industry. The clients usually request a lower price with the high quality end project. To fulfill the demand from the client, many workers from Indonesia, Bangladesh, Sri Lanka and others work as labor. The result of the arrival laborers in the construction industry will increase number of unskilled workers.

As the process of construction project development is very complicated and combines various parties' agenda, comprise many stages of work, and entail a long period until completion (Puspari 2006).

1.3 Research Aims and Objectives

The aim of this research is to identify the delay factors of construction projects on view of contractor and analyze these factors with the relative importance index method.

The objectives of the research are as following:

i. To identify the factor delay in construction project on view of contractor.
ii. Categorize the delay factors in construction project.
iii. Identify the factors and groups contributing most to delays.
iv. Suggest the recommendations in order to minimize or control delay in construction project.

1.4 Scope of Study

This study covered all activities involved in construction project correlated delays during construction. Scope of this study can be simplified as follows:

i. This study has been carried out around area of Selangor and Pahang.
ii. Information and data attained based on literature review and questionnaire survey.
iii. Main focus of respondent selected is contractor.
iv. Construction project that have been considered for this study are from government and private project which focus on building construction.
v. The relative importance index method (RII) is used to analysis data.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Construction delay is defined as the late of completion the project compared to the planned or contract schedule. Delay could be defined as the time over run either beyond completion date specified in a contract or beyond the date that the parties agree upon for delivery of a project (Assafand, 2006). Thus, delays are one of the most common problems that affect the competitiveness of construction companies (Orozco et al. 2011). The study finds that financial problem are the main factor and coordination problems are the second most important factor causing delay in construction projects in Malaysia (Wa'el et al., 2007).

The main causes of delays in large building projects and their relative importance (Assaf et al., 1995). Delay can be categories of two causes which are internal causes and external causes. Internal causes involve of parties in contract such as contractor, client and supplier while external causes involve problem such as weather, the government action and material from the supplier.

The top three common factor delays in construction is delay in honoring certificates, underestimation of the cost project and underestimation of complexity of project. The closure leading to material shortage was the most important performance

factor, as is has the first rank among all factors from the perspectives of owners, consultant and contractors (Enshassi et al., 2009).

2.2 Type of Delay

In the construction there a four type of delay which is Non – Excusable Delays, Excusable Non – Compensable Delays, Excusable Compensable Delays and Concurrent Delay (Wa'el et al., 2007)

i. Non – Excusable Delays
ii. Excusable Non-Compensable Delays
iii. Excusable Compensable Delays
iv. Concurrent Delays

2.2.1 Non – Excusable Delays

Inexcusable delays or known as non-excusable delays are caused solely by the contractor or its suppliers (Fugar and Agyakwah-Baah, 2010). This delay may cause from underestimates of productivity, improper planning and scheduling or poor site management and supervision. An example of a non-excusable delay would be when a contractor fails to provide sufficient manpower to complete the job on time (Majid, 2006).

Non - excusable delays is common delay that occur at construction site. It is widely accepted that construction project scheduling plays a key role in project management due to its significant influence on project success (Luu et al., 2009). The common results of schedule delays include late completion of the project, increased cost and disruption of work, loss of productivity, third party claims, disputes and

abandonment or termination of contracts. Therefore, schedule delays in construction projects give rise to dissatisfaction in all the parties involved (Majid, 2006).

2.2.2 Excusable Non-Compensable Delays

Excusable non compensable usually happen beyond the ability of contractor to control the problem occur. Non-compensable delays are caused by third parties or incidents beyond the control of either the owner or the contractor and are not attributable to any of the parties (Fugar and Agyakwah-Baah, 2010). For example the earthquake, unusual weather or dispute labor will entitle the contractor to additional time to complete the project but no compensation for delay damages.

2.2.3 Compensable Delays

Compensable delays are caused by the owner or the owner's agents (Fugar and Agyakwah-Baah, 2010). An excusable, compensable delay usually leads to a schedule extension and exposes the owner to financial damages claimed by the contractor (Soon, 2010). The example of this delay is the late release of drawing from the civil and structure consultant or architect. The contractor will face indirect cost which is needs to spend money to pay a extended field office and office overhead.

2.2.4 Concurrent Delays

The concurrent delay happen when two or more independent causes of delay overlap in same time. True concurrent delay is the occurrence of two or more delay events at the same time, one an employer risk event, the other a contractor risk event and the effects of which are felt at the same time. The term ‘concurrent delay’ is often used to describe the situation where two or more delay events arise at different times, but the effects of them are felt in whole or in part at the same time (James et al., 2011).

2.3 Factor of Delay

Many studies and research has been conduct to assess the factor delay in construction. There are two kinds of cause for delay in construction projects:

i. Internal Factor of Delay
ii. External Factor of Delay

2.3.1 Internal Factor of Delay

Internal causes of delay include the causes arising from four parties involved in the project. These parties include the owner, designers, contractors, and consultants. Other delays, which do not arise from these four parties, are based on external causes for example from the government, materials suppliers, or the weather (Ahmed et al,.2003) The example of internal factor is:

i. Consultant Related Factor
ii. Contractor Related Factor
iii. Design Related Factor
iv. Equipment Related Factor
v. External Related Factor

2.3.1.1 Consultant Related Factor

The responsibilities of the consultant on a construction project usually set out in a standard form agreement between the consultant and the owner. The consultant may be an architect or an engineer. During the design stage itself, the consultant determines the feasibility of the project from an artistic, technical, logistical and financial standpoint. The consultant creates project design concept and seeks approval for this design concept.

If the consultants do not follow the scope of works as agreed in the contract it will cause many problem. The consultant may contribute delay in construction such as lack of experience on the part of the consultant. The engineer that works under consultant needs experience in working to monitor the work progress at construction site. Plus, delay and slow supervision in making decisions also the factor delay under consultant. The engineer should make a right decision if anything happen at construction site.

In addition, incomplete documents and slowness in giving instructions is one of delay in construction. Example of incomplete documents can happen such as not complete drawing. Incomplete drawing makes the engineer take a time to review the drawing to proceeds the works. Work as one big teamwork, the miscommunication will happen. This occur because lack of communication between them. The conflict between consultant and engineer also can be a factor delay in construction. The late in reviewing and approving design documents of consultants also contribute to the delay. Every project of construction, they need to follow the timeline or Gantt chart from the planner. If the consultant takes a long time to review the documents it will affect the progress work.

