A POST-IMPLEMENTATION EVALUATION METHOD FOR ENTERPRISE ARCHITECTURE

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ABSTRACT

Enterprise Architecture (EA) is a strategy that is commonly used to improve the alignment of business and Information Technology (IT) within an enterprise. Implementing an EA is a sophisticated, lengthy, and costly process which tends to face serious failure. Thus, it is essential to perform a successful and thorough evaluation at the post-implementation stage of an EA project to evaluate how much the developed Information Systems (ISs) and IT solutions have succeeded in achieving its predetermined objectives and improving the integration and stability of enterprise.

Most existing evaluation models do not provide structured and comprehensive way to cover EA implementation aspects. As a consequence, EA projects may face inadequate adaptation for future changes, lack of structured guideline for evaluating the EA artefacts, and lack of structured practices for continual improvement of EA implementation. Moreover, without having structured and theory-based model for evaluating EA artefacts, the enterprise decision makers cannot achieve the targeted goals of EA implementation project, and they may waste time and budget. To address the issues, this thesis proposes the post implemented method to assist the implemented EA within the enterprise, which combine solid theory and good practices. Moreover, the proposed method focuses on two important dimensions which are crucial functionality and effectiveness. This thesis has gone through three phases: preparation, development, and evaluation. The first phase provides the foundations and requirements of the proposed method based on Systematic Literature Review (SLR) and interviews with EA practitioners for the required practices and factors that affect the EA implementation evaluation. The second phase focuses on the development of the method for EA implementation evaluation. Moreover, the basis for the proposed method are the program theory and IS Evaluation Theory using design science approach. Finally, the proposed method is validated by means of two case studies, cross case analysis and

expert reviews. Accumulated results from the evaluation reveals that the proposed method is usable and effective and it has the capability to facilitate the success of EA projects.

ABSTRAK

Senibina Firma (SF) adalah satu strategi yang biasa digunakan untuk membaiki penjajaran perniagaan dan Teknologi Maklumat (TM) di dalam sesuatu firma. Perlaksanaan SF adalah suatu proses yang canggih, panjang dan mahal yang kerap menghadapi kegagalan. Oleh itu, adalah suatu yang mustahak untuk melakukan suatu penilaian yang menyeluruh dan berhasil pada peringkat pasca perlaksanaan bagi suatu projek SF untuk menilai sejauh mana Sistem Maklumat dan penyelesaian TM yang dibangunkan dalam mencapai objektif dan meningkatkan integrasi dan kestabilan firma.

Kebanyakan model penilaian sedia-ada tidak menyediakan kaedah yang berstruktur dan menyeluruh untuk mencakupi aspek-aspek perlaksanaan SF. Akibatnya, projek SF kekurangan adaptasi untuk menghadapi perubahan masa hadapan, kekurangan panduan berstruktur untuk menilai artifak dan kekurangan amalan berstruktur untuk peningkatan berterusan bagi perlaksanaan SF. Malah, tanpa model yang berstruktur dan berasaskan teori , pembuat keputusan dalam firma tidak dapat mencapai matlamat sasaran bagi projek perlaksanaan SF serta mereka membuang masa dan wang.Untuk mengendalikan isu ini, kajian ini mencadangkan satu metod pasca perlaksanaan hibrid untuk membantu perlaksanaan SF dalam firma yang merangkumi teori yang kukuh dan amalan baik. Tambahan pula, metod itu fokus kepada dua dimensi penting iaitu fungsian kritikal dan keberkesanan. Kajian ini telah melalui tiga fasa: persediaan, pembangunan dan penilaian. Fasa pertama menyediakan asas dan keperluan untuk metod hibrid yang dicadangkan berdasarkan Kajian Literatur Sistematik (KLS) dan wawancara dengan pengamal SF untuk faktor dan amalan yang memberi kesan kepada penilaian perlaksanaan SF.Fasa kedua fokus kepada pembangunan metod hibrid bagi penilaian perlaksanaan SF. Lagipun, asas bagi metod yang dicadangkan ialah Teori Program dan Teori Penilaian Sistem Maklumat dengan menggunakan pendekatan sains rekabentuk. Akhirnya, metod ini telah di nilai dengan kaedah dua kajian kes, analisis kes bersilang

dan pemeriksaan pakar. Hasil keputusan daripada penilaian menunjukkan metod yang dicadangkan ini adalah mudah digunakan, berkesan dan ia mampu membantu kejayaan sesuatu projek SF yang dijalankan.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF SYMBOLS AND ABBREVIATIONS

CEO	:	Chief Executive Officer
CIO	:	Chief Information Officer
EA	:	Enterprise Architecture
EAIM	:	Enterprise Architecture Implementation Methodology
IS	:	Information System
IT	:	Information Technology
KPI	:	Key Performance Indicators
RO	:	Research Objective
RQ	:	Research Question
SPSS	:	Statistical Package for the Social Sciences
SLR	:	Systematic Literature Review
SUS	:	System Usability Scale

LIST OF APPENDICES

CHAPTER 1: INTRODUCTION

1.1 Introduction

Today's enterprises realize that appropriate Information Systems (ISs) through Information Technology (IT) is a critical factor to their business success (Cabrera, Abad, Jaramillo, Gómez, & Verdum, 2016; Simon, Fischbach, & Schoder, 2014), and it is an essential means to achieve competitive advantages(Närman, Franke, König, Buschle, & Ekstedt, 2014; G Plataniotis & Kinderen, 2015). Enterprise Architecture (EA) is a strategy for supporting the management and development of an organization through a set of methods including the viewpoints of business, and IT. EA is developed in order to align IT and business within an enterprise (Stephan Aier, 2014; Galliers & Leidner, 2014; Löhe & Legner, 2014) by providing integrated environment in its business and IT. EA represents three distinctive stages, As-Is architecture, To-Be architecture, and migration plan (Lankhorst, 2013b; Schekkerman, 2004).

In As-Is architecture, the current situation of business and IT of an enterprise are described by a set of definitions, which illustrate the current state of the enterprise's mission, business processes and technology's infrastructure. The key role of this stage is defining the vision of enterprise(Cabrera et al., 2016; Närman et al., 2011). In To-Be architecture, desired architecture of an enterprise is represented, including: future of business and IT based on vision of enterprise. This type of architecture is the result of enterprise's long-term strategies and plans. The key role of this stage is to identify the appropriate ISs (Banaeianjahromi & Smolander, 2016; Wan, Johansson, Luo, & Carlsson, 2013). In EA, migration plan is the essential strategy that will be employed for transition from the As-Is (current or baseline) to the To-Be (desired) one (B. Cameron & E. McMillan, 2013; Lankhorst, 2013a). The key role of this stage is using the proper implementation method. Appropriate EA implementation helps the enterprise

to innovate and change by providing both stability and flexibility (Buschle, Johnson, & Shahzad, 2013; Nogueira, Romero, Espadas, & Molina, 2013; Rouhani, Mahrin, Nikpay, Ahmad, & Nikfard, 2015).

