REQUIREMENT ENGINEERING BEST PRACTICES FOR MALAYSIAN PUBLIC SECTOR

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DEDICATION

Dedicated to :

My beloved husband  Haji Hasbullah Haji Ali,
My beloved daughters,  
Ain Syazwani, Auni Syazwina, Amna Syazwana and Alya Syazihah,
My Mothers,  
Hajjah Habibah Abdullah and Hajjah Misgiah Abd Hamid,  
My Late Fathers,  
Allahyarham Haji Haron bin Jana and Allahyarham Haji Ali Hamid,  
My Brothers,  
Aminduddin Haron, Azhar Haron, Allahyarham Azlan Haron and Azman Haron  
My Sisters  
Azizah Haron, Azurah Haron, Azila Haron and Azwin Haron  
My Best Friend,  
Hafidzah Md Nadzir, Dr. Hajjah Norma Sabtu, Haji Anuar Bachik, Raja Fauziah Raja Abdul Hamid, and Hajjah Zoraidah Ahmad,  
and My Relatives especially Allahyarham Haji Ismail Jana  

Thank you for your supportive and Doa.
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Amin
ABSTRACT

Although a variety of ICT standards have been developed as a guide for IT Managers, the Malaysian Public Sector is in tandem by developing new policies for them. The need of Requirement Engineering Best Practices for IT Manager is to produce an appropriate Software Requirement Specification. The proposed Requirement Engineering Best Practices aims to be a standard for the Malaysian Public Sector. The need of the standard is to resolve identified complexity during software project development. The complexity of present Requirement Engineering models and standard is either too specific or too general. These models do not meet the Public Sector’s requirement and the IT Manager depends on other proposed solution or does not use any Requirement Engineering models and standard. The complexity of present software process drives the Malaysian Public Sector to create several committees for monitoring the implementation of software project. It also includes several rules and policy. The rules and policy were prepared by different or multiple agencies and is complex to understand. The proposed software projects have to go through several levels of software project approval. This process is repeated and really took times to be approved. These complexities can be overcome with a proposal of Requirement Engineering Best Practices Guideline. The development of Requirement Engineering Best Practices Guideline is implemented based on the Requirement Engineering Best Practices Guideline Research Framework. This framework used with mixed method. Qualitative techniques were used for interview, refinement and validation. Meanwhile, quantitative techniques were used for the survey. Target respondents for this research are IT Managers in the Malaysian Public Sector. The guideline also consists of identified requirement processes: Software Project Approval Process, Software Requirement Specification Approval Process, Software Requirement Specification Activity Diagram and Software Requirement Specification Development Procedure. The proposed best practices is developed using the mutation and the mapping process between defined Requirement Engineering Process, Software Project Success Factor and Requirement Engineering Critical Issues which were explained in Requirement Engineering Best Practices Framework. This guideline also aligns with the ICT standard. The Requirement Engineering Best Practices had been tested with a pilot test by selected IT Managers and the actual survey had been randomly distributed to IT Manager in Malaysian Public Sector. Furthermore, the guideline had been refined by ICT experts using Delphi techniques. The proposed guideline fulfilled the criteria: completeness, sufficiency, reliability and acceptance. This compliance was validated by selected ICT experts who have different backgrounds and experiences. The proposed guideline will guide IT Managers in implementing the requirement gathering process and will also improve the Software Requirement Specification Process.
ABSTRAK

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<td>Information Communication Technology Steering Committee</td>
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<td>ICTSP</td>
<td>Information Communication Technology Strategic Planning</td>
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<td>INTAN</td>
<td>National Institute of Public Administration</td>
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<td>JTICT</td>
<td>Government IT and Internet Committee</td>
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<tr>
<td>JUSA</td>
<td>Jawatan Utama Sektor Awam</td>
</tr>
<tr>
<td>MPS</td>
<td>Malaysian Public Sector</td>
</tr>
<tr>
<td>PTM</td>
<td>Information Technology Officer (Pegawai Teknologi Maklumat)</td>
</tr>
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<td>RCMM</td>
<td>Requirement Capability Maturity Model</td>
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<tr>
<td>RES</td>
<td>Requirement Engineering Standard</td>
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<td>RET</td>
<td>Requirement Engineering Technique</td>
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<td>SDLC</td>
<td>Software Development Life Cycle</td>
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<td>SPD</td>
<td>Software Project Development</td>
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<td>SRS</td>
<td>Software Requirement Specification</td>
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<td>SWOT</td>
<td>Strength Weakness Opportunity Threat</td>
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SPAP - Software Project Approval Process (SPAP) is a set of processes that are required to get an approval from the management to implement software projects proposed from an organisation or agency.