2.3.1.2 Contractor Related Factor

A contractor is anyone who directly employs or engages construction workers or manages construction work. Contractors include sub-contractors, any individual self-employed worker or business that carries out, manages or controls construction work. Improper management from the contractor for project will causes a problem to the project. The examples of delay occur from the contractor responsibility is delay in delivery of materials to site. Sometimes, the contractor needs the material such as roof, tiles or cement to do a work. When the materials do not delivery on time, the contractor cannot proceeds the work.

In addition, shortages of material on site also major factor delay at construction site. The contractor needs the enough of material to do their work. If the contractor needs to wait for the material, it will drag the time to complete the project. Plus, defective work and incomplete instruction can be a factor of delay under contractor. As we know, the workers at construction from Bangladesh, Indonesia and Pakistan. They are work as unskilled workers. They need to guide and monitor from the engineer in order to reduce the miscommunication of instruction and avoid the mistakes.

Financial problem is a big issue in construction site. The contractor should have a stable financial as a backup planning if anything happens related to the cost of project. Sometimes, the client will pay the payment project based on the work progress. If the owner do not satisfied, they will hold the payment. As a contractor, they need to proceeds the works and pay the salary to the workers. Contractor should have a stable financial. Frequent change of subcontractors also the factor of delay. Sometimes, the reason changes of subcontractor because of the quality work of subcontractor do not satisfy as a target from the site engineer.

2.3.1.3 Design Related Factor

The complexity of project design is one of factor delay in construction. The complex project needs a long time to design. The project that needs to start at construction depends on the drawing from the designer. Plus, design changes by owner or his agent during construction. This situation occur when the owner do not satisfy the quality work by the designer.

In addition, design error made by designer also the factor delay. A site engineer doing their work based on the drawing from the designer. If the site designer detect the problem relate to the drawing, the site engineer will hold their works and send back the drawing to the designer. This mistake will drag the time to complete a project.

Insufficient data collection and survey before design will affect the designer to finish the drawing. Before the designer starts their work, they should have enough data about the site. This data should get at the stage of site investigation. If the designers do not have a complete date during site investigation it will affect during designing stage. Misunderstanding

2.3.1.4 Equipment Related Factor

Equipment also can be a factor delay of construction project. One of factor is equipment allocation problem. Misplace of equipment will affect the progress of work. Plus, frequent equipment breakdown also will affect the financial. The contractor needs to buy a new equipment to replace.

Low efficiency of equipment also can contribute to the delay in construction site. If the productivity does not achieve the target, it will affect the progress of work. In addition, shortage of equipment also factor delay in construction under equipment

related factor. If there is shortage of equipment from supplier, the contractor needs to wait for the equipment. The result, it will drag the time to complete the project.

2.3.1.5 External Related Factor

Accident during construction also one of factor delays in construction. The accident at construction can happen because of various factors. One of factor that can contribute to accident at construction is workers do not take a serious about the safety at site. This will increase the case accident at construction site.

Plus, they delay in permits from municipality also the factor delay. This situation happens when the contractor does not full fill the requirement that municipal needs. If the contractor does not get the permissions, they have no right to enter the site and do their work.

In addition, the factor delay under external related factor is delay in providing services from utilities such as water and electricity. The utilities are important to start a work. Delay in the utilities supply, will affect the progress of work.

2.3.2 External Factor of Delay

The external factor of delays usually relate to supplier or economy of the country. The example of external factor of delay is equipment related factor. The factor causing delays as state at below:

i. Lack of materials on the market
ii. Lack of equipment and tools on the market
iii. Poor weather conditions
iv. Poor site conditions

2.4 Quantification Data Analysis

A quantitative approach is often concerned with finding evidence to either support or contradict an idea or hypothesis. A hypothesis is where a predicted answer to a research question is proposed. Quantification of data is the numerical representation and manipulation of observations for the purpose of describing and explaining the phenomena that those observation reflect (Babbie, 2010).

Quantitative research is considered to have as its main purpose the quantification of data. Quantitative data analysis is helpful in evaluation because it provides quantifiable and easy to understand results. In quantitative data analysis, the level of measurements need to be identified. The level of measurement is important and it can influence the type of analysis.

The quantification analysis allows us to discover which phenomena which are merely chance occurrences.

2.4.1 Level of Measurement

There four level which is nominal, ordinal, interval and scale. Nominal data is basic classification data. For example, the gender of respondents either male or female. There are no order associated with male nor female.

Ordinal data is data that has logical order but the different between values are not constant. For example the education level either diploma level, degree level, master level or other. Interval data is continuous and has standardized differences between values but no natural zero. For example, the working experience at current company. It also can be measured on a Likert scale.

Ratio data is continuous, ordered and has standardized differences between. It also has natural zero. Natural zero means one measure twice as long as another. For example 10 cm is twice as long as 5cm.

2.5 Descriptive Data

A descriptive date refers to calculation that used to describe the data set. The most descriptive data used is mean, minimum and maximum, median and mode. Mean refer to the numerical average of scores for particular variable. Minimum and maximum refer to the highest and lowest value while median refer to the numerical middle point or score that cuts in half. Thus, mode refer to the most common number score or value in particular variable.

2.6 Method to Analysis Data for Quantitative Research

There are many method that can be used to analysis the data. The data can be analysis by calculation and software. Now days, various type of software has been developed to analysis quantification data.

2.6.1 SPSS Statics Software

The software was released in its first version in 1968 as the Statistical Package for the Social Sciences (SPSS) after being developed (Norman et al., 1998). SPSS is a widely used program for statistical analysis in social science. SPSS is a Windows based program that can be used to perform data entry and analysis and to create tables and graphs.

The many features of SPSS Statistics are accessible. The benefits of SPSS Software is reproducibility, simplifying repetitive tasks, and handling complex data manipulations. SPSS Statistics places constraints on internal file structure, data types, data processing, and matching files.

SPSS datasets have a two-dimensional table structure, where the rows typically represent cases such as individuals or households and the columns represent measurements such as age or gender.