EA comprises framework, methodology, and practical approach, which are utilized in order to support the designing, developing, implementing and managing (Lapalme et al., 2016; Nogueira et al., 2013). In EA, the framework is a logical structure for the classification and organization of the various descriptions of an enterprise. While EA framework provides a structure for place methods (Nikpay Fatemeh, Selamat Harihodin, Rouhani Babak Darvish, & Pourya, 2013; R. Schmidt, Wissotzki, Matthias-Jugel, Dirk-Mohring, Michael-Sandkuhl, Kurt-Zimmermann, Alfred, 2014), EA methodology provides techniques for getting various aspects of enterprise's business and transforming them into the methods and defining the developmental activities in an EA project (Alwadain, Fielt, Korthaus, & Rosemann, 2011; Lapalme et al., 2016; Leo Pruijt, Slot, Plessius, Bos, & Brinkkemper, 2012). Moreover, EA Implementation Methodology (EAIM) is the process of defining architecture for the use of information by creating an efficient and effective plan for implementing them in support of the business (Rouhani, Mahrin, Nikpay, & Rouhani, 2014; Sembiring, Nuryatno, & Gondokaryono, 2011b; Weiss, Aier, & Winter, 2013). In other words, since EA artifacts are passive production, including: documents, models, catalogues, diagrams and the others, EAIM tries to activate them by developing appropriate ISs and artefacts (Ronald E. Giachetti, 2012; M Lange & J Mendling, 2011). Although the framework is a basic tool for EA, and it does not address alignment between IT and Business on its own, implementation methodology is a complementary tool for EA (B. H. Cameron & E. McMillan, 2013; Vargas, Cuenca, Boza, Sacala, & Moisescu, 2016; Zarvić & Wieringa, 2014).

EA evaluation is defined as the process of determining the merit, worth, and value EA artifacts. A discipline of evaluation in EA is needed because enterprises, as well as

EA practitioners in general, require systematic, unbiased means of knowing if their products, practices, methods, and artefacts are good(Peter Andersen & Carugati, 2014; Lakhrouit & Baina, 2013; Osterlind, Johnson, Karnati, Lagerstrom, & Valja, 2013). Evaluation and measurement are thus not ends but means to generate information that assist in making judgments and decisions (for example about a program, service, policy, organization, person, or whatever else is being evaluated or measured) (Karimi, Sharafi, & Dehkordi, 2014; Vasconcelos, Sousa, & Tribolet, 2015). Evaluation provides information for supporting critical organizational and project business and technical decisions. Information is needed in the development and in the work of enterprises' architecture capabilities as well (Järvelin et al., 2015; Niu, Xu, & Bi, 2013). In EA, evaluation contains two types of approaches as follows:

- Approaches and techniques that generate information relating to a company's EA program and its results (e.g. EA program's efficiency, effectiveness, maturity, quality of results) to support planning, improvement, marketing (showing value), organization and management of EA works in an enterprise. A enterprise's business and IT goals are quite commonly used as the starting points in these evaluations (P Andersen, 2015; Osterlind et al., 2013).
- Approaches and techniques that generate information to support decision making on enterprise-wide IS issues through the analysis of the EA methods. In the following text, this is referred to as property oriented EA evaluation(G Plataniotis & Kinderen, 2015; Simon et al., 2014).

The overall structure of the chapter is depicted in Figure 1.1.

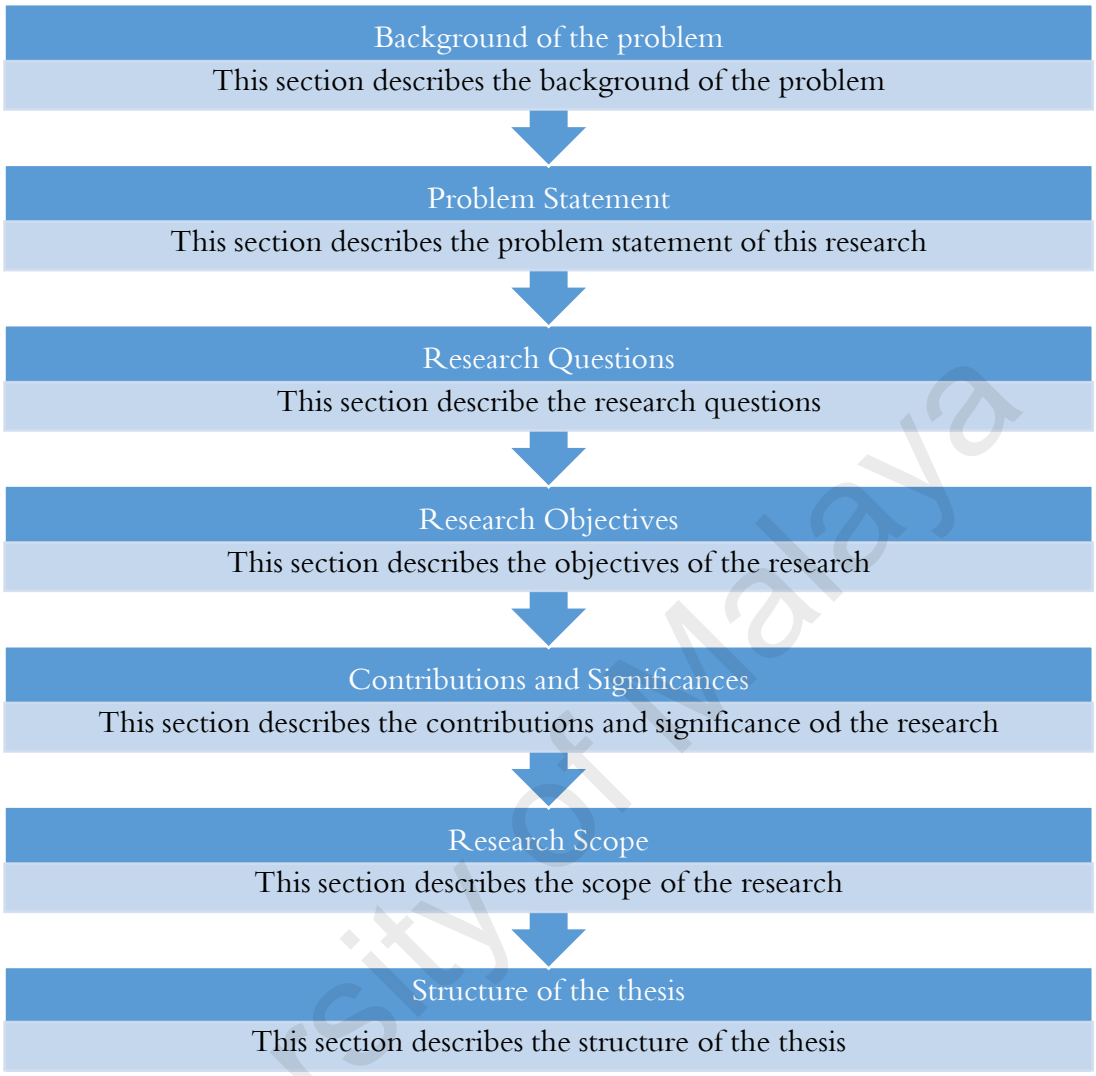

Figure 1.1: Structure of Chapter 1

1.2 Background of the Problem

In EA implementation, evaluation involves assessing the appropriateness and efficiency of each validated design alternative, with respect to predefined common evaluation criteria (Cabrera et al., 2016; Osterlind et al., 2013; Sobczak, 2013; Song & Song, 2010).

