STRATEGIES MODEL OF TIME PERFORMANCE FOR FLOOD MITIGATION PROJECTS

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DEDICATION

To my parents, husband and all my six children (sons and daughter)
who inspired and accompanied me until the end of this journey,
and, at times understood my commitments to my study and make allowances
to my shortcomings on family commitments.
I had to turn down all their entertainment schedule just to finish the journey of
Engineering Doctorate study, all the way…

siblings, relatives, friends and acquaintances… thanks for the unconditional love,
endless support, encouragement and patience.
This is for all of you!

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ABSTRACT

Over the years, Government of Malaysia through the Department of Irrigation and Drainage, Malaysia (DID) has allocated significant amount of budget on structural and non-structural measures to mitigate flooding. The flood mitigation project has been implemented and carefully planned by the government with the specific objectives of reducing and avoiding the negative effects of flooding on the environment and livelihood. In order to recognise its importance, the project's performance must at best be preserved throughout the project's life cycle. However, the implementation of the flood mitigation projects has been hampered by rising cases of poor time performance which caused by a wide range of factors. Furthermore, previous studies on project time performance were mainly focused on other civil engineering projects where the findings could not be directly adopted for solving time performance issues in flood mitigation projects. The lack of strategic reference that can be used by stakeholders in the decision-making process is seen as one of the obstacles to the successful implementation of flood mitigation projects. This research aims to develop a problem-solving model as a strategic reference to mitigate and improve poor time performance of flood mitigation projects authorised under DID. By realizing the issue of poor time performance, there is a need to support the research aim through these objectives: (1) to explore time performance of flood mitigation projects in Malaysia, (2) to examine critical activities affecting time performance of flood mitigation projects, (3) to evaluate the challenges within the critical activities that affect time performance of flood mitigation projects, (4) to propose strategies to address challenges of critical activities that affect time performance in flood mitigation projects, and (5) to develop a strategies model of time performance for flood mitigation projects. The research was conducted in three main phases: (1) exploring and analysing time performance of flood mitigation project through project document studies, (2) questionnaire survey to examine critical activities affecting time performance which the instruments were developed through the matrix mapping process and analysed using Partial Least Square - Structural Equation Modelling (PLS-SEM), then validated by Subject Matter Expert (SME) on flood mitigation field, (3) model development using critical activities generated from the PLS-SEM analysis and proposed strategies to overcome challenges in flood mitigation projects. Based on the findings, there are more than 50% of flood mitigation projects implementation performed behind time while 21 critical activities were identified affecting time performance out of 85 activities tabulated by SMEs and literatures. Besides that, 60 challenges were determined within the critical activities affecting time performance and 133 strategies were proposed to address the challenges. The establishment of the critical activities together with the challenges and strategies has led to the development of a model called "*Strategies Model of Time Performance for Flood Mitigation Projects*". The developed model is expected to assist the government to face unprecedented challenges in implementing future flood mitigation projects.

ABSTRAK

Selama bertahun-tahun, Kerajaan Malaysia melalui Jabatan Pengairan dan Saliran, Malaysia (JPS) telah memperuntukkan sejumlah besar belanjawan bagi perlaksanaan langkah-langkah struktur dan bukan struktur bertujuan mengurangkan kejadian banjir. Projek tebatan banjir telah dilaksanakan dan dirancang dengan teliti oleh pihak kerajaan bertujuan mengurangkan dan mengelakkan kesan negatif banjir terhadap alam sekitar dan kehidupan. Dalam mengenalpasti kepentingannya, prestasi keseluruhan projek harus diambil perhatian sepanjang kitar hayat projek berlangsung. Walau bagaimanapun, perlaksanaan projek tebatan banjir telah terjejas kerana peningkatan bilangan projek yang lewat dari jadual disebabkan oleh pelbagai faktor. Tambahan pula, kajian terdahulu mengenai prestasi masa projek hanya tertumpu kepada projek kejuruteraan awam di mana dapatan kajian tersebut tidak dapat diadaptasikan secara langsung dalam menyelesaikan masalah prestasi masa bagi projek tebatan banjir. Kekurangan rujukan strategik yang boleh digunakan oleh pihak berkepentingan dalam proses membuat keputusan dilihat sebagai salah satu halangan bagi kejayaan perlaksanaan setiap projek tebatan banjir. Penyelidikan ini bertujuan membangunkan model penyelesaian masalah iaitu sebagai rujukan strategik bagi mengurangkan isu prestasi masa projek yang merosot, justeru menambahbaik keadaan ini bagi projek-projek tebatan banjir yang dipertanggungjawabkan di bawah JPS. Dengan menyedari isu prestasi masa dalam perlaksanaan projek tebatan banjir di Malaysia, adalah perlu untuk memastikan matlamat penyelidikan ini dicapai melalui objektif berikut iaitu: (1) untuk mengenalpasti tahap prestasi masa projek-projek tebatan banjir di Malaysia, (2) untuk meneliti aktiviti kritikal yang mempengaruhi prestasi masa projek tebatan banjir, (3) untuk menilai masalah bagi aktiviti kritikal yang mempengaruhi prestasi masa projek tebatan banjir, (4) mencadangkan strategi penyelesaian untuk menangani masalah bagi aktiviti kritikal yang mempengaruhi prestasi masa dalam projek tebatan banjir, dan (5) membangunkan model strategi bagi prestasi masa untuk projek tebatan banjir. Kajian ini dijalankan dalam tiga fasa utama iaitu: (1) mengenalpasti dan menganalisis prestasi masa bagi projek tebatan banjir melalui kajian dokumen projek, (2) tinjauan kaji selidik bagi meneliti aktiviti kritikal yang mempengaruhi prestasi masa di mana instrumentasi kaji selidik dibangunkan melalui proses pemetaan metrik dan dianalisa dengan menggunakan *Partial Least Square - Structural Equation Modelling (PLS-SEM)* dan ditentusahkan oleh pakar bidang (Subject Matter Experts atau SME) tebatan banjir, dan (3) pembangunan model dengan menggunakan aktiviti-aktiviti kritikal yang dijanakan melalui analisis PLS-SEM dan saranan strategi penyelesaian dalam menangani cabaran projek tebatan banjir. Berdasarkan penemuan penyelidikan ini, terdapat lebih daripada 50% projek tebatan banjir yang dilaksanakan telah lewat dari yang dijadualkan. Sementara itu, 21 aktiviti kritikal telah dikenalpasti boleh mempengaruhi prestasi masa daripada 85 aktiviti keseluruhan yang telah disenaraikan melalui kajian literatur dan disahkan oleh SME bidang berkaitan. Selain itu, 60 cabaran telah dinilai bagi setiap aktiviti kritikal yang mempengaruhi prestasi masa dan 133 strategi dicadangkan untuk menangani cabaran dalam aktiviti kritikal tersebut. Pengenalpastian aktiviti kritikal beserta dengan cabaran dan strategi telah menyokong kepada pembangunan model yang dikenali sebagai "*Strategies Model of Time Performance for Flood Mitigation Projects*". Model yang telah dibangunkan ini dijangka dapat membantu pelbagai pihak terutama pihak kerajaan bagi menghadapi cabaran mendatang dalam perlaksanaan projek tebatan banjir di masa hadapan.