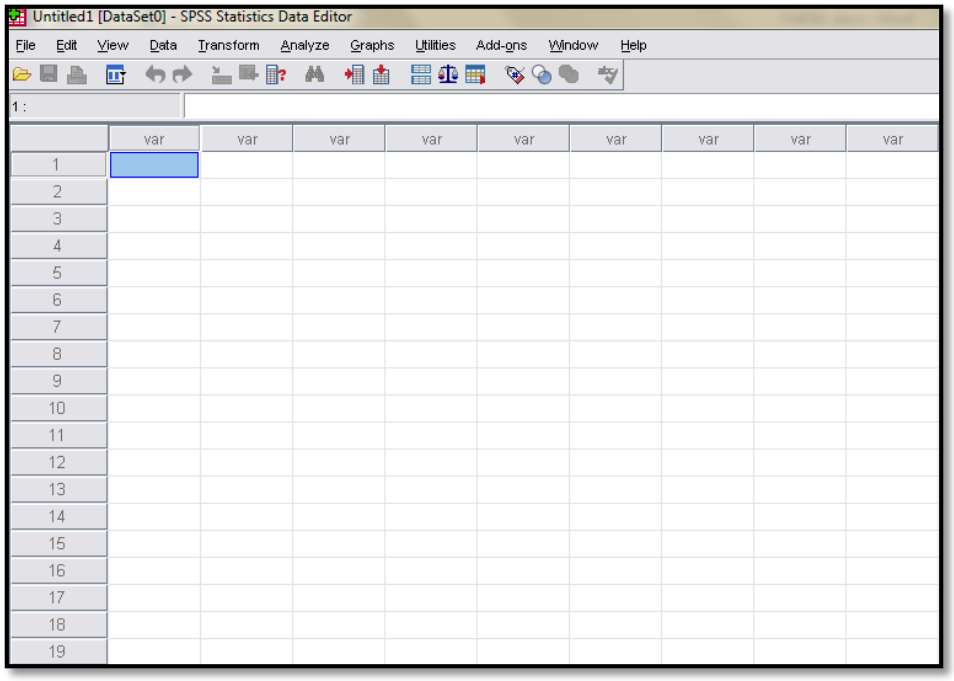


Figure 2.6.1: Interface of SPSS Software

2.6.2 Relative Importance Index Method (RII)

Multiple regression analysis has two distinct applications: prediction and explanation (Courville and Thompson, 2001). This equation can be applied to predictor scores within a similar sample to make predictions of the unknown criterion scores in that sample.

Relative Importance Index or weight is a type of relative importance analyses. RII was used for the analysis because it best fits. According to Johnson and Le Breton RII aids in finding the contribution a particular variable makes to the prediction of a

criterion variable both by itself and in combination with other predictor variables. In the calculation of the Relative Importance Index (RII), the formula below was used

$$\mathbf{RII} = \frac{\sum \mathbf{W}}{\boldsymbol{A}*\boldsymbol{N}} \quad (1)$$

Where;

RII = Value of relative importance factor (generally 0-1)

W = Weighting given for each factor by the respondents (ranging from 1-3 for low, medium, and high influence reason respectively.)

A = Highest weight (3 in this case) N total number of respondents

N = Total number of respondents

Relative weights allow decision makers to allocate scarce resources to the issues that are actually most highly related to respondent satisfaction. Relative importance analysis can reveal the specific areas that contribute the most to employee or customer satisfaction, which helps decision makers set priorities for where to apply scarce organizational resources (Lundby et al., 2002).

2.7 Method of Data Collection

Various method of collecting data are employed by social scientist. There are two type of data which is primary data and secondary data. Primary data is data that collect for the first time while secondary data is data that has been collected by someone else.

There are a few method that can be used to collect data which is observation, interview, telephonic interviews and questionnaire.

2.7.1 Observation Method

Observation method is a method which data from the field is collected by the observer or by personally going to the field. There are two type of observation which is structured and unstructured observation. Structured observation is conduct by recording the observed information, selection of pertinent data of observation and standardized the conditions of observation. Unstructured observation is conduct by thought before observation.

2.7.2 Interview Method

This method involve of collecting data presentation or oral – verbal communication. There are two type of interview which is personal interview and structured interview. Personal interview contains predetermined questions, follows rigid procedure laid down and not necessary of skill or specific knowledge. Structured interview contains a flexibility in asking questions, no predetermined questions and ask question without following sequence.

The advantages of this method is information at greater depth, sample can controlled more effectively and personal information can be obtained. The disadvantage is expensive method, respondent may give bias information and takes more time when samples are more.

2.7.3 Telephonic Interview Method

This method is conduct by contacting respondents on telephone. The advantage of this method is flexible compare to mailing method and cheaper than

personal interview method. The disadvantage is bias information may be more and little time is given to respondents.

2.7.4 Questionnaire Method

This method of data collection is popular. This method is conduct by sent a questionnaire to respondent with request to answer the questions and return it back. The advantage of this method is low cost, enough time to answer the questions and free from the bias answer. The disadvantage is difficult to know the respondents have filled by their own or by someone else and slow method of data collection

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Literature review

In this research, one method is used to analysis the data collection which is Relative Importance Index Method. It is used to regression analysis. Regression analysis is a statistical tool to identify the relation between variable. Example of relation between variable is the factor delay of project in construction by contractor. In conclusion, we believe that researchers should more regularly perform relative importance analyses when conducting multiple regression analyses (James 2011).

Many type of data collection can be conduct for a research such as interview, questionnaire, observation and case study. The questionnaire was choose and conducted for this research. The advantages of questionnaire method are easy to compare, low cost, uniformity of questions and can get lots of data.

The survey questionnaire is done based on open ended question and closed ended question. Open-ended questions are those which require more thought and more than a simple one-word answer. The answers could come in the form of a list, a few sentences or something longer such as a speech, paragraph or essay. Open-ended questions are also helpful in finding out more about a person or a situation, whether it's during an interview. Close-ended questions can be answered in only one word or very short phrase. Close-ended questions are also those which can be answered by a simple.