According to the preliminary study and interview with EA practitioners, which reveal a few shortcomings that should be improved to ensure the achievement of the

objectives of EA evaluation. The shortcomings of the EA implementation literature can be summarized as follows:

1.2.1 Lack of Structured EA Evaluation method

Existence evaluation methods are not based on any theoretical basis to provide the holistic understanding of EA evaluation and do not provide structured mechanisms to evaluate the implemented EA (B. H. Cameron & E. McMillan, 2013; M. Iacob & Meertens, 2014). Reviewed evaluation methods assume that the developed EA artefacts situations are well-defined with established business units and identifiable users who have well-defined roles and positions within the enterprise (Ronald E Giachetti, 2016; Wolff, 2016). The methods are mainly developed based on the users' experiences from previous projects and there is no theoretical foundation behind them. The EA evaluation methods are inapplicable in situations that may not have well-defined alignment between enterprise IT and business (Lakhrouit & Baina, 2013; Raadt & Bonnet, 2010).

Since the process of evaluation or analysis the EA artefacts within an enterprise is critical for the success of EA implementation, the process should support by an effective and useful method to facilitate evaluation and analysis of EA projects. Evaluation methods do not provide the step by step guideline of the EA evaluation processes (Bente, Bombosch, & Langade, 2012; Iyamu, 2012; Santana, Fischbach, & Moura, 2016). Using appropriate method for implementing the EA evaluation processes, which consist step by step guidelines contribute to preventing users' interpretation on evaluation processes and activities.(Matthias Lange & Jan Mendling, 2011; Wissotzki & Koc, 2013; F Zandi & M Tavana, 2012).

1.2.2 Difficulties in EA Evaluation Methods Aspects

Existing evaluation methods do not provide easy to learn and easy to implement practices to be applied in evaluating EA implementation. The typical usage of

evaluation methods in the EA implementation is to increase human understanding in complex matters such as the effectiveness of implemented EA artefacts and achievement of defined EA objectives(Stephan Aier, 2014; Bradley, Pratt, Byrd, Outlay, & Wynn Jr, 2012; Morganwalp & Sage, 2015). In the context of EA implementation, stakeholders need to consider comprehensively the implemented artefacts of EA and competitive external environments to ensure a full understanding of enterprise situation. Existing EA evaluation methods mostly present too detailed, which are time consuming and expensive practices, or too abstract which are not applicable in EA project. Besides, they introduce the main structures and concepts of evaluation in high perspective and do not provide holistic and appropriate metric for evaluation (Stephan Aier, 2014; Brosius, Haki, Aier, & Winter, 2016; Karimi et al., 2014). In this regards, the evaluation faces to difficulties in terms of using the metrics, learning the practices, and implementing the practices (Löhe & Legner, 2014; F Nikpay, Ahmad, & Rouhani, 2015).

1.2.3 Lack of a Comprehensive EA Evaluation Method

Rapid changing of the enterprise requirements are the norm currently. Hence, there is a need to focus not only on the present requirements but also the requirements of the immediate future. This is not catered for in most of the reviewed EA evaluation methods. The scope of requirements should not only focus on the main operational activities of the enterprise but also should cover the managerial activities (Lakhrouit & Baïna, 2013; Lee, Oh, & Nam, 2016; Song & Song, 2010). A wider scope of analysis that includes all the essential activities of the enterprise such as planning and coordinating will enhance the enterprise planning capability in identifying an extensive variety of IS applications that can instigate and sustain the enterprise successfully(Stephan Aier & Schelp, 2010; Ojo, Janowski, & Estevez, 2012). This has to be reflected in methods for EA evaluation particularly in identifying and relating the

requirements of the enterprise to its ISs and information requirements. Existing EA evaluation methods seem to stress on identifying cost and benefit of developed EA artefacts. Very few methods continue to identify further information and data requirements for the EA evaluation, which will be very beneficial to bridge the semantic gap from the business requirements to IT capabilities and developed EA artefacts.

The conclusion that can be made from the reviewed methods is that they are mainly deficient in the ability to assess or evaluate the functionality and the effectiveness of the developed EA artefacts and the ability to relate the business requirements to IT capabilities and specifically to provide structured method to facilitate further future changes analysis. It is offer comprehensive approach for evaluating all aspects of EA implementation. Subsequently, this thesis is directed towards addressing such deficiencies. It intends to develop a method for EA evaluation for covering important aspects of implemented EA artefacts. The proposed method will be equipped with the mechanism to support the evaluation of functionality and effectiveness.

1.3 Problem Statement

According to the preliminary study and interviews with EA practitioners and experts, most existing EA evaluation methods are designed for EA maturity, quality, value, benefits, however very few methods have focused on the implementation process and the post implemented evaluation (Lakhrouit & Baina, 2013; Senff, De Carvalho, Da Veiga, Duclos, & Pancote, 2015). Most existing EA evaluation methods are fixed or proprietary for specific EA frameworks and methodologies(Guerreiro, Gaaloul, & Franke, 2016; Vasilecas, Saulis, & Dereškevičius, 2015). Moreover, existing evaluation methods do not provide a structured and comprehensive way to evaluate developed EA artefacts particularly in the aspects of functionality and effectiveness. As a consequence, EA projects may face inadequate adaptation for future changes, lack of structured

guideline for evaluating the EA artefacts, and lack of structured practices for continual improvement of EA implementation. Additionally, without having structured and theory-based method for evaluating EA artefacts, the enterprise's decision makers cannot achieve the predetermined goals of EA implementation project, and that can lead to waste of time and budget.

Therefore, based on the gaps identified, this thesis intends to fill up the gap by developing a post-implemented evaluation method for evaluating the developed EA artefacts.

1.4 Research Objectives

The following research objectives were answered at different phases throughout the research and will be respectively described in subsequent chapters.

RO1- To identify the requirements for developing the EA evaluation method

RO2-To propose an evaluation method for post implementation EA

RO3-To evaluate the applicability and usability of the proposed evaluation method

1.5 Research Questions

The five research questions which form the basis of conducting this thesis are formulated as follows:

RQ1-What are the existing evaluation methods?

RQ2-What are the recommended practices for evaluating EA implementation projects?

RQ3-What are the current issues of EA implementation evaluation?

RQ4-What are the required components of the evaluation method for EA post implementation?

RQ5-How to evaluate the proposed method?

1.6 Research Approach

The main purpose of conducting this thesis is to provide researchers or practitioners with a method which is capable of EA implementation evaluation. This thesis proposes the post implemented method to assist the implemented EA within the enterprise, which combine solid theory and good practices. Moreover, the proposed method focuses on two important dimensions which are rarely been addressed problem which are functionality and effectiveness. This thesis has gone through three phases: preparation, development, and validation.

The first phase assess and build the foundations and requirements of the proposed method. It uses Systematic Literature Review (SLR) and interviews with EA practitioners for the required practices, methods and issues of EA implementation evaluation.