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LIST OF ABBREVIATIONS

AMOS	-	Analysis of Moment Structures (statistical software)
AVE	-	Average Variance Extracted
BCI	-	Bootstrap-t Confidence Interval
C&S	-	Civil and Structure
CA	-	Cronbach's Alpha
CB-SEM	-	Covariance-based SEM
CIDB	-	Construction Industry Development Board Malaysia
CIMP	-	Construction Industry Master Plan
CITP	-	Construction Industry Transformation Program
CLT	-	Central Limit Theorem
CMB	-	Common Method Bias
CR	-	Composite Reliability
CV	-	Convergent Validity
DID	-	Department of Irrigation and Drainage, Malaysia
DMSS	-	Decision Making Support System
DV	-	Discriminant Validity
EAA	-	Exploratory Activity Analysis
EFA	-	Exploratory Factor Analysis
EOT	-	Extension of Time
EPU	-	Economic Planning Unit
GoF	-	Goodness of Fit
HOC	-	High Order Construct
HTMT	-	Heterotrait-Monotrait Ratio on Correlation
ICR	-	Internal Consistency Reliability
IPMA	-	Importance Performance Matrix Analysis
IR	-	Indicator Reliability
JPM	-	Jabatan Perdana Menteri
KATS	-	Ministry of Water, Land and Natural Resources
KMO Index	-	Kaiser-Meyer-Olkin
LISREL	-	Linear Structural Relations

LOC	-	Low Order Construct
LV	-	Latent Variable
LVs	-	Latent Variables
LVS	-	Latent Variable Score
M	-	Mean
ML	-	Maximum Likelihood
MLE	-	Maximum Likelihood Estimation
MOF	-	Ministry of Finance Malaysia
MP	-	Malaysia Plan
MSAN	-	National Water Resources Council
NEDO	-	New Energy and Industrial Technology Development
NRE	-	Ministry of Natural Resources and Environment
OLS	-	Ordinary Least Square
P.W.D	-	Public Work Department
PBCI	-	Percentile Bootstrap Confidence Interval
PC	-	Principal Component
PhD	-	Doctor of Philosophy
PID	-	Project Initiation Document
PLS	-	Partial Least Square
PLS-SEM	-	Partial Least Square - Structural Equation Modelling
PMBOK	-	Project Management Body of Knowledge
PMI	-	Project Management Institute
PMO	-	Prime Minister's Office
RII	-	Relative Importance Index
RMK	-	'Rancangan Malaysia'
SCADA	-	Supervisory Control and Data Acquisition
SD	-	Standard Diversion
SEM	-	Structural Equation Modelling
SI	-	Single Item Measurement
SME	-	Subject Matter Expert
TDIST	-	T-Distribution Function in Microsoft Excel Software
TPI	-	Time Performance Index

LIST OF SYMBOLS

ξ_j	-	Minimal error
ξ_i	-	Diameter
ε_j	-	Force
β_{jo}	-	Velocity
β_{ji}	-	Pressure
L_i	-	Moment of Inersia
e_i	-	Radius
L_i^2	-	Reynold Number

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CHAPTER 1

INTRODUCTION

1.1 Overview

Successful of construction projects are heavily dependent on their performance. Construction performance is hampered by many factors that result in poor time performance (delay) and failure of construction projects. Compared to other industries, the construction industry is generally considered underperforming (Saraf, 2013). Moreover, statistics in the Malaysia's construction industry board report showed that Malaysian construction industry is underperforming (CIDB Malaysia, 2015).

There are often no standard benchmarks for evaluation of project performance and its success for the ever-changing construction sector, where the project proponent strives to deliver successful projects. The success of a project has been defined and the performance of the projects has been evaluated by the project proponents in a multitude of ways over the time, while some are still using conventional performance measures such as time, quality and cost of the projects for the performance evaluation measures of the projects.

The benchmarking for each project to be categorised as successful is basically the construction project that is delivered on time within the agreed cost and completed with acceptable quality (Omran *et al.*, 2012; Hasli *et al.*, 2008). However, it is necessary to identify of the key performance measures and the activities commonly carried out in the construction field (Bhatti, 2013). In addition to the statement, Sarhan *et al.* (2013) advocated the need to raise awareness of the project proponent in order to determine the appropriate performance measures as it has received significant attention from researchers and the construction industry over the past two (2) decades. Joshi (2009) translated the performance statistic for projects in the public sector as

facing poor condition of time performance. Furthermore, the poor time performance report on the implementation of public sector projects was stated as evidence of effect on the lagging performance measurement plan in the early stages of the implementation of construction projects (Abdullah *et al.*, 2010).

Moreover, research conducted by Al-Momani (2000) found poor time performance (delays) occurred in 106 out of 130 construction projects in the public sector through his study in Jordan, while Sambasivan and Soon (2007) reported that approximately 17.3% of government contract projects in Malaysia were considered sick (delayed more than three months or completely abandoned) and more than 50% of the government contract projects were faced poor time performance problems.

In addition, time performance can either be referred to good time performance or poor time performance. Good time performance refers to the construction project that completes or finishes within the duration specified in the contract, whereas poor time performance refers to the construction that cannot be completed or finished within the duration specified in the contract. This situation of contract also known as "delay". Poor time performance or delay in delivering construction projects on schedule has become a serious and expensive problem for the parties involved. Late completion of projects can prevent employers from benefiting or profiting from the project. Failure to perform may also expose them to grave financial and economic risks such as high rate of interest and market loss (Ibrahim *et al.*, 2010).

Basically, poor time performance could be defined as an act or event, which prolongs the time needed to perform the contractual task. It usually appears as additional working days or as a late commencement of an activity (Sweis *et al.*, 2008). Delay was defined by the Oxford Dictionaries (2013) as a "period of lateness or postponement of something". Delays can be defined as late completion of work in comparison to the planned contract timetable in accordance with Abedi *et al*. (2011). In Assaf and Al-Hejji (2006) study, poor time performance could be defined by exceeding the time either after a contract or after the date agreed by the parties to deliver the project. It is a project that falls short of its schedule.