3.2 Methodology Flow Chart

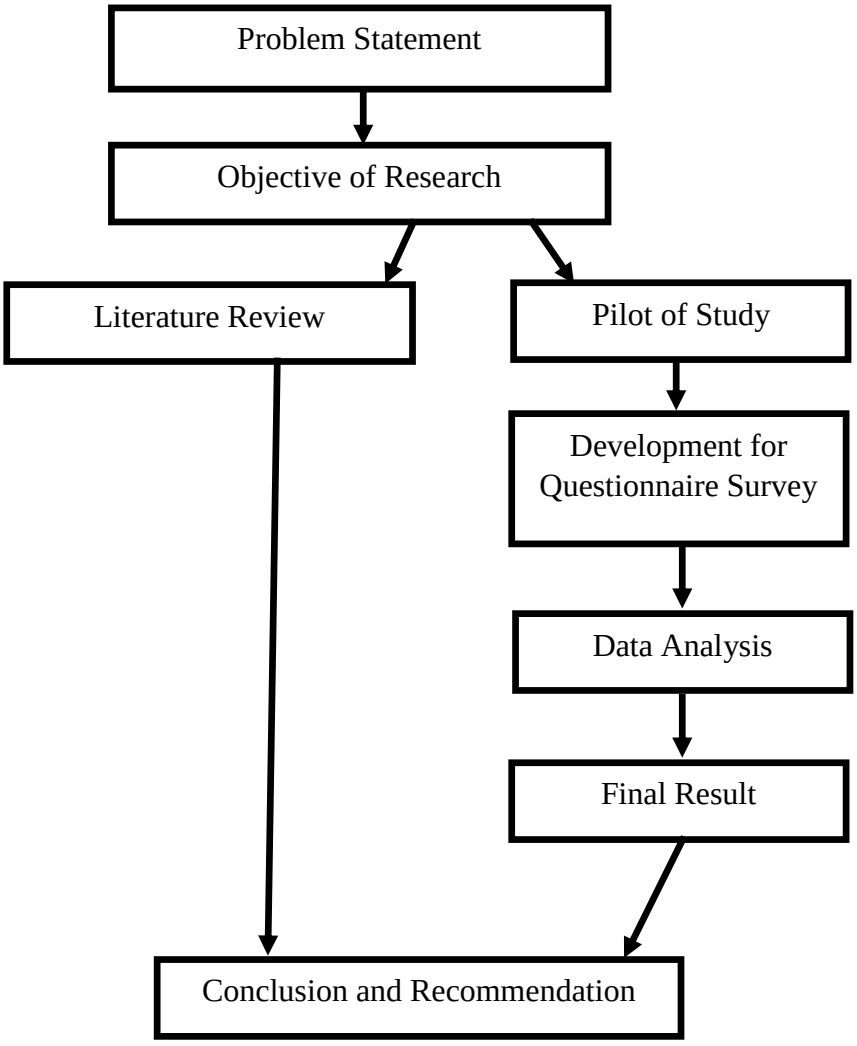


Figure 3.2: Flow Chart for Final Year Project

3.3 Pilot Study

A pilot study is a mini-version of a full-scale study or a trial run done in preparation of the complete study. It gives the preliminary idea of the research. Before distribute the questionnaire, a pilot study is done by submit the questionnaire to supervisor. Based on the pilot study, the total thirty (30) factors are identified through detailed literature review and the factor is groups under five (5) categories. The group is state at below:

i. Consultant Related Factor
ii. Contractor Related Factor
iii. Design Related Factor
iv. Equipment Related Factor
v. External Related Factor

3.4 Development of Survey Questionnaire

3.4.1 Design Survey Questionnaire

The questionnaire survey is distributed to contractor in Pahang. The 60 sample questionnaire is conducted to collect the data from the contractor. The various company of contractor is chosen for this research.

Survey form consist of three sections is prepared. First section is the demographic profile of respondents which is the question related to the name of company, the positions and year of experience. The second section of the survey is closed ended question which include the Likert Scale question. The important of this section to collect data that related to the factor delay at construction industry.

The third section of the survey is to get the opinion or suggestion to overcome the delay from the contractor. This section is important because the opinion based on the experience of contractor.

3.5 Data Collection

3.5.1 Sample Size

Sample size is chosen using the following formula.

$$\mathbf{Ss} = \frac{\boldsymbol{Distribution}\ (\%)}{\left(\boldsymbol{M}\ (\%) \div \boldsymbol{Z}\ (\%)\right)^2} \qquad (2)$$

Where,

Ss	= the sample size required
Distribution (%)	= 10% reflects to the respondents
M (%)	= Margin error at 5%
Z	= Confidence level at 95 %

Hence the sample size = 36 (total of 60 set of questionnaire have been delivered). The total questionnaire is returned are 50 sets which are 83.3 % of return rate based on the total questionnaires prepared.

3.5.2 Likert Scale

Likert scaling is a bipolar scaling method, measuring either positive or negative response to a statement. Sometimes an even-point scale is used.

For this research, a data is collect based on open ended question and closed ended question using. The respondents need to select which factors they consider that contributes on delay of construction project based on their experience. The questionnaire have 5-point Likert Scale range from 5 (strongly agree) to 1 (strongly disagree). The higher the number of Likert Scale is chosen, the bigger influence on the delay.

3.5.3 Study Area

The research was carried out around Selangor and Pahang. The questionnaire is distributes to contractors company. The contractors company is select based on the following reason:

i. The Grade for contractor G7.
ii. The project must be on-going and must have started from 2008 until now.

This research will conduct around Selangor and Pahang. The reason Selangor and Pahang is chosen because the Selangor is the highest value work done while Pahang is record as intermediate range of work done. This information is from Department of Statistic Malaysia.

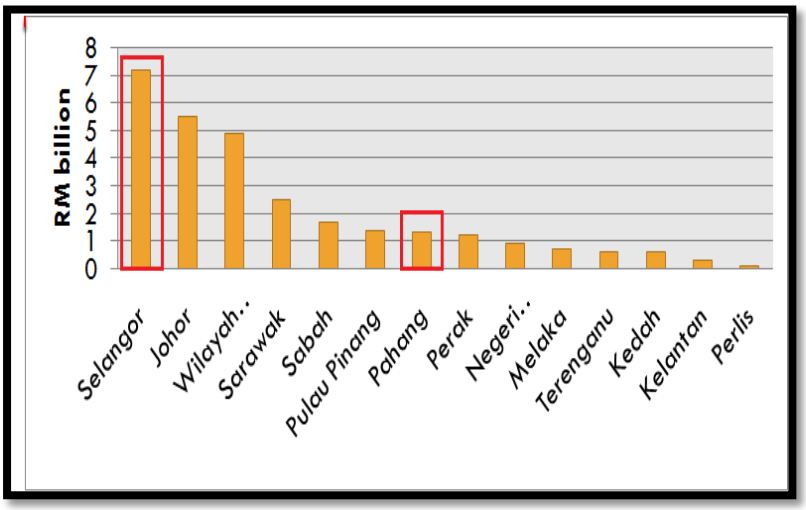
STATISTIK PROJEK-PROJEK PERUMAHAN SWASTA MENGIKUT KATEGORI HINGGA SEPTEMBER 2015

BIL.	NEGERI	PROJEK LANCAR			PROJEK SAKIT		
		BIL. PROJEK	UNIT RUMAH	BIL. PEMBELI	BIL. PROJEK	UNIT RUMAH	BIL. PEMBELI
1	Johor	763	133,421	53,389	16	3,300	2,612
2	Kedah	305	32127	5843	3	1031	752
3	Kelantan	74	2875	2562	13	1009	689
4	Melaka	154	21016	15171	1	86	64
5	Negeri Sembilan	156	19161	12710	3	394	379
6	Pahang	472	12100	9130	10	961	601
7	Perak	457	24312	13352	27	2784	2158
8	Perlis	29	1751	327	0	0	
9	Pulau Pinang	257	39106	31701	4	589	287
10	Selangor	863	356,625	99,214	68	15,109	9,310
11	Terengganu	50	1991	1247	3	489	448
12	W.P. Kuala Lumpur	205	1182	526	7	1182	526
	JUMLAH	**3,785**	**645,667**	**245,172**	**155**	**26,934**	**17,826**

Sumber : Jabatan Perumahan Negara, 2015

Graph 1: Value of construction work done by location project

From the analysis of *Jabatan Perumahan Negara 2015*, Selangor have highest number of project delay under private residential which is 68 cases and Pahang is 10 cases. This is the reason Selangor and Pahang is chosen.