SRSPF - SRS Process Flow (SRSPF) is a set of processes for developing SRS for software projects that have been approved in SPAP. SRS have to endorse by the Committee.

SRSEP - SRS Evaluation Process (SRSEP) is a component in SRSPF

SRSAP - SRS Acceptance Process (SRSAP) is updated from SRSEP and replace with the SRSPF.

SPIs - Software Project Issues (SPIs) are a group of issues that always appear during requirement gathering and faced by IT Manager. These issues were classed as SPSF.

SPC - Software Project Components (SPC) is component that related to the development of software projects. The determined SPC is people, process and technology.

SPSF - Software Project Success Factor (SPSF) contains of SPC that involved in every of SPD. The successor of a software project depends on how we manage the SPC.

SRSAD - SRS Activity Diagram (SRSAD) is a roles been implemented in SRSDP by key IT Personnel or related people appointed by the management for the requirement gathering.

SRSDP - SRS Development Procedure (SRSDP) contains of steps should follow by the key IT Personnel in order to develop the SRS. SRSDP is part of SRSPF.

RECI - Requirement Engineering Critical Issues (RECI) are issues related with the SPSF and REP-MPS

REP-MPS - The redefined REP for Malaysian Public Sector consist of Management, Elicitation, Analysis and Negotiation, Verification and Validation, and Documentation
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CHAPTER 1

INTRODUCTION

1.1 Introduction

The aim of the research is to create Requirement Engineering Best Practices Guideline for Malaysian Public Sector. The research gap found there is complexity during software project development. The complexity are in implementing Requirement Engineering in Malaysia Public Sector, complexity of the implemented Requirement Process and complexity of applying the Requirement Engineering model/framework/standard in Malaysian Public Sector. The problem statement has no standardization in implementing requirement engineering in Malaysian Public Sector. This research implementation is based on the research question and is to achieve the objective based on the research objective within the scope that has been defined. The significance of the research defined should align with the research contribution.

1.2 Motivation

The aim of the research is to create Requirement Engineering Best Practices Guideline as a guideline for software requirement specification for software projects.

In the development phase, the developer should refer to software requirement specification, as it is the required documentation. They can plan the user’s expectation, further requirement design, do the validation of the system and meet the
original needs of the user (Saiedian & Dale, 2000). The software requirement specification is referred if there are any changes needed to update during the testing phase. Ideally, the software requirement specification is referred as a documentation checklist at the end of the software development project. The developers help a well-written software requirement specification. Software Engineering offers the structured stage in the development process. The specific field is requirement engineering which is needed in software development process. Requirement Engineering is a branch of Software Engineering concerned with the real-world goals to and constraint on software systems (Wan et al., 2010). The use of Requirement Engineering Process structured the IT Personnel working style. Requirement Engineering is well established as a part of system engineering and it is also part of a feasibility study in the System Development Life Cycle.

The Requirement Engineering Process is a very complex process and requires an understanding of the stakeholders to select the right requirements. It is an ideal starting point for the software project development which can improve the decision making and its outcomes (Aurum & Wohlin, 2005). The Requirement Engineering Process, as a guideline, organized the IT Personnel task. Nevertheless, the guideline should be simple and easily understood by the reader. Its alignment with the goals of Requirement Engineering Process includes understanding the stakeholders, refining into requirements, resolving the requirements’ conflicts, the requirement explanations must meet the requirements of stakeholders, and act as a foundation for system design and implementation (Castro et al., 2003). In addition, the IT Personnel need the Requirement Engineering Process Activity to improve their current practice. Requirement Engineering is a continuous activity to help IT Personnel establish the Requirement Engineering Process. The Requirement Engineering Process Activity is developed based on the relationship of Requirement Engineering Process. The actor should play these activities with most appropriate Requirement Engineering techniques.
1.3 Background of the Problem