The second phase focuses on the development of the method for EA implementation evaluation. Moreover, the basis for the proposed method is the Program Theory and IS Evaluation Theory using design science approach. Finally, the proposed method is validated by means of two case studies, cross case analysis and expert review. Accumulated results from the evaluation reveals that the proposed method is usable and effective and it has the applicability to facilitate the success of EA projects

1.7 Contribution and Significance of Research

The overall contribution of this thesis is the development of a method for evaluating the achievement of EA objectives in terms of functionality and its effectiveness. The proposed method is a post-implemented EA based on using the concepts and principles of EA evaluation practices and verified evaluation theories which are program theory and IS evaluation theory. The proposed method provides:

- A post-implemented EA evaluation method, which is founded on program theory, evaluation theory and practices
- A set of guidelines about the evaluation practices which can extend the Enterprise Architecture Body of Knowledge (EABOK) and can be used for improving the effectiveness and functionality of developed EA or developing a customized EA evaluation method by practitioners
- A novel method of applying program theory in EA evaluation in order to evaluate the developed EA artefacts in post-implemented EA project

1.8 Importance of the Research

EA is the process of translating business vision and strategy into effective and appropriate ISs and infrastructure. In EA, implementation comprises a set of methods and processes in order to transfer enterprise from current architecture to the desired architecture. The key value of EA should be measured in structured manner. The evaluation results are a useful basis for the EA improvement concerning the achievement of the organization's goals and vision. The evaluation supports the definition of the desired EA. Currently, there is a need of structured and purposeful method in enterprises that can evaluate the effectiveness and functionality of EA

artifacts in post-implementation phase. Lack of coherent evaluation method that cover the whole EA may cause dissatisfaction of stakeholders and EA project managers.

This thesis proposed an evaluation method, which is mainly based on solid theory and current industrial practice. The proposed method is useful for practitioners and researchers who need to tackle complex and uncertain EA implementation evaluation and it is a structured method that contain exhaustive aspects of EA. For researchers, this thesis is the first attempt to apply program theory in developing a method for EA evaluation.

The proposed method has many potential benefits to motivate enterprises to utilize and measure EA; these benefits are:

- Provide a more systematic way of evaluation instead of a haphazard way of evaluation.
- Provide enterprise to assess how well its EA project has reached intended outcome and how satisfied the participants are on the EA project
- Improve enterprises credibility and reputation by adding the value to the EABOK. It will provide evidence of why targets and outcomes are or are not being achieved and may provide causes to the identified issues.
- Contribute to having integrated evaluation report for supporting the effectiveness and the functionality of the implemented EA project.

1.9 Research Scope

The scope of this thesis is confined to the domain of EA implementation within enterprises. It focuses on developing an evaluation method for post-implementation EA to facilitate the process of EA evaluation and implementation. This includes identifying practices which provide effects on EA implementation evaluation and representing

those practices to the concerned group. Subsequently, the essence is on enabling the enterprise to identify practices, and using appropriate metrics to achieve proper evaluation and facilitating the process of implementing future EA projects.

1.10 Structure of the Thesis

This thesis is organized into seven chapters, as shown in Figure 1.2. All of the chapters are interrelated to one another. Thus, the chapters should not be read in isolation. Chapter 2 and 3 are the chapters which introduce the topic of the thesis and discuss the related literature and planning in conducting the research. Chapter 4, 5 are the chapters which describe the foundations and concepts the proposed method. Chapter 6 describes the empirical work conducted in the research and evaluation of the proposed method. Finally, chapter 7 provides the overall analysis and conclusion of this thesis.

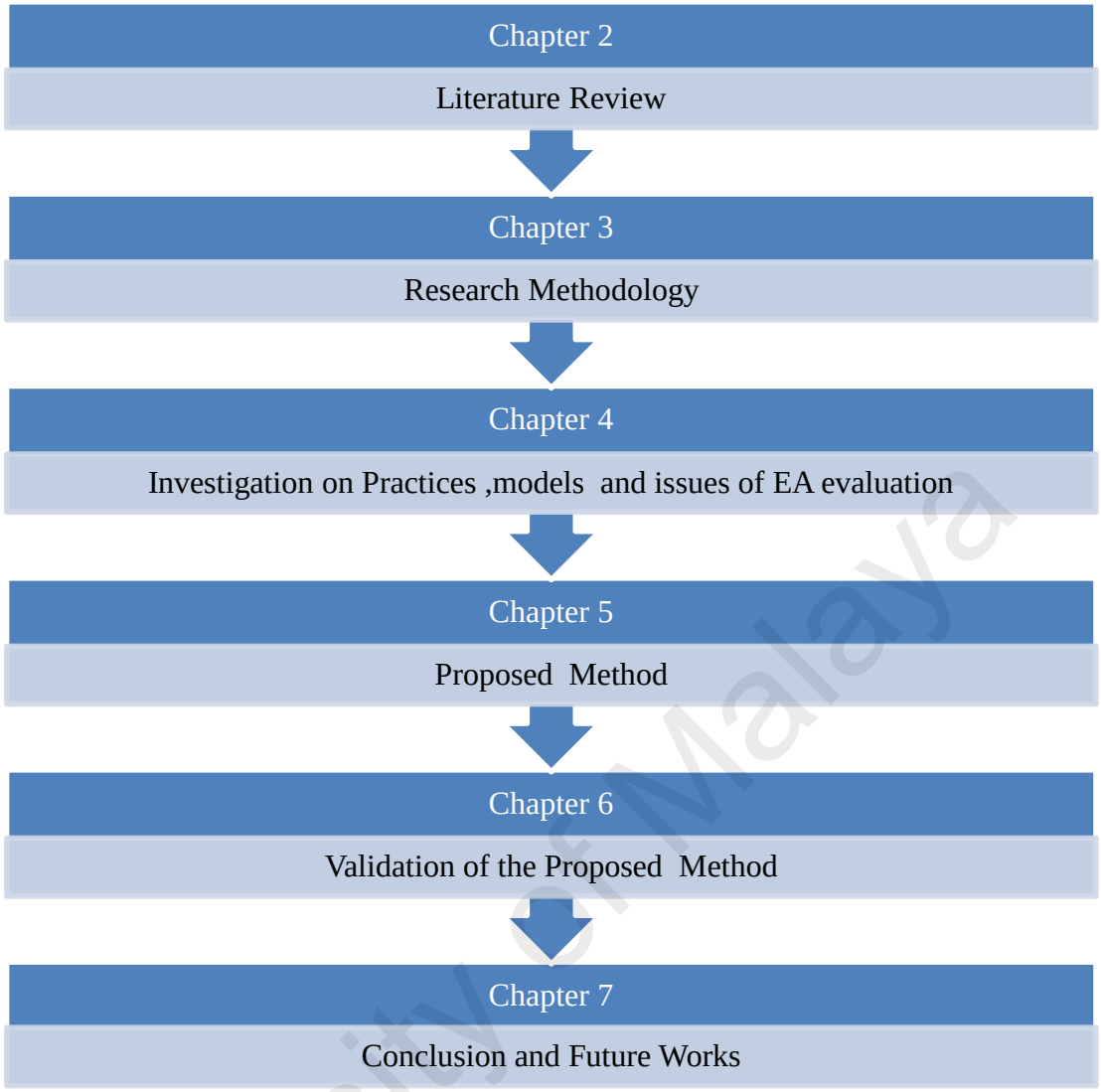

Figure 1.2: Organization of the Thesis

1.11 Summary

This chapter represented the introduction of this thesis as well the overview and background of problem in order to provide preliminary understanding about the research. The specific problem statement and five research questions were defined for this study. Five research objectives are defined in order to answer the defined research questions. The significances and contributions of each research objective are represented. Finally, the scope of this thesis is described.in the next chapter, summary of related work and existing literature of evaluation method will be presented.

CHAPTER 2: LITERATURE REVIEW

2.1 Overview

This chapter introduces the importance of Enterprise Architecture (EA) post-implementation evaluation and summarizes related work from existing literature. It also presents previous work that addresses issues on EA implementation evaluation. Research gaps are identified and analyzed to justify this thesis work. The subsequent introductory discussion on EA implementation and evaluation provides the basis for understanding EA evaluation methods, which is helpful in identifying the current study research gaps. Figure 2.1 outlines the structure of this chapter.