Graph 2: Statistic Delay Project

3.6 Data Analysis

3.6.1 Relative Importance Index Method

To analysis the data, the relative importance index method is choose. The formula of Relative Importance Index Method:

$$\mathbf{RII} = \frac{\sum \boldsymbol{W}}{\boldsymbol{A}*\boldsymbol{N}}$$

Where;

RII = Value of relative importance factor (generally 0-1)

W = Weighting given for each factor by the respondents (ranging from 1-3 for low, medium, and high influence reason respectively.)

A = Highest weight (3 in this case) N total number of respondents

N = Total number of respondents

CHAPTER 4

DATA ANALYSIS AND DISCUSSION

4.1 Introduction

The questionnaire consists of 3 parts of questions. The first part of the questionnaire which is Part A built out of demographic questions. The second part of questionnaire which is Part B consists of closed format questions where Likert scale (1= very low importance, 2 = low importance, 3 = medium importance, 4 = high importance, 5 = very high importance) will be provided for each questionnaire based on the factor of delay in construction and the last part of questions in Part C consist of open ended question where the respondents are allow to add suggestion and recommendation.

The total number of questionnaire distributed is 60 samples for 15 company of contractor. The 70% from the 60 sample is distributes around Selangor and 30% is distributes around Pahang. The total number return questionnaire is 50 samples. The return questionnaire from Selangor is 35 samples and 15 samples from Pahang.

4.2 Analysis of Demographic Profile of Respondents

This section consists of 4 most basic questions regarding the demographic profile of the respondents which include age of the respondent, education level of the respondent, a gender and working experience.

4.2.1 Descriptive Analysis

This analysis is the section where respond of the respondents based on the question presented in graph format to illustrate the numbers of respondents and percentage of total respondents that respond in that particular question with particular answer.

4.2.1.1 Gender of respondents

From Figure 4.1, out of 35 respondents from Selangor, 30 respondents are male while 5 respondents are female. Out of 15 respondent from Pahang, 14 respondents are male while 4 respondents are female. Male are highest number respondents for both state. This could be attributes to the nature of the cultural where males are expected to work to provide for the family. However, the respondents were not gender bias. The sampling technique ensured inclusion of all respondents' population being sampled for this research.

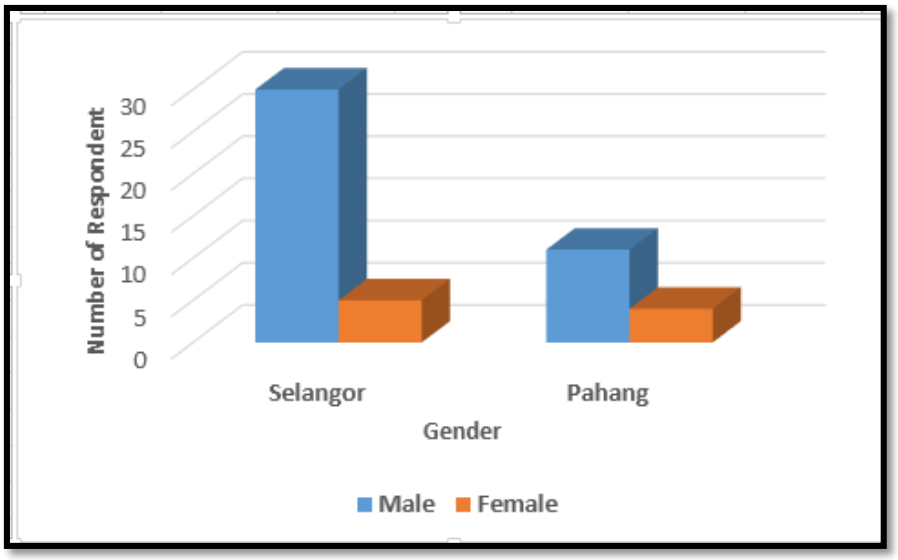


Figure 4.1 Gender of Respondents

4.2.1.2 Age of respondents

From Figure 4.2, out of 35 respondents from Selangor, 6 respondents are age between 24 – 35 years old, 8 respondents are age between 36 – 45 years old, 15 respondents are age between 46 – 55 years old and 6 respondents are age 56 years old and above. The highest respondents are age between 46 – 55 years old.

Out of 15 respondents from Pahang, 4 respondents are age between 24 – 35 years old and age between 36 – 45 years old, 6 respondents are age between 46 – 55 years old and 1 respondent are age 56 years old and above. The highest respondents are age between 46 – 55 years old.

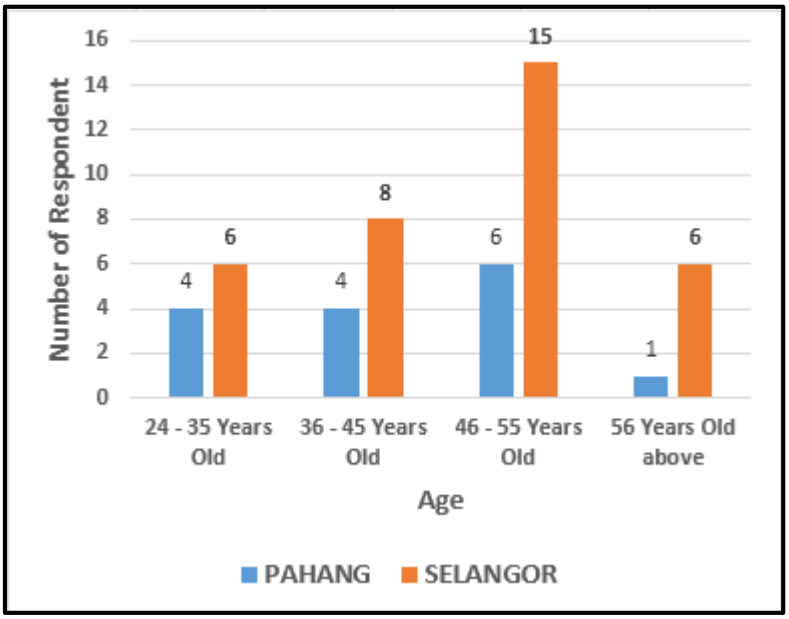


Figure 4.2: Age of respondents

4.2.1.3 Education level of respondents

From the analysis, out of 35 respondents from Selangor, 31 respondents are degree level and 4 respondents are master level. For Pahang, 13 respondents are diploma level and 2 respondents are degree level.