Software projects involve very high cost, but provide a good investment for high-growth industries in many countries. They also involve a costly element in improving the capability of government to serve the people (Tessler, Barr, & Hanna, 2003). The government ICT services usually are criticised, especially the counter service as poor in quality (Muhammad Rais, 1995). The quality of service delivery gave the positive impact to the public perceptions. Nowadays, the Malaysian Government combined the services in software project development as a one stop portal in improving the services. Data is the basis of a live electronic government application. Good and secure data indicate the security level of the application (Omar & Mohd. Yusof, 2006).

![Figure 1.1 The complexity of Requirement Engineering Process in Malaysian Public Sector](image)

The quality of software project depends on the user satisfaction. It is important to fulfill the user’s satisfaction of any system with the basic requirement, there are no bugs in the systems, the consistency of the user interface, ease of use, response rates in interactive systems, coding and documentation (Omar & Mohd. Yusof, 2006). Failure to meet the users’ satisfaction is the cause of the poor
communication amongst developers, stakeholders and managers (Charette, 2005). Badly defined system requirements of immature technology will give impact to the level of accessibility and availability of system application. Information will not be accurate caused by poor project managements, inability to handle the project's complexity, poor reporting of the project’s status, unmanaged risks, and inaccurate estimates of needed resources (Charette, 2005).

Issues that are often overlooked is the complexity of the processes involved during the development of a software project. A proposed software project must undergo several stages of approval. In addition, it must refer to some guideline has been provided both in terms of requirements for business and ICT. The complexity has been classed into three groups as shown in Figure 1.1.

1.3.1. The complexity of Requirement Engineering

Requirement Engineering is involved in the whole requirements approaches, tools and techniques and the implementation in the software development life cycle (Dorfman, 1977). Requirement Engineering introduced general model such as for management information system and specific model such as for small medium enterprise as explained in Chapter 2-Requirement Engineering Best Practices Framework. These models are created based on certain issues or target groups. The implementation of Requirement Engineering Process in Requirement Engineering model must also depends on the understanding of researcher as explained in Chapter 2-Analysis of Requirement Engineering Process Model. The connection between the activities is also not clearly defined. The actors implement these activities also based on the Requirement Engineering Process that have been selected for their model. The difficulty of understanding the Requirement Engineering Process will lead to the actor performing the activity based on his or her experiences rather than following the stated role. Some of the implementation is based on a combination of researchers' ideas. The related Requirement Engineering standards such as ISO/IEC 122007 focus on software life cycle process, while RCMMi implemented in small medium enterprise for Malaysia as shown in Chapter 2-The differentiation between
RCMM with RCMMi. Constraints of personnel in understanding the standards made the implementation to be in an inappropriate way, and most of the outsourcing project implements the method that was proposed by the vendor consultant.

The developer is the most important personnel that must understand the Requirement Engineering Process. The requirement should define and determine the generic and specific requirement. Both requirements have their own goals to achieve in making the software project a success. A good requirement will decrease the degree of failure of software projects. However, sometimes the software project fails because of an uncompleted requirement process, no controlling of requirement changes and monitoring system design. The changes of requirement influence the changes of the business process, changes of ICT infrastructure, and cause the business process to reorganise, restructure, and react on new opportunities for improvement. The requirement is more complex and complicated especially for the large application system. The developer will need to struggle and understand the stakeholder’s needs. While, the stakeholders continue gaining new insights into the problem, it will somehow lead to changes in the requirements. This problem, requirements gathering, should be resolved through the use of the guideline.