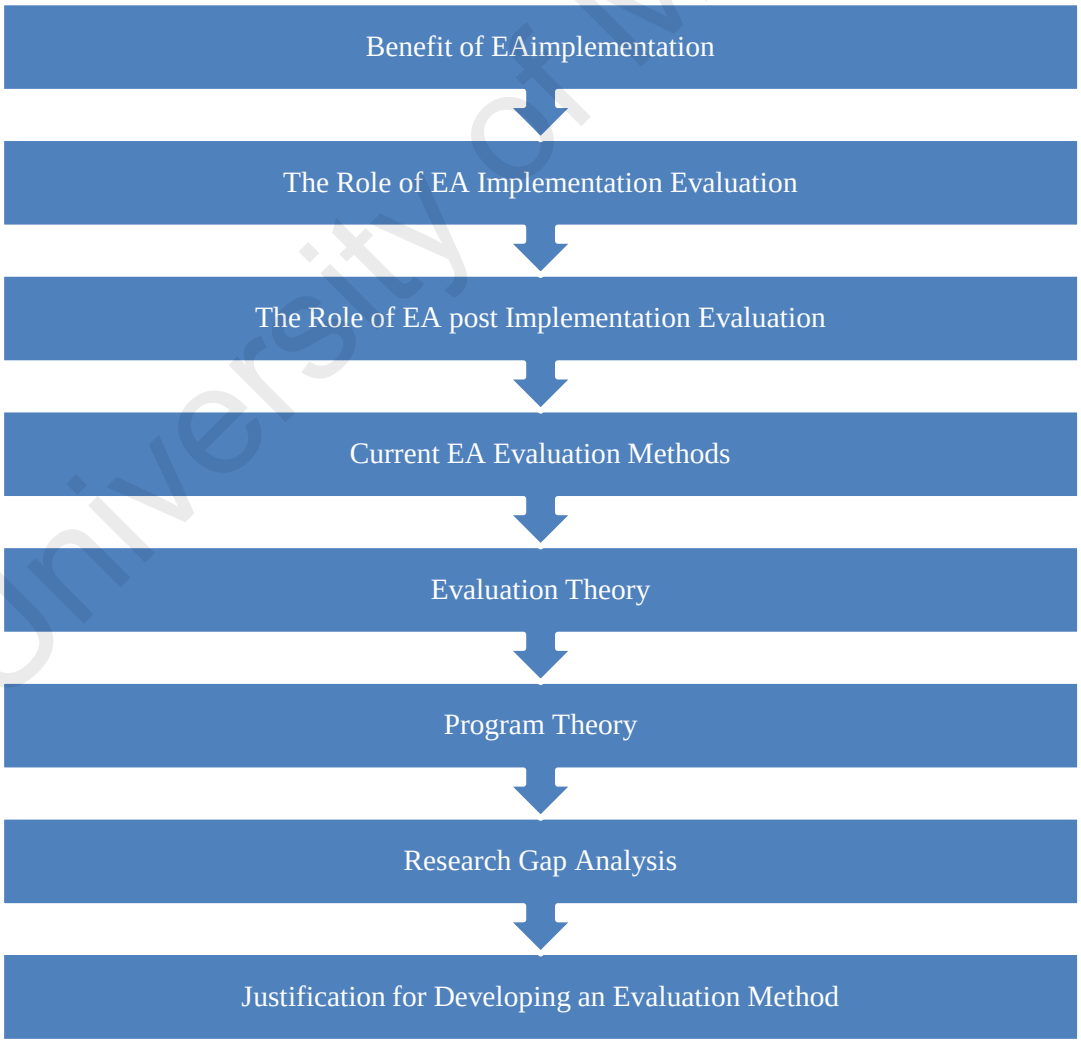

Figure 2.1: Organization of Chapter 2

2.2 Benefits of Enterprise Architecture Implementation

EA is the process of translating business vision and strategy into effective and appropriate Information Systems (ISs) and infrastructure. In other words, EA leads to the alignment between an enterprise's business and IT (Arnold, Erner, Möckel, & Schläffer, 2010; Azevedo et al., 2015; Chorafas, 2016; Dale, 2016). Moreover, EA is an ongoing business function that helps an enterprise figure out how to best execute the strategies that drive its development (Närman, Buschle, & Ekstedt, 2014; Simon et al., 2014). In EA, implementation comprises a set of methods and processes to transfer the enterprise from its current architecture to the desired architecture (Stephan Aier, 2014; Niemi & Pekkola, 2013; Nogueira et al., 2013; Wan et al., 2013). Potential benefits that motivate enterprises to utilize and implement EA include (Farwick, Breu, Hauder, Roth, & Matthes, 2013; Gama, Sousa, & Silva, 2013; Lankhorst, 2013b):

- EA leads to a way of going from chaos and disagreement to order and structure in an enterprise
- EA enables an integrated vision and a global perspective of an enterprise’s informational resources
- EA eliminates redundancy in business processes and reduces information system complexity
- EA contributes to achieving integrated information systems to support competitiveness
- EA fills gaps between the business and technical domains in an enterprise

2.2.1 Enterprise Architecture Artefacts

In an EA project, artefacts include the documents, charts and analysis of architectural levels, as-is description, to-be description and a migration plan (B. H. Cameron & E. McMillan, 2013; Chorafas, 2016; Kotusev, Singh, & Storey, 2015).

One of the missions of EA is to provide appropriate ISs in order to fulfil the enterprise's business requirements. In this regard, the description of developed ISs and their interrelations are considered EA implementation artefacts (Medini & Bourey, 2012; Ojo et al., 2012; Sembiring, Nuryatno, & Gondokaryono, 2011a).

2.3 The Role of Enterprise Architecture Implementation Evaluation

Evaluation can be defined as a form of "disciplined inquiry," which "applies scientific procedures to the collection and analysis of information about the content, structure and outcomes of programs, projects and planned interventions (Koziolek, 2010; Lumor, Chew, & Gill, 2016; Song & Song, 2010; Willcocks, 2013)".

The purpose of evaluation research is not to explore new knowledge as is the case with other forms of research. Rather, it is aimed at using current knowledge to assess and study the effects, effectiveness and outcomes of some innovation, intervention, policy, practice or service and then to inform on decision-making to guide practical actions (Nakakawa, Bommel, & Proper, 2009; Niemi & Ylimäki, 2008; Osterlind et al., 2013).

EA was introduced by zachman as IS framework to reduce complexity of IS development and improve integration of Enterprise ISs, In terms of IS research, evaluation is particularly important. Given the large investments and high failure rates related to IS implementation, evaluation is now recognized as an increasingly

significant task that can directly contribute to IS success (S. Chen & Osman, 2011; Kim & Lee, 2010; Vasconcelos et al., 2015). In particular, evaluation is very useful in predicting and assessing potential costs, benefits and risks associated with the development, implementation and use of ISs, as well as assisting decision-makers with taking proper actions to mitigate the identified risks (Hoffman, 2007; Karimi et al., 2014; Georgios Plataniotis, de Kinderen, & Proper, 2013).