Many construction projects with an extension of time do not realize that the cost of the project will rise over the same period. Over the past (3) decades, researchers and industry practitioners have recognized construction time as one of the most important performance criteria of many successful projects. A considerable number of literatures therefore emphasized the time aspect as an indicator of the success of the project. Nkado (1995) and Chan and Kumaraswamy (1997) agreed that project should be completed on time as a symbolic of an efficient construction industry. Furthermore, Latham (1994) also suggested that timely implementation of projects is an important requirement for project proponents in the construction sector.

In addition, Rwelamila and Hall (1995) found that the timely completion of the project was often seen as a key factor in the success of the project, while Xiao and Proverbs (2003) stated that poor time performance of construction project had a significant impact on the cost and quality of project deliverable. New Energy and Industrial Technology Development Organization (NEDO) Report (1983) supported the statement and further quoted that project success is a function of the management effort needed to complete the project on time and the discipline approach helped control the cost and quality of the project deliverables. Subsequently, this raises a growing global concern about the benchmarking of best practice measures by having the framework or reference model for construction time performance for the use of customers, consultants, contractors or analysts in the construction industry in project life cycle stages (Walker, 1995; Chan and Kumaraswamy, 1996 and Georgy *et al.,* 2000).

Besides that, construction time was perceived as one of the most important performance measures among various successful projects. Substantial efforts were made to identify best practice measurements for construction time performance in the construction industry. Time performance is critical to carry out temporary, unique, complex construction projects that are gradually presented and not repeated in short time. Time performance becomes a benchmark for construction project success. Time performance, as stated earlier, is an intact problem to improve performance in the project, as the needs of construction projects increase rapidly. The precise use of the

time needed to implement the project is a benchmark for the success of every project activity (Palmer, 2018).

More importantly, above researchers forms the basis of this research with all the circumstances that have been studied and discussed earlier. The Department of Irrigation and Drainage, Malaysia (DID), which is the authorised flood mitigation project implementation agency through the Sistem Maklumat Kontrak (SMARTRAK) in the info portal of the department (website DID; http://www.water.gov.my), revealed that overall flood mitigation projects implementation in recent years suffered from the poor time performance issue. This research will aim to achieve the objective of establishing a framework or strategic reference for improving poor time performance in flood mitigation projects in Malaysia.

This chapter establishes the research by the introduction and divides it into eleven (11) sections. Section 1.1 demonstrates the research overview, while Section 1.2 provides an overview on the research background. Section 1.3 then explains the research problem statement summarise from the point of view of previous studies. The problem statement at the beginning highlights the importance of the construction industry as well as the ills that will eventually lead to the research area. Section 1.4 then provides research questions to be linked with the aim and objectives of the research. Section 1.5 sets out the goals and objectives of this research. Section 1.6 subsequently highlights the research gap and Section 1.7 highlights the research scope. Section 1.8 further covers the importance of the research that will contribute to the construction industry research field. Section 1.9 provides a general overview of the methodology for the research, consisting of the initial research flow and Section 1.10 provides a comprehensive thesis structure in overall. Finally, the conclusion of this chapter is presented in Section 1.11 as the closing part of this chapter.

1.2 Research Background

Construction is reflected in the homes in which we live, the buildings and infrastructure around us, the cities and townships in which we inhabit. The

contributions are more than purely economic, but the results of construction play a significant role in creating a quality lifestyle for the local population. The government has contributed in various ways to the development of the construction industry, and is the major contributor to infrastructure projects in many developing countries, including Malaysia (Ngai *et al.,* 2002)

In Malaysia, the construction industry has been growing healthily and has progressed well on several sides, but the fact remains that a number of urgent problems need to be addressed urgently. The construction industry is one of the industries that has involved many situations of uncertainty throughout the implementation of the construction project. Recent literature studies have shown that construction projects are usually done with time overrun, excessive budget and concern in quality as the effects of poor time performance.

Arditi and Pattanakitchamrron (2006) stated that poor construction time performance could cause a lot of changes in a project such as late completion, loss of productivity, acceleration, higher costs, changes in scope and termination of contract. In general, however, poor time performance situations are inherently complex. An activity delay may not lead to the same amount of project delay. A delay caused by a party may or may not affect the completion date of the project and may or may not cause harm to another party. Poor time performance over time may occur at the same time as other poor performance over time, and all of them may affects the completion date of the project.

Notwithstanding these results, many projects have not been completed in accordance with the agreed contract period and at the price for which they were offered. Poor time performance is not always caused by a single catastrophic event (Ahmed *et al.,* 2003). The problems of the past often develop slowly with the progress of the project. Minor time-related performance issues are usually overlooked until their cumulative effect is financially obvious. While timely completion is considered to be one of the key criteria for project success, late completion is always an important topic for discussion not only in Malaysia, but worldwide, due to poor time performance (Al-Momani, 2000; Georgy *et al.,* 2000; Chan *et al.,* 2002).

On the other hand, as reported in the Construction Industry Transformation Programme (CITP) by CIDB Malaysia, all of us are either directly or indirectly affected by the construction processes and their deliverables (Shaffii, 2017). The Malaysian construction industry is still dominated by conventional practices (Abdul Shukor *et al.,* 2011) and the urgent need for industrial transformation was reflected in the Master Plan 2006-2015 for the Malaysian Construction Industry (CIMP, 2007). In addition, the government places greater emphasis on strategic thrusts in the four (4) areas: (1) quality, security and professionalism (QSP); (2) sustainability of the environment; (3) productivity; and (4) internationalisation. Each of the thrust is the key pillar to transform the construction industry in Malaysia (Shaffii, 2017). In order to transform the entire industry, strategic thrusts must be implemented in all areas of the construction industry.

Government remains as the construction industry's largest customer. The government project or public sector projects are mainly focused on developing basic infrastructure such as roads, dams, irrigation works, schools, houses, factories and other physical development. The Malaysian National Budget 2015 (Abdul Razak, 2014) has allocated RM 770 billion in public sector projects, but previous audit reports also show that some public sector projects are reported to have been underperformed or suffered as a result of poor management at various stages of the life cycle in the construction project.