1.3.2. The complexity of requirement process in Malaysian Public Sector

This research clarified the problem based on Software Project Development scenario in the Malaysian Public Sector. The decision in implementing a Software Project Development is usually from the manager, as the decision maker. It started with a concept paper, where the idea of the software project presented among the team. The Management will appoint a consultant on behalf of the Malaysian Government to do research on the importance and the needs of the software project. The consultant will produce a “Blue Print” as a guideline during the implementation of the project. The research on process improvement will be done by the selected vendor or by the developer. Then, the consultant should assess the current situation and the particular procedure and come out with a new idea in improving the current process. This is the most crucial part where the changes of the process improvement
will affect the changes of policy of the business process. The proposed concept paper will be presented to the committees involve in ICT Steering Committee and Government IT and Internet Committee.

The proposed concept paper should align with the e-Governance. The governing organization also should align with ICT regulation or standard. The IT Personnel is responsible to ensure the conformity and accountability of the rules. Currently, the problem is lacking the appropriate guidance and support in managing within the relevant information systems. This study shows that, there is little support to manage the requirements and their relationships to various policies and regulations (Breaux, Antón, & Spafford, 2006).

The proposed software project should be advised by the IT Department and align with the role and responsibility of the IT Department such as Data Center, Network and Security. Then, the proposed papers have to get the approval from ICT Steering Committee in the organization, followed by ICT Steering Committee ministry, and finally by the Government IT and Internet Committee which is chaired by MAMPU. This process will take about three months without correction, and sometimes will go beyond six months as shown in Chapter 6–Software Project Approval Process. Besides that, the team has to follow the schedule plan of the committee, which sometimes affects the implementation schedule plan. This situation shows the complex role of the committee that should be facing by the IT Personnel. IT Personnel not only should have the technical knowledge and project management, but also need to have the soft skills in order to convince the committee. Otherwise, the proposed software project development is not important for the committee.

Several rules and guidance are being developed by organisation, ministry and treasury in order to ensure that the proposed software project development consider the management, organization and other beneficiary recipient as example in APPENDIX C. The proposed software project development should also follow and meet the international standard to ensure software project development is recognized and reliable. The government ICT framework, which is too general, also binds the
software project development and the agencies have different understanding or just use their assumption. Sometimes the vendor proposes a methodology, which needs involvements from other parties such as consultants during the implementation. The proposed methodology needs to be customised by the personnel that really have experience and supported by the training which usually is not included in the earlier plan. Otherwise, it will raise other issues such as rescheduling the implementation phase or extending the schedule planned.

1.3.3. The complexity of Requirement Engineering in Malaysian Public Sector

The Software Project Development involves many disciplines, this research identifies issues happened during the implementation of some of the Software Project Development in the Public Sector as shown in Chapter 2-Identification of Software Project Issues for ICT Project. The purpose is to ensure the problem early at the requirement gathering stage. These issues are grouped as Software Project Success Factor. Every factor is dependent on each other and the main factor is the business process. Business process directly relates to the stakeholder and the developer and finally, compacted into three main components, people, process and technology.

This research determines the complex role of the actor in between the requirement engineering process as shown in Chapter 2 - The relationship between the defined Requirement Engineering Process. Due to the constraints of people and skills, most of the software project development is outsourced. The complex role will make the conflict of task, communication and understanding between Government Project Team and Vendor Project Team. The roles of Project Director from the vendor are more difficult and messy because he has to manage different projects, which have different views, needs, goals, and objectives. Some of the issues cannot be managed urgently such as commercial issues because they involve the management’s decision. A part of their task is given to the Project Manager.

The failure of Project Managers to play their roles and responsibilities give serious impacts to the schedule and deliverables of the software project
implementation. As mentioned earlier, the personnel involved in software project should have experience in software project management. Lack of the soft skills, knowledge, expertise, and decision making give impact to the software project implementation, and the capability of Project Manager will be questioned. Project Manager often lacks visibility of the project team and resources, shares team members with the other projects, depends on the third party, uses incompetent principles to resolve the issues and is not serious in meeting the project objectives.

1.3.4. Gap Analysis for the Complexity

The involvement of several committees, rules and guidelines, and the methodology in software project development raises critical issues such as constraints in applying and aligning the rules and guidelines, changes in the requirement, facilitation of ICT infrastructure, identification and understanding of needs, and decision making. Figure 1.2 shows the research gap that has been defined in Malaysian Public Sector. The gap defined is based on current Requirement Engineering Model/Practice/Standard and Current Requirement Engineering Practice in Malaysian Public Sector. The research gap is divided into three components; Requirement Engineering Model, software process and Requirement Engineering Standard.