The evaluation process should enable identifying and controlling the critical areas of EA project implementation (Nielsen & Persson, 2016; Petter, DeLone, & McLean, 2013; Phillips & Phillips, 2016). A covering set of evaluation criteria should be used to ensure that all dimensions of the EA endeavor are taken into account and assessed (Arvidsson, Holmström, & Lyytinen, 2014; Niu et al., 2013; Sobczak, 2013; Vasconcelos et al., 2015). EA evaluation practices should be integrated into the business development, IS development, IS procurement and IT processes (Foorthuis, Van Steenbergen, Brinkkemper, & Bruls, 2015; Guerreiro et al., 2016; Wissotzki & Koc, 2013). The evaluation result needs to be delivered to each person related to the EA project, so information obtained from the evaluation can be employed in the decision-making phase.

In particular, there is a range of IS evaluation methodologies, each with its own strengths and limitations. Moreover, different IS lifecycle stages are associated with different goals, changes and outcomes (S. Chen, Osman, & Peng, 2012; Choi, 2016; Vasilecas et al., 2015). As a result, the aims and focus of evaluation at different stages also vary; such diversity and complexity causes practitioners and evaluators to face difficulties in selecting an evaluation methodology. Figure 2.2 demonstrates evaluation methods based on two perspectives. The goal of this thesis is proposing method for post-implementation evaluation which consider summative concept, as well as

problems carries out, functionality and effectiveness are the specific criteria that should be consider, this concept consider criteria based evaluation.in this regards, follows the goal-based summative and criteria-based summative processes to develop an evaluation method. These two methods are described below.

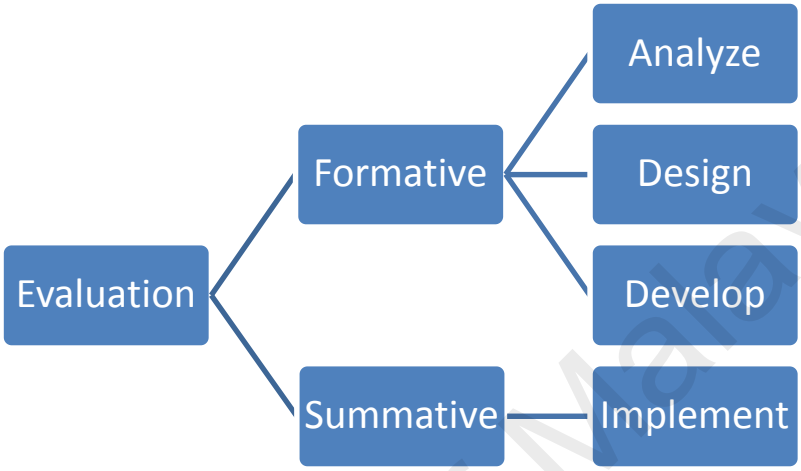

Figure 2.2: Evaluation Methods

a) Goal- based summative evaluation

This type of evaluation is a result of combining goal-based with summative evaluation. Here, the main aim of the evaluation is to assess if the implemented IS fulfills the business goals. Apart from evaluating the attainment of business goals and system requirements, goal-based summative evaluation is also used to assess the costs and benefits of implementing ISs in order to assist with decision-making (S. Chen et al., 2012; Prat, Comyn-Wattiau, & Akoka, 2015; Vasconcelos et al., 2015; Willcocks, 2013). There are four types of evaluation in this category, including financial, non-financial, tangible and intangible.

Financial measures: Evaluations with financial measures are carried out in terms of cost-benefit assessment based on the traditional capital investment measure analysis.

Non-financial measures: IS investment contributions can also be evaluated from non-financial aspects. This indicates that decision-makers should consider non-financial costs and benefits of IS implementation along with rapid IS development. Not only information technology but also the interaction between users and ISs should be considered in an evaluation, such as user opinions.

Tangible: Tangible performance measures are usually from the operational or tactical levels of ISs, such as sales in a period and production time cycle.

Intangible: Within organizational IS evaluation, intangible measures such as company reputation and technological factors must be considered.

According to the current thesis direction, non-financial and intangible approaches are selected to develop the evaluation method.

b) Criteria-based summative evaluation

This type of evaluation research combines criteria-based principles with a summative approach. Similar to the previous summative approaches described, it is usually carried out after IS development completion. This type of evaluation is usually aimed at certification with accrediting bodies, acceptance testing and quality assurance (S. Chen et al., 2012; Posavac, 2015). It is an exercise also mostly undertaken by experts, but with a much less constructive purpose than in the formative stages of IS design and development.

In fact, in order to generate both comprehensive and in-depth results, a method that fuses the use of various evaluation methods is always applied by evaluators in practice. Summative evaluation can be utilized at the end of a project in the post-implementation

inspection of the overall quality, efficiency and adequacy of the implemented IS. As this research concentrates on EA post-implementation, this is explained in section 2.4.

The outcomes of an EA implementation evaluation project are identified as the success of: 1) IS implementation, 2) IS investment, and 3) IS functionality, all of which are recognized as EA artefacts (Arvidsson et al., 2014; Kotusev et al., 2015; Lumor et al., 2016; Vasconcelos et al., 2015). EA evaluation should not function only as a justification mechanism, as it is also a tool for experience learning.

During the IS development process, feedback from the evaluation process should lead to corrective actions if necessary. In evaluating the success of EA artefacts, at least two dimensions should be considered: the process and product success (Abdulrazak & Malik, 2014; Vasconcelos et al., 2015). Evaluating the conduct of the EA development process facilitates learning for future projects. Product success includes both IS functionality and the realization of expected benefits from IS investment (Alaeddini & Salekfard, 2013; Šaša & Krisper, 2011).

2.4 The Role of EA Post -Implementation Evaluation

"Completing a project" is not the same thing as ending an EA project management process. Simply finishing does not ensure that the enterprise benefits from the project's outcome (M Lange, J Mendling, & J Recker, 2015; C. Schmidt & Buxmann, 2011; Tian & Xu, 2015). The EA project team also needs to ensure that lessons learned during the EA implementation project are not forgotten. The team can design and execute future EA projects more effectively when the project team members take advantage of lessons learned through experience from previous projects. A Post-Implementation Review (PIR) can serve to properly measure a project's success and work towards its continuity

(Galy & Sauceda, 2014; Matthias Lange, Jan Mendling, & Jan Recker, 2015). PIR provides answers to the following key questions:

- Did the EA project fully solve the problem that it was designed to address?
- Can we take things further and deliver even bigger benefits?
- What lessons did we learn that we can apply to future EA projects?

PIR is conducted after a project has been completed. The purpose of PIR is to evaluate how successfully the project objectives have been met and how effective the project management practices were in keeping the project on track. In this thesis, we concentrate on the PIR process to determine the method.

2.5 Current Enterprise Architecture Evaluation Methods

Existing EA evaluation methods basically focus on improving EA management and the management process (Montilva, Barrios, Besembel, & Montilva, 2014; Simon et al., 2014; Zarvić & Wieringa, 2014). Therefore, an enterprise's maturity methods and IT-Business alignment evaluation are utilized(George & Feuerlicht, 2013; P. Johnson, Lagerström, Ekstedt, & Österlind, 2014; Zhang, Murad, Risher, & Simmons, 2016).

The Capability Maturity Model for Software (CMM) is also frequently used in enterprises. It was developed by the Software Engineering Institute (SEI). CMM enables evaluation and concentrates on IT processes as well as the evaluation of an enterprise's development competence (de Carvalho, Rocha, & de Vasconcelos, 2016; Lakhrouit & Baina, 2013; Senff et al., 2015; Sobczak, 2013; Syynimaa, 2013).