In addition, the general perception of the public construction project in the construction industry of Malaysia as a whole is underperforming (Jatarona *et al.*, 2016). Government spending has been distributed accordingly for infrastructure and utilities under the Malaysia Plan (MP) programme. The allocation under the Eighth Malaysia Plan (2001-2005) was RM 38.7 billion while the allocation was RM 46.8 billion in the Ninth Malaysia Plan (2006-2010) as reported by the Economic Planning Unit, Department of Prime Minister; Ninth Malaysia Plan (2006). Other than that, more than RM 100 billion has been allocated on the 10th Malaysia Plan (2010-2015) for the development of physical infrastructure (Economic Planning Unit, Prime Minister's Department; Tenth Malaysia Plan, 2010).

Furthermore, the allocation has increased tremendously, so definitely increasing in the number of public sector projects that will be awarded. There has been considerable and ongoing interest in the effects of poor time performance in construction. Therefore, in implementing these projects, there is a need to reduce the incidence of poor time performance.

More specifically, Ministry of Finance, Malaysia (MOF) has planned to spend RM 138 billion to boost the construction industry's growth (CIDB Malaysia, 2010). Besides that, the Ministry of Water, Land and Natural Resources (KATS), or formerly known as the Ministry of Natural Resources and Environment, Malaysia (NRE) through the Department of Irrigation and Drainage, Malaysia (DID), an authorised flood management agency, has been allocated annually from the MOF budget for flood mitigation and flood control. This allocation is to be spent and implemented throughout Malaysia in order to reduce flooding.

Since the Malaysia Plan (MP) or *'Rancangan Malaysia'* (RMK) began with RMK-1 (1966-1970) until RMK-11 (2016-2018), the Government of Malaysia has spent more than RM 20 billion, as shown in Figure 1.1 on implementing structural and non-structural measures under the jurisdiction of flood mitigation projects, in particular to mitigate flooding across the country (Economic Planning Unit: EPU, Prime Minister Department, 2013). The data generated from each MP's EPU reports has been compiled, reorganized and translated to show that the trend is rising on government spending as the government allocation given to the authorizing agency to implement flood mitigation projects in Malaysia.

From RMK-1 (1966-1970) to RMK-11 (2016-2018), the data generated from archived documents provided by the EPU database shows the trend of expenditure on flood mitigation projects is important as it will reflect the importance of the projects to be implemented. Furthermore, the project needs to be carried out with the proper planned, meaningful and valuable means of living.

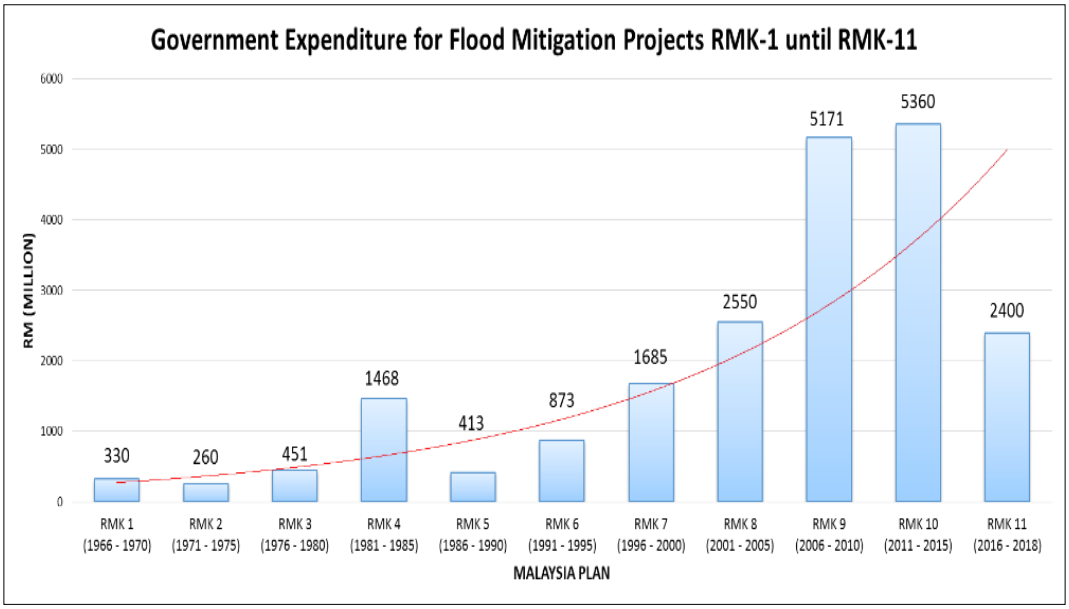

Figure 1.1 Government Expenditure for Flood Mitigation Projects

Concerns over the year about the worsening and increasing flood areas in Malaysia, data from DID's project offices across Malaysia revealed that poor time performance becomes a serious issue throughout the implementation of the project. In order to improve the said performance, further research on the issue is needed. The actual factors affecting time performance of flood mitigation projects in Malaysia in recent years will be determined from the performance of flood mitigation projects data derived from DID's project office documents at each state.

In addition to the expenditure distributed by the Malaysia federal government, the data from the DID project office documents generated the above-mentioned trend. From the records of DID's project office documents in each state, it was revealed that poor time performance of the projects resulted in an increase in costs of projects, caused changes to the scopes planned earlier and affected the quality at the end of the project life cycle.

In supporting of these facts and figures, the Prime Minister's Office (PMO) Department in the formal site visit on 13 July 2018 to the projects of Sabah DID stated that government must draw valuable lessons from both the failed projects and the successful projects.*"We have to put in place new initiatives to streamline the procurement processes, ensuring projects are awarded to competent contractors and*

installing systems to monitor every project on near real-time basis to spot any delivery problems and try to resolve it immediately and effectively". These initiatives, he said, will prevent the projects suffering from the poor time performance and further fail the overall implementation project.

In other concrete terms to agree with the minister's statement, the opening speech by previous Secretary General, Ministry of Water, Land and Natural Resources, Malaysia or Kementerian Air, Tanah dan Sumber Asli Malaysia (KATS) for the *"Project Management Nation Talk"* programme on 24 September 2018, Dato' Dr. Tan Yew Chong said *"an effective and efficient project management must be emphasizing to ensure the construction of projects can be finished by the time spelt in the contract, with the cost and quality expected by the client. In addition, the three (3) main principles must be looked into for the outcome of each project implementation was the fastest implementation as it is reflecting to the time performance, given high impact to the people with the lowest cost to the government of Malaysia".* He stressed the statement in his speech, hoping that the outcome achievement will be more important than output-oriented projects, considering that all the development projects for the public sector are based on time performance and will be monitored by each five (5) years Malaysia Plan (MP) basis. This opening speech was published on the official portal for the ministry (http://www.kats.gov.my).