Currently, there are many Requirement Engineering Models that have been introduced or developed. The problem is how to evaluate the best Requirement Engineering Model and which is appropriate for the software project. The owner of the software project lets the vendor proposes the appropriate Requirement Engineering Model as the solution. The impact of this solution, the developer too, depends on the vendor when applying the model, even after the software project commissioning. This working culture continues to the next software project.

Requirement Engineering also produces software process in order to guide the developer in ensuring the software project meets the software quality criteria. Again, the department should have an expert during the implementation of the
The Malaysian Public Sector created several committees to review the proposed ICT project requirements before giving the approval. The role of these committees is either to evaluate the proposed software projects that have been approved or suggest some modification should be done to meet the organisation’s objectives. The committee members are appointed based on their experience and expertise. The issue is to manage the ideas into one concrete solution.

**Figure 1.2 Research Gap**

Requirement Engineering also developed several standard or guidelines to help the developer in selecting the right requirement. Most of the guidelines are based on special issues or certain situations. Some changes are made to adapt to the organization's objectives. Malaysian Public Sector consists of many levels of management such as ministry, department and agency which all have their own core business, customers and stakeholders. Therefore, they have different issues and problems to solve. The guidelines that have been developed cannot meet the (requirements/suggestions) of the ministry, department and agency.
The gap analysis also shows the weaknesses of people, process and technology as presented in Chapter 2-Gap Analysis of People, Process and Technology.

**Table 1.1: SWOT of Requirement Engineering, People, Process and Technology**

<table>
<thead>
<tr>
<th>REQUIREMENT ENGINEERING</th>
<th>PEOPLE</th>
<th>PROCESS</th>
<th>TECHNOLOGY</th>
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<tr>
<td><strong>STRENGTH</strong></td>
<td>• Need of the systems improving the current process</td>
<td>• Training Program Business Process</td>
<td>• Circular Framework Service Delivery e-Government Expert MAMPU</td>
</tr>
<tr>
<td><strong>WEAKNESS</strong></td>
<td>• Lack of RE knowledge • Lack of REP element • Lack of implementation of International standard • Difficulty to adopt a model of RE • Less exposure to RE technique</td>
<td>• Technical Skill Business Skill Movement of people</td>
<td>• Change Management Vision and Mission R&amp;D Awareness</td>
</tr>
<tr>
<td><strong>OPPORTUNITY</strong></td>
<td>• Model/technique of RE • Literature from Journal</td>
<td>• Local Training Attachment Program Certification Abroad Training</td>
<td>• Innovation Competition</td>
</tr>
<tr>
<td><strong>THREAT</strong></td>
<td>• Type of the self-system application</td>
<td>• Management Security Restructure Rebranding Different</td>
<td></td>
</tr>
</tbody>
</table>

### 1.4 Statement of the Problem

Generally, Requirement Engineering is implemented in the Malaysian Public Sector. The implementation of Requirement Engineering in organisations is different from the Malaysian Public Sector, even though in the same section. This situation happens because of the constraints that will be discussed in Chapter 2. The project team has to depend on the method proposed by the vendor.

The software project development in Malaysian Public Sector involves several committees. The software project development should have the approval from the IT Department, followed by ICT Steering Committee Organisation and Ministry. Some of the software project development has to go through the
Government IT and Internet Committee. And, most importantly, Software Project Development has to be approved in the Cabinet Meeting.

The current standard that has been developed for the Malaysian Public Sector or International Standard cannot be adapted directly to the software project development. A lot of tailoring or customisations have to done to the standard. This process needs expert personnel that understand the standard or method. The International Standard such as RCMMi developed for the SME, ISO/IEC 122007 focuses on software life cycle process.

The Malaysian Public Sector needs a standard regulatory guideline for IT Personnel in order to guide them in the software project development approval process, followed by the activity after getting the software project development approval, and the development of the software requirement specification. The proposed guideline is to ensure that the technical specification proposed for acceptance is aligned with the Public Sector ICT’s Vision.