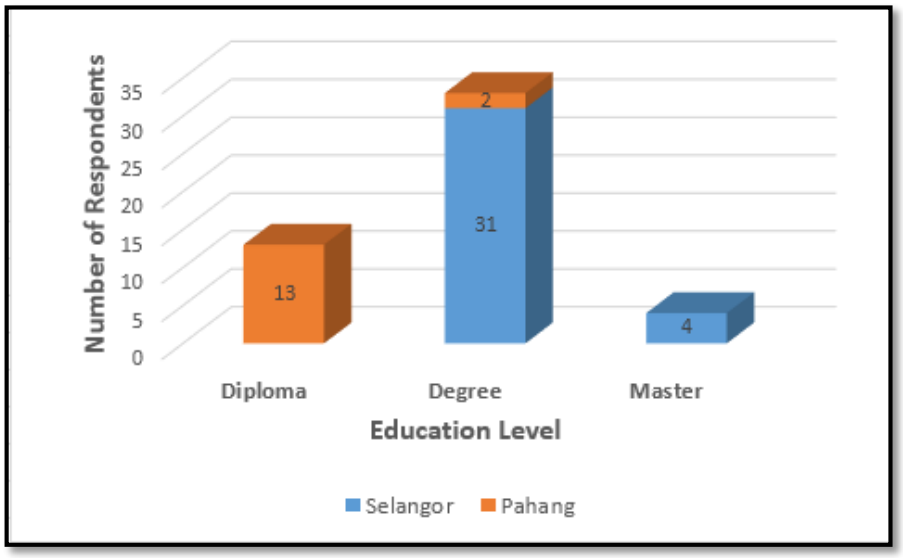


Figure 4.3: Education level of respondents

4.2.1.4 Working experience of respondents

From Figure 4.4, out of 35 respondents from Selangor, 15 respondents has working experience between 6 – 10 years old, 13 respondents has working experience 10 years old above and 7 respondents has working experience between 1 – 5 years old.

Out of 15 respondents from Pahang, 4 respondents has working experience between 1 – 5 years old and 10 years old above. 7 respondents has working experience between 6 – 10 years old and

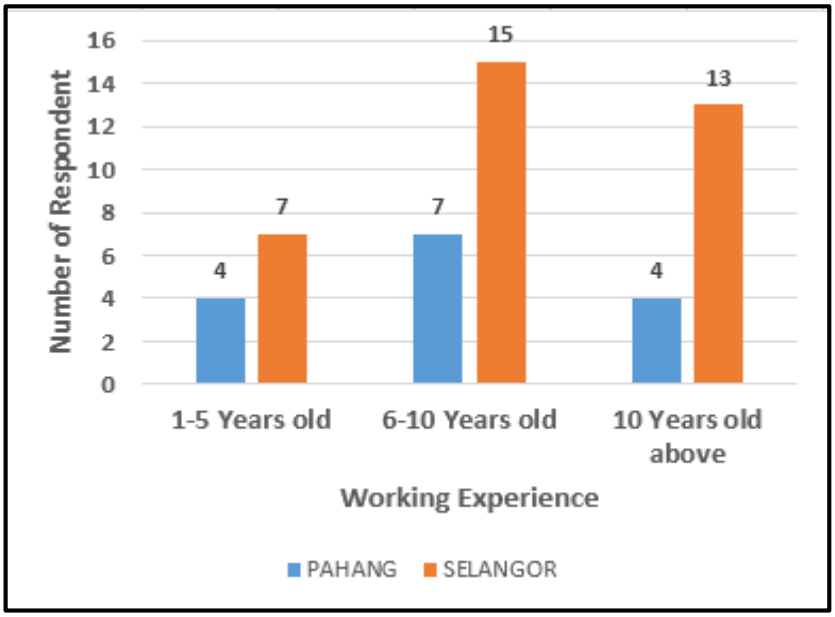


Figure 4.4: Working experience of respondents

4.2.1.5 Working experience at current company of respondents

From Figure 4.5, out of 35 respondents from Selangor, 1 respondent has 1 year, 3 year, 6 year and 7 year working experience at current company. 14 respondents has 2 year working experience at current company, 12 respondents has 4 year working experience at current company. 2 respondents has 5 year working experience at current company.

Out of 15 respondents from Pahang, 6 respondents has 4 year working experience and 3 respondents has 1 year working experience at current company. In addition, 2 respondents respectively has 2 year and 3 year working experience at current company. 1 respondent respectively has 5 year and 6 year working experience at current company.

Figure 4.5: Working experience at current company of respondent

4.3 Research Findings and Result

Relative Importance Index (RII) score is tabulated in Table 1.0 that show the delay factors and respondents score at Selangor. While, Table 2.0 show the Relative Importance Index (RII) score of delay factors and respondents score at Pahang.

The score of RII are calculate by using formula of Relative Importance Index method. The score are ranked from the highest score to the lowest.

Table 1.0: RII Ranking of Delay Factors and Respondents Score at Selangor

Factor Group	Number	Factor Causing Delay	Score of Respondents					RII	Rank
			Very low importance	Low importance	Medium importance	High importance	Very high importance		
Consultant	1	Lack of experience of consultant in construction project			1	22	12	0.863	4
	2	Conflicts between consultant and design engineer			7	25	3	0.777	**10**
	3	Delay in approving major changes in scope of work by consultant		1	14	13	7	0.749	**13**
	4	Delay in performing inspection and testing			14	13	8	0.766	**11**
	5	Inaccurate project management assistance	2	5	5	16	7	0.720	**15**

Contractor	1	Frequent change of subcontractor		2	14	9	10	0.754	**12**
	2	Inadequate contractor experience		3	10	14	8	0.754	**12**
	3	Inappropriate construction method		1	8	18	8	0.789	**9**
	4	Incompetent project team			8	20	7	0.794	**8**
	5	Ineffective project planning and scheduling		1	10	13	11	0.794	**8**
Design	1	Complexity of project design		10	17	4	4	0.611	**19**
	2	Design changes by owner or agent during construction		7	13	11	4	0.669	**17**
	3	Design error made by designer		5	10	16	4	0.709	**16**
	4	Insufficient data collection and survey before design			8	17	10	0.811	**7**