In order to further reinforce the argument of the minister and the secretary general, the researcher's work experience of more than fifteen (15) years in DID Malaysia has the role of project implementer (as project owner, project superintendent officer (SO) or as project engineer at the various offices / projects) in implementing government construction projects, the problem of poor time performance within the department is not yet to be solved. The issue has disrupted each project's construction, which can cause project failure. Since the action to solve the problem is not addressed properly, it will not solve the poor time performance situation. Therefore, the circumstances of poor time performance attracted the researcher to look into the scenario and assist the department in improving the performance of the construction time, especially in the implementation of flood mitigation projects.

1.3 Research Aim and Objectives

Research aim and objectives are the statements to be made by the research project. It provides measurable information about the purpose of research and defines the standards of what research is accomplished (Mahmud, 2009).

Out of definition above, the aims of this research was focused to develop a problem-solving model (strategies model) as to mitigate and improve poor time performance in flood mitigation construction projects which authorised under the Department of Irrigation and Drainage, Malaysia (DID) as mentioned in the previous Section 1.3. Realizing the issue of poor time performance in flood mitigation construction projects in Malaysia, there is a need to support the research aim as to make sure that the aim is well responds logically to the problem statement, the research objectives for this research established as the followings:

(i) To explore time performance of flood mitigation projects in Malaysia;

(ii) To examine critical activities affecting time performance of flood mitigation projects;

(iii) To evaluate the challenges within the critical activities that affect time performance of flood mitigation projects;

(iv) To propose strategies to address challenges of critical activities that affect time performance in flood mitigation projects; and

(v) To develop Strategies Model of Time Performance for Flood Mitigation Projects.

1.4 Problem Statement

The problem statement is referred to as a clear, accurate and succinct statement of the question or issue to be investigated with the aim of finding a solution or answer

to the outlined problem (Sekaran, 2003; Sekaran and Bougie, 2009). The rising spending trend as shown in the previous Figure 1.1 indicated the need for detailed planning of the flood mitigation project each year to reduce the impact of flooding on people in the affected areas. Indirectly, with the responsibilities given to DID, it is necessary to ensure that the proper promoter is concerned with proper implementation of flood mitigation project in order to avoid poor time performance of flood mitigation project throughout the whole project life cycle stages.

Delay in delivering flood mitigation projects on schedule has become serious and expensive problems for Department of Irrigation and Drainage, Malaysia (DID) and other parties involved through the project life cycle of flood mitigation construction projects in Malaysia. As illustrated in the Figure 4.2, the project that encountered poor time performance generated from the Table 4.2. It can be seen that the poor time performance is a serious issue that occurred in Malaysia where 56.5% of overall data for flood mitigation projects were implemented and completed in year 2013 to 2016 facing the problem of poor time performance (Project Document in Project Office, 2017)

As the country among the developed nation, the construction industry has become one of the key economic pillars of Malaysia and as a result, it is necessary and important to carry out the study of activities affecting time performance (Nor Haslinda, 2018). A few years before the findings, Abd El Razak *et al.* (2008) identified that poor time performance in construction project is considered one of the most complicated problem causing multiple negative effect on the project and its participating parties. Ahmed *et al.* (2003) supported the statement and stated that it is essential to determine the actual factors and activities affecting poor time performance in order to minimise the effect on the construction projects. Thus, as mentioned by the above researchers, there is the need to carry out the study on the problems as to form the basis of this research where the flood mitigation projects data was not covered by the above studies and there is the need to model the strategic reference for this type of project to improve the project's implementation as a whole as stated by Mohammad *et al.* (2014), the establishment of such strategic reference or guidance can enhance the decision-making process for the construction implementation. The importance and significance of this

research will be further discussed in the Section 1.8. In addition to the problems mentioned earlier (at the second paragraph of this section), this research outcome was expected to help the authorisation agency to implement flood mitigation projects in Malaysia, known as DID, to structures their strategy to minimise the effect of poor time performance for flood mitigation projects.

Moreover, research into construction project to mitigate floods must be investigated in terms of relationship or correlation between project life cycle stages and construction projects time performance. On the other hand, this research will be resulted the critical activities that need to be focused on their challenges and strategies to address challenges within the project life cycle stages which influencing the time performance of flood mitigation projects in Malaysia substantially. It is anticipated that the framework model being developed will be the strategic reference and guidance to the project proponent for the field, in order to improve the existing poor time performance towards different phases of project life cycle.

1.5 Research Questions

Research question can be found by asking what motivates the researcher, the kind of research one wants to do and the outcome of the research to achieve. On what others propose suggestions in literature of where most research is needed (Oats, 2009). Essentially, as indicated by Bryman (2012), a research question is a question that provide an explicit statement of what is it that the researcher wants to know.

In this study, quantitative research questions inquire about the relations between constructs that need to be answered. This proposed research offers several primary research questions intended to help reveal the essential of time performance factors in flood mitigation projects as perceived by the flood mitigation project proponents. To help meet the aim and objectives of the research, the following over-arching questions guided this research;

(i) How is the time performance condition of flood mitigation projects implementation in the Department of Irrigation and Drainage, Malaysia (DID)?

(ii) What is the critical activities that cause poor time performance of flood mitigation projects life cycle stages in Malaysia?

(iii) How is the experts evaluate the challenges or problems of critical activities on flood mitigation projects in Malaysia?

(iv) What is the solutions or strategies proposed for the challenges that significantly affect poor time performance of flood mitigation project implementation in Malaysia?

(v) What is the best project management practise / framework / strategies model that can be a valuable tool to improve and structures the effort in minimizing the occurrence of poor time performance of flood mitigation projects implementation in DID Malaysia?

(vi) How will this research contribute to the body of knowledge and practise or to be used as a strategic reference to the construction players within the department's project management division of DID Malaysia?

1.6 Research Gap

This research adapted the criteria of measuring each type of construction project performance in terms of time, cost and quality that has attracted the interest of researchers and practitioners which in line of what has been discussed earlier as the knowledge boundary for this research. There are various types of construction projects determines under civil engineering field in Malaysia such as building, road / highway, water supply, tunnelling, dam, telecommunication and pipeline projects. This research will be focused on flood mitigation construction projects in Malaysia where it is also classifying under the civil engineering type of construction project and rarely discuss

in previous literatures of the related field. This research will try to fill in the gap establish by the worldwide scholars from previous research so that they can open a door for future study in this field.