Another method for assessing EA management and development processes is IT-Business alignment. There is general agreement that alignment entails the fit between business strategy, IT strategy, organizational structures and processes (Lantow et al.,

2016; Zhang et al., 2016). The aim of alignment is for IT activities to support the entire business architecture maturity (Kasemsap, 2015; Sobczak, 2013).

Literature in the area of EA evaluation methods has brought to light an obvious lack of evaluation methodologies. (Bertolino, Inverardi, & Muccini, 2013; Iyamu, 2012).

Moreover, existence methods meant to measure the costs and benefits of IT investment have been investigated (Gabier, Seymour, & Van Belle, 2010; Matthias Lange et al., 2015; Georgios Plataniotis et al., 2013; Sun & Chen, 2010). These measures are always a relevant basis for managerial decision-making but there is insufficient consideration of the effectiveness and functionality of EA evaluation.

Since this thesis represents Systematic Literature Review (SLR) reports on EA evaluation, this section describes EA evaluation methods that have appropriate foundations for providing basic understanding. Although these methodologies can be discussed in several ways, this section focuses on effectiveness and functionality based on the current research trends.

2.5.1 Effectiveness in Evaluation Methods for EA Implementation

Foundational research in ISs design-science literature stresses the importance of evaluation. The effectiveness of EA is highly uncertain and little research evidence is established, while these criteria would help enterprises assess their architecture and investigate their intended goals (Stephan Aier, 2014; Morganwalp & Sage, 2015; van der Raadt, Slot, & van Vliet, 2007; Zhang et al., 2016). Insufficient studies have been done by both researchers and practitioners regarding the effectiveness of EA implementation.

Effectiveness is determined by the degree to which EA implementation outputs can help the enterprise attain its intended goals (Stephan Aier, 2014; Faller & De Kinderen, 2014; Van der Raadt, Bonnet, Schouten, & Van Vliet, 2010).If the goals intended by the enterprise regarding EA coincide with the individual goals of stakeholders, then EA effectiveness is determined (R. Schmidt, Wissotzki, Matthias-Jugel, Dirk-Mohring, Michael-Sandkuhl, Kurt-Zimmermann, Alfred, 2014; Weiss et al., 2013; Whittle & Myrick, 2016). Besides, an EA function of effectiveness is the degree to which organizational objectives are attained through the EA function outputs (Stephan Aier, 2014; Weiss et al., 2013). Effectiveness may be measured objectively using organizational performance data related to the implementation of EA decision-making (Löhe & Legner, 2014; G Plataniotis & Kinderen, 2015; Weiss et al., 2013). Some useful studies regarding effectiveness in EA evaluation are described as follows.

Current EA evaluation methods mostly focus on finance and efficiency of EA functions (Gabier et al., 2010; Matthias Lange et al., 2015). However, in order to understand the degree to which EA implementation functions achieve the objectives being pursued, the effectiveness of EA implementation plays a major role in contrast to efficiency or cost (Dale, 2016; Matthias Lange et al., 2015; Lee et al., 2016; Morganwalp & Sage, 2015). In EA implementation, the main concerns are with achieving EA functions. Obtaining the intended results by using EA implementation practices is the key concern in EA implementation effectiveness.

Bas van der Raadt (2010) proposed an effectiveness method for EA implementation evaluation through an empirical study and investigation of EA stakeholder satisfaction and EA alignment. They presented an EA effectiveness measurement method by proposing a set of quality attributes of an EA function in order to evaluate EA implementation. Alignment and agility are the principal components of the mentioned effectiveness method(Van der Raadt et al., 2010). The study focused on EA

implementation output in terms of agility and alignment, but the main limitation is that it did not present a step-by-step method of performing evaluation practices. Figure 2.3 illustrates the measurement method of EA effectiveness proposed by Bonnent and Van der Raadt.

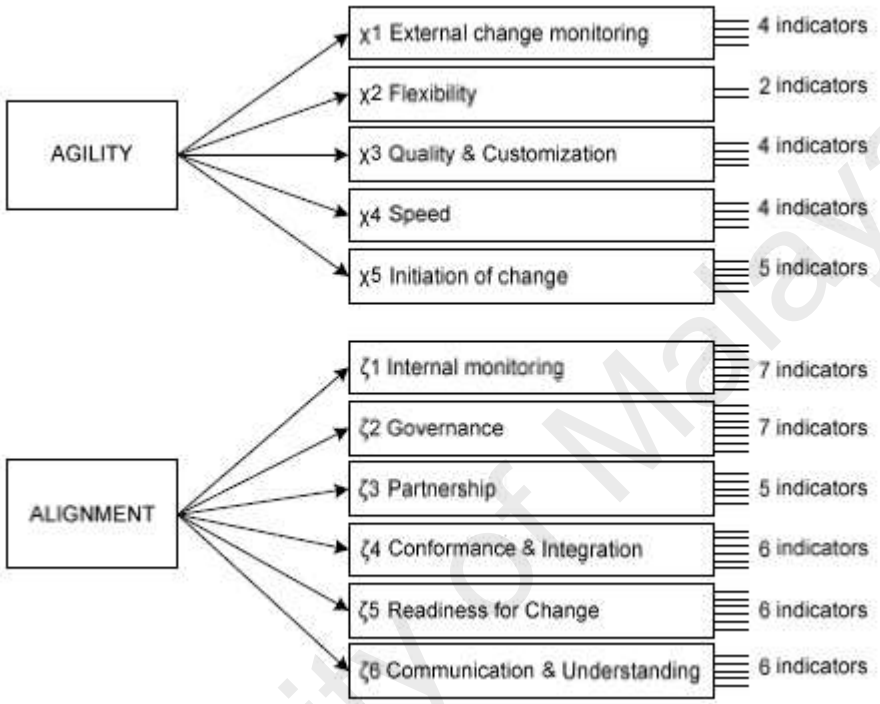

Figure 2.3: Measurement Method of Effectiveness (Van der Raadt et al., 2010)

Kamogawa and Okada (2005) developed a framework for assessing EA effectiveness in the context of e-business. In doing so, the authors focused on the effect of EA on four business values, namely business process excellence, customer orientation, innovation and strategic adaptability (Kamogawa & Okada, 2005). However, Kamogawa and Okada (2005) did not justify why they chose those values to define EA effectiveness, neither did they make explicit how the EA function contributes to the four values. Therefore, this framework does not seem to be suitable. The method does not contain any specific dimensions that can be used to evaluate the effectiveness of EA artefacts.

Steenbergen and Brinkkemper (2010) introduced the "Architecture Effectiveness Method," in which the choice of Key Performance Indicators (KPI) for EA effectiveness can be based on the selected KPI. They used a graphical representation, including effects and cause-effect relations. Effects were then divided into three types, moving from left to right: "architectural results," "organizational performance effects" and "business goal effects" (Steenbergen & Brinkkemper, 2010). The range of their study was limited to a business perspective and did not explain EA functions entirely. Figure 2.4 shows Steenbergen and Brinkkemper's method.