	5	Lack of experience of design team in construction project		1	5	15	14	0.840	**6**
Equipment	1	Equipment allocation problem			1	12	22	0.920	**1**
	2	Frequent equipment break down			3	10	22	0.909	**2**
	3	Improper equipment			1	14	20	0.909	**2**
	4	Inadequate modern equipment			5	17	13	0.846	**5**
	5	Low efficiency of equipment			2	16	17	0.886	**3**
Externality	1	Accidents during construction		2	11	18	4	0.737	**14**
	2	Change in government regulations and laws	20	12	1	2		0.314	**20**
	3	Conflict, war and hostilities	27	6	1	1		0.263	**21**
	4	Delay in obtaining permits from municipality		4	19	10	2	0.657	**18**

	5	Delay in performing final inspection and certification by a third party		1	10	18	6	0.766	**11**

Table 2.0: RII Ranking of Delay Factors and Respondents Score at Pahang

Factor Group	Number	Factor Causing Delay	Score of Respondents					RII	Rank
			Very low importance	Low importance	Medium importance	High importance	Very high importance		
Consultant	1	Lack of experience of consultant in construction project			8	7		0.693	**6**
	2	Conflicts between consultant and design engineer			9	6		0.680	**7**
	3	Delay in approving major changes			5	10		0.733	**4**

		in scope of work by consultant							
	4	Delay in performing inspection and testing		1	8	5	1	0.680	**7**
	5	Inaccurate project management assistance		3	8	2	2	0.733	**4**
Contractor	1	Frequent change of subcontractor		1	6	7	1	0.707	**5**
	2	Inadequate contractor experience			7	8		0.707	**5**
	3	Inappropriate construction method			9	5	1	0.693	**6**
	4	Incompetent project team			8	6	1	0.707	**5**
	5	Ineffective project planning and scheduling			6	4	5	0.787	**1**
Design	1	Complexity of project design		2	9	3	1	0.640	**9**
	2	Design changes by			9	6		0.680	**7**

		owner or agent during construction							
	3	Design error made by designer		1	9	5		0.653	**8**
	4	Insufficient data collection and survey before design		4	6	4	1	0.627	**10**
	5	Lack of experience of design team in construction project		1	7	5	2	0.707	**5**
Equipment	1	Equipment allocation problem			3	11	1	0.773	**2**
	2	Frequent equipment break down			2	13		0.773	**2**
	3	Improper equipment			5	7	3	0.773	**2**
	4	Inadequate modern equipment			4	10	1	0.760	**3**
	5	Low efficiency of equipment			3	10	2	0.787	**1**
Externality	1	Accidents during construction		1	7	7		0.680	**7**

	2	Change in government regulations and laws	3	7	5			0.427	**11**
	3	Conflict, war and hostilities	8	5	2			0.320	**12**
	4	Delay in obtaining permits from municipality		1	10	4		0.640	**9**
	5	Delay in performing final inspection and certification by a third party			5	10		0.733	**4**

4.3.1 Analysis Relative Importance Index (RII) Method at Selangor

The equipment-related group of delay factors was the most important group to cause delays. This was mainly due to the factors equipment allocation problem (RII = 0.920), frequent equipment break down and Improper equipment (RII = 0.909), and low efficiency of equipment (RII = 0.886).

The second most important group was contractor-related group, whose most significant factors were incompetent project team and ineffective project planning and scheduling (RII = 0.794), inappropriate construction method (RII = 0.789), frequent change of subcontractor and inadequate contractor experience (RII = 0.754).

After the contractor group, the consultant-related group of delay factor came in as the third most important group. The significant factors was lack of experience of consultant in construction project (RII = 0.863), conflicts between consultant and design engineer (RII = 0.777), delay in performing inspection and testing (RII = 0.766).

The design-related group of delay factor at ranking fourth place. The significant factors was lack of experience of design team in construction project (RII = 0.840), insufficient data collection and survey before design (RII = 0.811) and design error made by designer (RII = 0.709)

The externality-related group of delay factors was the last and least important group. The delay in performing final inspection and certification by a third party (RII = 0.766), accidents during construction (RII = 0.737) and delay in obtaining permits from municipality (RII = 0.657)

4.3.2 Analysis Relative Importance Index (RII) Method at Pahang

The equipment-related group of delay factors was the most important group to cause delays. This was mainly due to low efficiency of equipment (RII = 0.787), equipment allocation problem frequent equipment break down, improper equipment and low efficiency of equipment (RII = 773), and inadequate modern equipment (RII = 0.760).

The second most important group was contractor-related group, whose most significant factors were ineffective project planning and scheduling (RII = 0.787), frequent change of subcontractor, inadequate contractor experience and incompetent project team (RII = 0.707), and inappropriate construction method (RII = 0.693),

After the contractor group, the consultant-related group of delay factor came in as the third most important group. The significant factors is delay in approving major change in scope of work by consultant and inaccurate project management assistance (RII = 0.733), lack of experience of consultant in construction project (RII = 0.693), conflicts between consultant and design engineer and delay in performing inspection and testing (RII = 0.680).

The design-related group of delay factor at ranking fourth place. The significant factors was lack of experience of design team in construction project (RII = 0.707), design changes by owner or agent during construction (RII = 0.680) and design error made by designer (RII = 0.653)

The externality-related group of delay factors was the last and least important group. The Delay in performing final inspection and certification by a third party (RII = 0.733), accidents during construction (RII = 0.680) and delay in obtaining permits from municipality (RII = 0.640)

4.4 Mean Score for Relative Importance Index (RII) and Ranking of Groups of Delay Factors at Selangor and Pahang

Mean for each delay factor are calculated. Table 3.0 shows that the first ranked of mean score are equipment with RII = 0.894, second are contractor with RII = 0.777, the third ranked are consultant with RII = 0.775, the fourth ranked are design with RII = 0.728 and last ranked are externality with RII = 0.547.

Table 4.0 shows that ranked of mean score at Pahang. The first ranked are equipment with RII = 0.773, the second are contractor with RII = 0.720, the third are consultant with 0.704, the fourth are design with 0.661 and last ranked are externality with RII = 0.560.

Table 3.0: Mean RII and Ranking of Groups of Delay Factors at Selangor

Group of Factors	RII	Rank
Equipment	0.894	**1**
Contractor	0.777	**2**
Consultant	0.775	**3**
Design	0.728	**4**
Externality	0.547	**5**

Table 4.0: Mean R11 and Ranking of Groups of Delay Factors at Pahang

Group of Factors	RII	Rank
Equipment	0.773	**1**
Contractor	0.720	**2**
Consultant	0.704	**3**
Design	0.661	**4**
Externality	0.560	**5**

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Introduction

This chapter concludes on the findings that have been analyzed and discussed in detailed in Chapter 4. It explains on the summary of the study and recommendations from the respondents on related research.