The successful implementation of the flood mitigation project in Malaysia is measured in terms of its performance measurement of time, cost and quality where this research will focus only on its time performance measurement. To be specific, time performance will be measured as good time performance and poor time performance of construction project which to be specific in this research will only look into poor time performance or well-known as "delay" on the project implementation. This illustrated on the Figure 1.2 as the basis of this research.

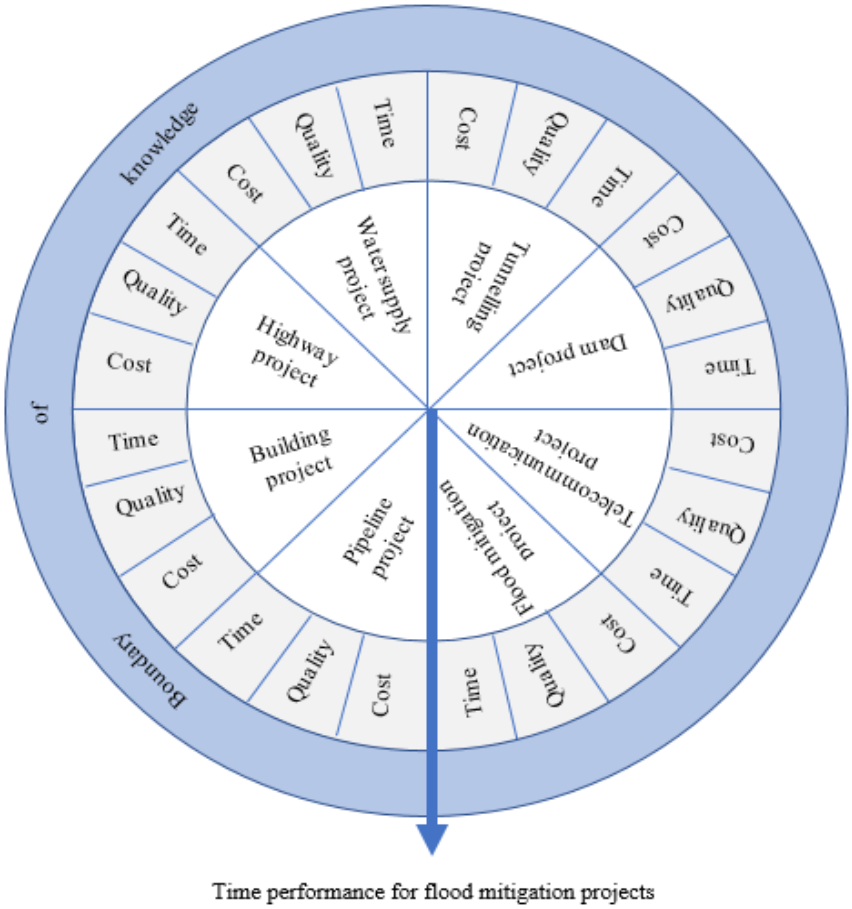

Figure 1.2 Knowledge Boundary for the Research

Previously, many studies had been carried out on poor time performance for the projects, but mostly focused on infrastructure scope and building projects in

general. However, further refinement and specific study are required in this research to nail on poor time performance of flood mitigation projects, especially in Malaysia. Table 1.1 indicates the various type of construction project field focused by the previous researchers for the past few decades till recent ones, without having any study specifically on the flood mitigation projects field on the list.

Table 1.1 Type of Construction Projects Focus by the Previous Authors

No.	Type of Construction Project	Authors
1.	Irrigation & Power Projects	Healey (1964)
2.	Power Plant Projects	Wilson (1969)
3.	Lab Research Building Projects	Allen *et al.* (1970)
4.	Reclamation Projects	Gerni (1970)
5.	Highway, Water, Buildings Project	Merewitz (1973)
6.	Power Plants Project	Blake *et al.* (1976)
7.	Pipelines Project	Cochran (1978)
8.	Nuclear Power Plant	Parvis (1979)
9.	Military Building Projects	David (1982)
10.	Dam Projects	Fattah (2015)
11.	Building Projects	Ogunlana *et al.* (1996)
12.	Buildings, Nuclear Power Plants, Tunnelling Works (simple to complex type of projects)	Abdul Majid *et al.* (1998)
13.	Building projects	Odeyinka and Yusif (1997)
14.	Building & Infra Projects	Kumaraswamy *et al.* (1998)
15.	Construction projects - general	Mezhar *et al.* (1998)
16.	Building & Highway projects	Abdullah and Battaineh (2002)
17.	Building Projects	Al-Momani (2000)
18.	Building & Highway projects	Oden and Battaineh (2002)
19.	Highway projects	Manavazhia and Adhikari (2002)
20.	Major construction projects	Terry Williams (2003)
21.	Large Scale of Construction Projects	Assaf and Al-Hejji (2006)
22.	Construction projects - general	Moura *et al.* (2007)
23.	Construction projects - general	Sambasivan and Soon (2007)
24.	Construction projects - general	Azhar *et al.* (2018)
25.	Development & telecommunication projects	Ameh, Soyingbe and Odusami (2010)
26.	Building construction projects	Fugar and Agyakwah-Baah (2010)
27.	Infrastructure projects	Amu and Adesanya (2011)
28.	Large MARA construction projects	Abdullah *et al.* (2010)
29.	Construction projects - general	Nawaz *et al.* (2013)
30.	Infrastructure Projects	Aziz (2013)
31.	Highway projects	Gunduz *et al.* (2013)
32.	Infrastructure projects	Pai and Bharath (2013)
33.	Construction projects - general	Marzouk and El-Rasas (2014)
34.	Building projects	Rahman *et al.* (2012)
35.	Road construction projects	Hasan (2014)
36.	Housing Projects	Chang and Aminah (2015)

As evidence to this, flood mitigation projects are not yet to be explored by other researchers in this research field. Thus, this research tends to focus on the critical activities, challenges within the critical activities and strategies to address challenges

affecting time performance of flood mitigation construction projects. In addition, a strategic reference model for flood mitigation projects in Malaysia is being developed as the research goal that to be used by DID Malaysia as guidance to improve the poor time performance of flood mitigation projects in Malaysia.

1.7 Research Scope

This research involves quantitative approach using structured questionnaire survey to identify significant stages and life cycle activities to be improved in order to minimise poor time performance of flood mitigation construction projects in Malaysia. Fundamentally, the research parameters are limited to the implementation of flood mitigation construction projects (public sector projects) in Malaysia. As will be further decribed in Chapter 3, the respondents for this research, are DID Engineers (the highest level / the most grade who involved in flood mitigation construction projects), contractors (the highest grade involved in flood mitigation construction projects Grade G7 and registered under CIDB, Malaysia) and also Civil and Structure (C&S) consultants (the majority of consultancy field involved in flood mitigation projects and was registered with Board of Consultant, Malaysia).