1.5 Research Question

Our research study is based on the following research question:

i. What are the activities involved in determining requirements of software project development? The researcher lists the related activities based on literature and fieldwork.

ii. What is the most appropriate guideline for software project development in the Malaysian Public Sector? The researcher makes a comparison of requirement engineering process model, standard and requirement engineering practice framework.

iii. How to evaluate the proposed Requirement Engineering Best Practices for the appropriate Software Project development in the Malaysian Public Sector? The researcher had done the evaluation and validation for the proposed Requirement Engineering Best Practices Guideline with experts.
1.6 Objectives of the Research

The research objective was determined based on the problem statement as follows:

i. To evaluate the current practices of requirements for software project development;
ii. To develop the Requirements Engineering Best Practices as an appropriate guideline in developing software projects in the Public Sector; and
iii. To evaluate the proposed Requirement Engineering Best Practices for requirements using Software Project Development in the Public Sector as case study.

1.7 Scope of the Research

The following statement covers the scope of this research:

i. Business: Focuses on related ICT fields for the software project that is implemented in Malaysia’s Public Sector. The respondents will be selected among software practitioners (Pegawai Teknologi Maklumat, Level F48 and above) in Malaysian Public Sector;
ii. Standard: This research is based on several standards namely Requirement Engineering Process, Requirement Engineering Standard and Requirement Engineering Capability.
1.8 Significance of Research

The significances of the study are as follows:

i. Gap Analysis: Analysis of Requirement Engineering Practices implement by the IT Managers during the requirement gathering. Analysis includes the determination of methodology and standard that is usually referred by the IT Manager. In making it reliable to the organisation, the analysis should involve SWOT analysis of people, process and technology. The software project issues are a part of the requirements in this research.

ii. Requirement Process: There are several processes involved during the acceptance of Software Requirement Specification. The proposed Software Requirement Specification is gathered by the Project Team, managed by Project Manager, and lead by the Project Director. And, this process is controlled by the ICT steering committee and management of the organisation.

iii. A proposed guideline for software requirement specification: This research proposes a guideline for software requirement specification which is Requirement Engineering Best Practices Guideline in the Malaysian Public Sector. This Requirement Engineering Best Practices Guideline must be understood by IT Personnel and can be implemented in requirement gathering. A model/method/tools and technique that is suitable in this research.

1.9 Thesis Organisation

This thesis is organised into seven chapters as detailed below:

i. Chapter 1 Introduction. This chapter compresses the whole content of the thesis. The introduction of Requirement Engineering, background of the problem, statement of the problem, research question, research objectives,
scope of the research, significance of the research, and finally, thesis organisation.

ii. Chapter 2 Literature Review. This chapter elaborates the literature of Requirement Engineering, the related issues to Requirement Engineering such as a Requirement Engineering Process, Requirement Engineering Techniques Requirement Engineering Standard, and Requirement Engineering Capability. This chapter also describes the Malaysian Public Sector, the Requirement Engineering in the Malaysian Public Sector and the comparison Requirement Engineering Best Practices Framework in the Public Sector.

iii. Chapter 3 Research Methodology. This chapter describes the methodological aspects of the research for the development of Requirement Engineering Best Practice Guideline, a process flow of Requirement Engineering Best Practices Guideline. This chapter also presents how we conduct the research study for Requirement Engineering Best Practices Guideline based on the Requirement Engineering Best Practices Guideline research framework, and describes the research procedure.


Procedure and Software Requirement Specification Activity Diagram. This chapter also describes the reliability of Requirement Engineering Practices.


vii. Chapter 7 Discussion and Conclusion. This chapter discusses the journey of the research with the summarization diagram, research objective and the achievement, discussion on research contribution. Finally, this chapter also presents the limitation and future work.

1.10 Summary

This chapter focuses on the background of the problem, problem statement of the research, research question as guidance to this research, research objective that this research should achieve, the research boundaries, the significance of the research, and how the research is organised.
REFERENCES