5.2 Conclusion of Study

Based on the analysis that have been done, the objective to identify the factors and groups contributing most to delays has been achieved for both state which is Selangor and Pahang.

The mean score RII that has been ranked in table 3.0 and table 4.0 are the ranked of factor delay for the research.

According the mean score RII for the factor delays at Selangor, the equipment related factor are the main factor that contributed to the delay at construction site with RII = 0.894. The first ranked in equipment related factor that causes the delay are equipment allocation problem with RII = 0.920, the second ranked are frequent equipment break down and improper equipment with RII = 0.909, the third ranked are low efficiency of equipment with RII = 0.886 and the last ranked are inadequate modern equipment with RII = 0.846.

The highest mean score RII for the delay factor at Pahang shows that equipment related factor are contributed to the delay at construction site with RII = 0.773. The first ranked RII that have been calculated under equipment related factor are low efficiency of equipment with RII = 0.787. The second ranked are equipment allocation problem, frequent equipment break down and improper equipment with RII = 0.773. The third ranked are inadequate modern equipment with RII = 0.760.

5.3 Recommendation from the Respondents to the Research

Based on the part three of questionnaire which is to identify the recommendation from the respondents are concluded. The recommendations are contractors should have experience before the bidding stage. Plus, project manager should preparing effective planning and scheduling to make sure the progress run smoothly.

In addition, contractor should make sure the subcontractor have experience or capability to handle the project and progress payments should be on time to contractors to finance the work. The store keeper should make sure the delivery material to site not be late so that work can be executed in the planner order.

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APPENDIX

Questionnaire Explanation

Dear Respondents,

This survey questionnaire is to study about **"Quantification of Delay Factors Using the Relative Importance Index Method for Construction".** It is fulfill the subject's requirement for my Final Year Project. I sincerely hope that you will answer the question truthfully and your identity will be remained confidential. Thank you for your cooperation.

Instruction: Please answer the entire question.

Kepada responden,

*Soal selidik ini adalah untuk mengkaji tentang "***kuantifikasi faktor kelewatan dengan menggunakan kaedah kepentingan relatif indeks dalam pembinaan***". Soal selidik ini adalah untuk memenuhi keperluan Projek Sarjana Muda tahun akhir.*

Saya amat berharap tuan/puan akan menjawab soalan ini dengan jujur dan identiti tuan/puan akan dirahsiakan. Terima kasih atas kerjasama tuan/puan.

Arahan: Sila jawab semua soalan.

Section A: Respondent Details

Instructions: Please put a tick (/) in the space provided to the answer of your choice.

Arahan: Sila tandakan (/) dalam ruangan yang disediakan bagi pilihan jawapan anda.

1. Gender:

Jantina:

Male ( ) **Female ( )**

Lelaki ( ) *Perempuan ( )*

2. Ages:

Umur:

24-35 years old ( ) **36-45 years old ( )**

24-35 tahun ( ) *36-45 tahun ( )*

46-55 years old ( ) **56 years old above ( )**

46-55 tahun ( ) *56 tahun keatas ( )*

3. Education level:

Tahap pependidikan:

Certificate ( ) Diploma ( ) Degree ( ) Master ( ) Others ……..

Sijil ( ) Diploma ( ) Ijazah ( ) Master ( ) Lain-lain ……..

4. Working experience:

Pengalaman bekerja:

1 – 5 years ( ) **6 - 10 years ( )** **10 years above ( )**

1 – 5 tahun( ) *6 – 10 tahun( )* *10 tahun keatas( )*

6. Working experience in current company: ……. Year/s

Pengalaman bekerja di syarikat sekarang: …… tahun

Section B: Causes of project delay

Objective of the study: To identify the factor of project delay in construction industry.

Objektif kajian : mengenalpasti faktor kepada penangguhan projek dalam industri pembinaan.

Based on the scale below, please choose the factor of the project delay in construction industry that you think related.

Berdasarkan skala yang diberi, sila pilih faktor kepada penangguhan projek dalam industri pembinaan yang tuan/puan fikir berkaitan dengan projek.

The scale that use:

Range	Very Low Importance	Low Importance	Medium Importance	High Importance	Very High Importance
	1	2	3	4	5

Question: Which of the following related factors stated below that contribute to delays of construction project?

Soalan: Yang manakah faktor-faktor yang dinyatakan di bawah telah menyumbang kepada faktor - faktor kelewatan projek pembinaan?

No	Factor of Delay	Very Low Importance 1	Low Importance 2	Medium Importance 3	High Importance 4	Very High Importance 5
Group : Consultant						
1	Lack of experience of consultant in construction project	1	2	3	4	5
2	Conflicts between consultant and design engineer	1	2	3	4	5
3	Delay in approving major changes in scope of work by consultant	1	2	3	4	5
4	Delay in performing inspection and testing	1	2	3	4	5
5	Inaccurate project management assistance	1	2	3	4	5

Group : Contractor						
1	Frequent change of subcontractor	1	2	3	4	5
2	Inadequate contractor experience	1	2	3	4	5
3	Inappropriate construction method	1	2	3	4	5
4	Incompetent project team	1	2	3	4	5
5	Ineffective project planning and scheduling	1	2	3	4	5
Group : Design						
1	Complexity of project design	1	2	3	4	5
2	Design changes by owner or agent during construction	1	2	3	4	5
3	Design error made by designer	1	2	3	4	5
4	Insufficient data collection and survey before design	1	2	3	4	5
5	Lack of experience of design team in construction project	1	2	3	4	5
Group : Equipment						
1	Equipment allocation problem	1	2	3	4	5
2	Frequent equipment break down	1	2	3	4	5

3	Improper equipment	1	2	3	4	5
4	Inadequate modern equipment	1	2	3	4	5
5	Low efficiency of equipment	1	2	3	4	5
Group : Externality						
1	Accidents during construction	1	2	3	4	5
2	Change in government regulations and laws	1	2	3	4	5
3	Conflict, war and hostilities	1	2	3	4	5
4	Delay in obtaining permits from municipality	1	2	3	4	5
5	Delay in performing final inspection and certification by a third party	1	2	3	4	5

Section C: Recommendation or suggestion to reduce the delay.

Objective of the study: To recommendation or suggestion to reduce the delay in construction industry.

Objektif kajian: Memberikan cadangan untuk mengurangkan penangguhan projek dalam industri pembinaan.

Question: State the recommendation or suggestion to reduce the delay?

Soalan : Nyatakan cadangan untuk mengurangkan penangguhan projek?

END OF QUESTIONS, THANK YOU