The scope of this research is focused on civil engineering construction project in Malaysia and particularly on flood mitigation projects implemented by Department of Irrigation and Drainage Malaysia (DID), which is the authorised flood mitigation projects implementation agency for the Government of Malaysia. Each phase approach in the research consists of different scopes for the research but will lead to achieve the research aim and objectives as stated on the previous Section 1.5. Table 1.2 shows the frame that highlighted the related parameters and boundaries of this research.

Table 1.2 Scope of the Research

No.	Research Area	
	Parameters	**Boundary for this Research**
1.	Project Performance Measurement (Time / Cost / Quality)	Time
2.	Time Performance (Good / Poor)	Poor
3.	Type of Project Sector (Public / Private)	Public
4.	Respondents (Selective Construction Players)	1) DID Engineers (the most level / grade who involved in flood mitigation construction projects) 2) Contractors (the most grade involved in flood mitigation construction projects - Grade G7 and was registered under CIDB Malaysia) 3) Civil & Structures (C&S) Consultants (the most field of consultancy involved in flood mitigation construction projects and was registered under Board of Consultant Malaysia)
5.	Government Agency (Technical Authorities Department: JKR / DID)	Department of Irrigation & Drainage (DID)

1.8 Significance of the Research

This research is set to develop a problem-solution model to mitigate poor time performance in flood mitigation projects by considering the life cycle stages for this type of projects. The need for this research becomes necessary due to the vibrant importance of best management practises while implementing construction projects in Malaysia. The fact that the discipline plays a vital role in improving poor time performance and helping the said department to structure the strategic reference model in minimizing the impact of poor time performance for flood mitigation projects in Malaysia. It is important to explore the critical activities in each stages of the project life cycle that donates and reflects the time performance of this research. As the research problem was clearly stated in the previous Section 1.3, the need to have the strategic reference for the time performance improvement due to delay in delivering flood mitigation projects on schedule is viewed as very significance needs to the department (DID Malaysia) and the construction industry especially to the field area.

In line with this, it is hoped that the results from this research can be assisted the Department of Irrigation and Drainage, Malaysia (DID) and the flood mitigation projects proponents to improve the existing practices for implementing this type of construction projects. Furthermore, research findings are expected to provide a model of strategic reference and a better understanding of the best practises in flood mitigation projects in Malaysia.

More fundamentally, project management practises ware recognised as one of the strategies to minimise the impact of poor time performance, which the industry cannot deny. This research also hopes to educate students, researchers and scholars about the necessary to adopt project management practises for the implementation of flood mitigation projects. This will allow them to carry out project management knowledge areas throughout the various activities in the project life cycle, as it is clearly shown in most literatures relating to this research field.

Therefore, government, policymakers, construction industry as well as the authorised department, DID Malaysia could find the outcome of this research is useful in the process of understanding the extent of the research contribution. Research contribution in the forms of contribution to the knowledge, to the construction industry and to the departments as well will be explained in detail at the Section 5.4 in the Chapter 5. According to Iram *et al.* (2016), the simple definition of project success has only been based on the implementation phase of the project's life cycle. Project success is required from the beginning to the end of the project's life cycle. As Prabhakar (2008) argued, good time performance in projects means very little that the project faces underperforming situation during and towards the end of projects. The findings from this research hopefully will add to the wealth of literatures and serve as a reference information material for researchers and construction industry players as a guide throughout the project's life cycle stage of each project in the research area of construction project time performance.

1.9 Overview of Methodology

This research consists of five (5) stages namely: (1) initial reporting; (2) data collection; (3) data analysis and interpretation; (4) framework model development; and (5) final reporting. During the first stage, the research undergoes literature review to gather information from previous study related to this research's objectives. Then, the project document study was performed in DID's project office to explore the time performance of flood mitigation projects in Malaysia. From this, a set of questionnaire survey was developed when the matrix mapping process established (through the project documents study and supported with literatures) with further validated by subject matter expert (SME) in this field. This research has been designed with a mixed mode method for data collection with the sequential explanatory design, which started with quantitative and followed by qualitative (Creswell, 2017).

Furthermore, mixed mode method has been used for this research as it can fulfil the research objectives. The Objective (i); to explore time performance of flood mitigation projects in Malaysia, was fulfil through data exploration from project documents study in the Department of Irrigation and Drainage, Malaysia (DID). The data were then analysed to determine the percentage of flood mitigation projects experienced poor time performance. Then, data collected for Objective (ii); to examine critical activities affecting time performance of flood mitigation projects, where performed via quantitative method which is using questionnaire survey approach through the statistical analysis (PLS-SEM) to get the answer for the relationship between the independent variables (stages in the project life cycle) and the dependent variable (time performance of flood mitigation project). On top of that, the Importance-Performance Matrix Analysis (IPMA) based on mean score scoring was then take part to find the most critical activities of each project stages. The Objectives (iii); to evaluate the challenges within the critical activities that affect time performance of flood mitigation projects and then Objective (iv); to propose strategies to address challenges of critical activities that affect time performance in flood mitigation projects. Other than that, Objective (v); to develop Strategies Model of Time Performance for Flood Mitigation Projects where accomplished by qualitative method through interviews with subject matter expert (SME) in flood mitigation projects.

Since these objectives requires information on challenges and strategies for critical activities that affect time performance in flood mitigation projects, this research was selected interview experts for validation process as to meet all these objectives. SME in this research is the group that best meets the variables as mentioned by Peggy *et al.* (2015) and the experts have a wiser view of their area. Detailed of SME background for Interview 1 and Interview 2 are presented on the data analysis part which is in the Chapter 4.

Other than that, pilot study was conducted to test the reliability of the questionnaire survey for the first stage of data collection. Thirty (30) respondents or 10% from the random sample (300 respondents) were managed to response the pilot test as recommended by Hair *et al.* (2010). The reliability test can be accepted if the Cronbach's Alpha (CA) value exceeds 0.6 (Hair *et al.*, 2010). The main purpose of this questionnaire survey is to achieve Objective (ii); to identify critical activities affecting time performance of flood mitigation projects. From the data received, Structural Equation Modelling (SEM) was used to identify the critical activities throughout the flood mitigation project life cycle. Consequently, the critical activities will be validated by SME of the field.

Moreover, the validation of critical activities will be done through semi-structured interview with SME. The SME will be required to validate the critical activities listed based on the statistical data analysis of the questionnaire using SEM. At the same time, SME will be questioned to evaluate the main challenges within the critical activities and to propose the strategies to address challenges of critical activities that affect time performance in flood mitigation projects. In the first series of the interview with the SME, they will be asked to do the validation of the critical activities, obtaining challenges within the critical activities and proposing strategies to address the challenges of critical activities throughout the interview process.

Once the critical activities are validated, the challenges and strategies for critical activities are obtained, a model called "Strategies Model of Time Performance for Flood Mitigation Projects" is developed. This model will also go through SME's validation process, which will be conducted through the SME's second series

interview. The details of SME's background for model validation are presented in the Chapter 4. The end stage is the final reporting stage consisting of the conclusion and recommendation of the thesis.

The methodology that was divided into five (5) stages employed in this research is dependent on input quality, which includes effective control over the entire research process. Figure 1.3 shows the summary of the stages in this research which briefly explained at the early of this Section 1.9. The detail activities for the research will be explained further in the next Chapter 3. This research attempts to reduce the organisational (department) problem of poor time performance in the implementation of flood mitigation project and further understand the uniqueness of this type of project (flood mitigation project) and the more importantly, the particular context of research to be performed by the researcher.

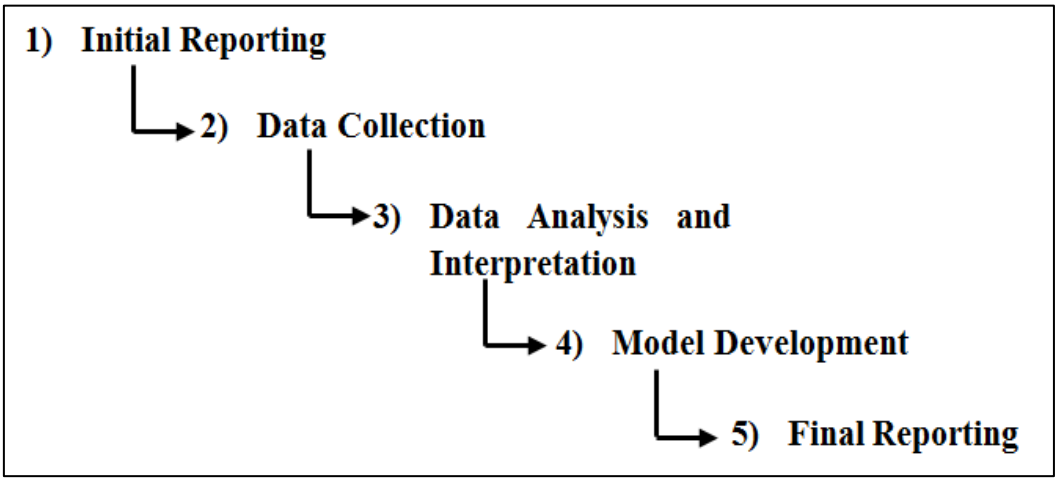

Figure 1.3 Summary of Steps in the Research (Conceptual Framework of the whole research)

1.10 Structure of the Thesis

This thesis is to be organized into five (5) essential chapters. In this research, consideration was given to the construction industry, which focused on the flood mitigation projects that faced poor time performance for Malaysia scenario. This includes identifying flood mitigation projects in Malaysia that experienced poor time

performance and determining critical activities affecting time performance in flood mitigation projects based on the perspectives of flood mitigation projects players in Malaysia. By evaluating problems within the critical activities and proposing solutions to the problems of poor time performance in flood mitigation projects, this research will support the aim of improving the time performance of flood mitigation projects in DID by developing problem-solution model (strategies model) to mitigate poor time performance in flood mitigation projects. Besides, the result of this research can contribute to DID and the said model can be used as a strategic reference for the project management improvement in DID.

Chapter 1 serves as a frame for the rest of the thesis. It consists of a brief introduction chapter that includes the background and describes the research's problem statement. It also explains the aim and objectives, research scope as well as the initial flow of the research to be used for the study that outlines the entire research arrangement with the summary at the end of the chapter.

Chapter 2 reviews research literature including characteristic of successful project, time performance in the construction industry included cause and effect to the industry, flood mitigation project in Malaysia with poor time performance, current and future development of this type of project. This chapter also explained about construction project management covered the process and construction project life cycle. In addition, activities in the construction project life cycle were discussed in details on each flood mitigation project stage. Challenges within the critical activities and strategies to address the challenges were discussed for the improvement of project management model development. Following which, the theoretical framework of the research was discussed, ended with the summary of the Chapter 2.

Chapter 3 discusses on the methodology used in this research to achieve objectives of the study. This chapter explained the method used to fulfil each objectives of the study. Basically, this research has gone through data exploration (project documents study) from Department of Irrigation and Drainage, Malaysia (DID), questionnaire survey to the construction players involves in flood mitigation projects and interviews with subject matter expert (SME). At the end of the chapter,

the development of problem-solution model (strategies model) will be discussed to mitigate poor time performance and as a strategic reference in the implementation of flood mitigation projects. Then, the summary will be the closing paragraph for the chapter.

Chapter 4 explains the outcome, data interpretation and discussion for each objective. Based on each objective, the data were presented to show that the objectives are fulfilled and the readers had a clear picture throughout the research. The chapter then closed with a summary of the research findings.

Chapter 5 will be the last chapter of the thesis. It discusses research findings, interpretation of findings, theoretical and practical contributions, implications, study limitation and recommendations for the future field work. This also includes the conclusions of entire research as the book end of the thesis.

1.11 Summary of Chapter 1

Chapter 1 or Introduction's Chapter provides a brief overview of the key aspects of the research. The research concerns to improve time performance of flood mitigation projects implemented by the authorised agency (DID Malaysia) by establishing the model as a strategic reference to improve the existing practices. In addition, the development of a problem-solution model (strategies model) in flood mitigation projects will help the previous practice to mitigate poor time performance and will determine the critical activities as to improve every project life cycle stage towards time performance of flood mitigation projects.

Chapter 1 contains the overall thesis framework starting with the research overview, research background and the problem statement. Furthermore, the content extends for research questions before further towards research aim and objectives, research gap and research scopes were briefly explained in this chapter. Other than that, the significance of the research will take place before the overview of the methodology explained as a whole. The structure of the thesis also discussed at the

end of the chapter as to capture the research structures in overall. The significance and methodology overview of the research was explained before the organization of the thesis took place at the end of the thesis.

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