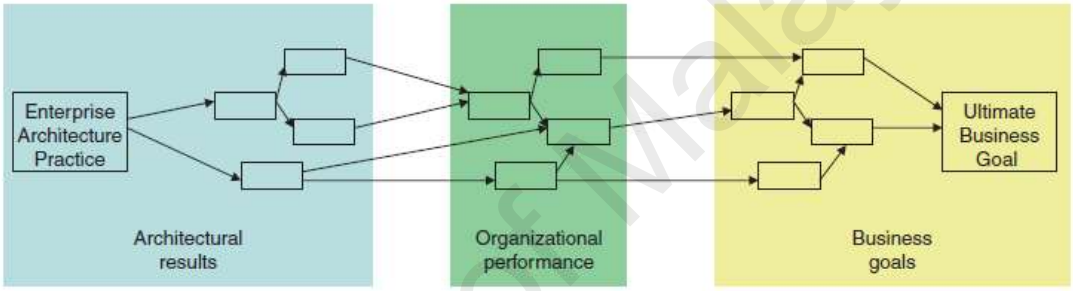

Figure 2.4: Steenbergen and Brinkkemper Method

Magnus and Marten (2007) identified three dimensions of an evaluation method, which consist of the IT organization, IT system and business organization. They indicated that existing EA frameworks cannot encompass all EA methods and it is difficult for IT management to control all areas. The IT management's responsibilities are enterprise IT business alignment, IT investment decisions, IT system quality assessment and improvement. Magnus and Marten's IT management method is a guide for determining EA evaluation and scenario (Gammelgård, Simonsson, & Lindström, 2007). There is neither a structure behind this method for EA implementation evaluation nor a proposed method for application in EA projects.

Schelp and Stutz (2007) acknowledged that evaluating EA is one of the main issues in the EA field. They proposed an evaluation method based on Kaplan and Norton's

Balanced Scorecard (BSC). The BSC perspectives of Schelp and Stutz' (2007) evaluation method contain services, processes, assets and finance. The proposed method is based on the Goal Question Metric (GQM) approach (Schelp & Stutz, 2007). It also presents a framework for EA performance from a business perspective to solve governance challenges and focus on evaluating EA from a financial aspect.

Pruijt et al. (2012) developed the Enterprise Architecture Realization Scorecard (EARS), aimed at improving EA effectiveness measurement. EARS uses five EA activities: define the vision, develop sub-architectures, plan migration, supervise implementation projects and exploit the architecture in operation. Moreover, it is argued that the results of these activities should be scored based on three aspects: product, acceptance and scope (Leo Pruijt et al., 2012). Their thesis focused on the EA management function. Moreover, the most wide-spread approaches were maturity methods. The authors primarily addressed the EA and development process but not the evaluation of architectural decisions and solutions concerning enterprise goal achievement.

In short, although several methods exist for evaluating EA project implementation, it still lacks comprehensive method that support whole aspects of implemented EA artefacts. Planning, modeling, managing, maintaining and governing are major aspects of EA implementation, which require appropriate and effective method to facilitate the progress of evaluation. Current EA projects handle evaluation by utilizing several types of evaluation for each project aspect, hence making projects more complex. Table 2.1 is a summary of existing problems with the evaluation methods reviewed.

Table 2.1: Summary of Existing Problems (H Plessius, R Slot, & L Pruijt, 2012; Schelp & Stutz, 2007)

No.		Not Covering all aspects of EA	Lack of structured methods	Difficulties in EA evaluation	Lack of methods for EA evaluation
M1	Schelp and Stutz (2007)	✓	✓	✓	✓
M2	Aier, S., & Schelp, J. (2010)		✓	✓	✓
M3	Van Steenbergen, M., & Brinkkemper, S. (2010)	✓			✓
M4	Kamogawa and Okada (2005)		✓	✓	✓
M5	Van Der Raadt, at al (2008)	✓	✓	✓	✓
M6	Magnus and Marten (2007)		✓		✓
M7	Närman et al., 2011	✓		✓	✓
M8	Pruijt et al. (2012)	✓	✓		✓

The methods listed in Table 2.1 do not provide appropriate methods of applying practices within evaluation procedures. Moreover, they fail to provide the structures behind the methods to make appropriate evaluation methods. Covering all aspects of EA for evaluation is another criterion that is not supported by the aforementioned methods. Furthermore, some methods do not represent structures that are easy to understand and use in evaluation processes.

It can be concluded regarding the reviewed methods that they mainly lack a systematic method to facilitate the process of evaluating EA project implementation. Moreover, the majority of methods do not provide comprehensive evaluation nor make use of the developed EA artefacts effectively.

2.5.2 Functionality in Evaluation Methods for EA Implementation

From the functional perspective, EA describes how different components of an organization, such as organizational units, business processes, people and ISs are related to each other and work as a whole towards the organizational goals (Chorafas, 2016; DeLone & McLean, 2016; P Närman et al., 2014). EA deals with business architecture artefacts such as business services and processes only to allow the development of IT solutions that are better aligned with those functional components (Gorla & Somers, 2014).

The necessity to evaluate the functionality performance of ISs has emerged from the importance of IT in leveraging the effectiveness and efficiency of work processes in an organization, causing rapid demand growth in terms of resource performance in ISs (Akbarifar & Hamdi, 2016; Chorafas, 2016; Whittle & Myrick, 2016). The evaluation of IS performance indicates the evaluation of performance in hardware, software, computer networks, data and human resources. The main purpose of IS functionality performance evaluation is to upgrade and improve the quality of IS maintenance. IS functionality evaluation represents the procedure of assessing how successfully an IS fulfills its objectives (Davenport, 2013; P Närman et al., 2014; Vasconcelos et al., 2015). The process of evaluation includes synthesizing and determining gathered individual scores with the purpose of forming a common opinion about the functionality of the evaluated Information System. In the process of expressing general opinion, professionals usually rely on their individual assessment abilities (Buschle et al., 2013;

Pearlson, Saunders, & Galletta, 2016; Ward & Peppard, 2016). There is no particular or specific method of evaluating the functionality of EA post-implementation, and existing evaluation methods only concentrate on describing user satisfaction in terms of functionality.

2.5.3 Summary of Evaluation Methods

In order to appropriately understand the mentioned methods, this thesis defines the relevant criteria for comparison. Table 2.2 shows the definitions of the selected criteria, and Table 2.3 represents the results of comparing the aforementioned methods based on the selected criteria.

Table 2.2: Definitions of Comparison's Criteria

Criteria	***Definition***
Theory-based	Supports the related theory for evaluation
Completeness	The ability to support all aspects of an enterprise
Decision-making support	Refers to considering practices that support decision-making by enterprise architects and stakeholders
Multi-disciplinary coordination	The set of disciplines that exist in an enterprise to convey decisions in one plan with common objectives
Structured method	A well-defined pattern of the practices/processes for keeping EA artefacts
Covers the gaps	The ability to cover the gaps between EA implementation objectives and stakeholders' perspectives without leaving further gaps
Flexibility	A set of dynamic practices that are flexible in addressing new changes
Step-by-Step Guideline	Describing a step-by-step guideline to better understand the implementation practices/processes of an evaluation method
Easy to understand	The ability to understand the practices/processes of an evaluation method
Support Tools	Recommending and using the appropriate tools for

Criteria	*Definition*
	implementing an evaluation method

Table 2.3: Comparison's Results (Steenbergen & Brinkkemper, 2010; Steenbergen & Schipper, 2010)

Criteria	M1	M2	M3	M4	M5	M6	M7	M8
Theory-based	No	No	No	No	No	No	No	No
Completeness	Not Considered	Not Considered	Not Considered	Not Considered	Considered	Not Considered	Considered	Considered
Decision-making support	Considered	Not Considered	Not Considered	Considered	Not Considered	Not Considered	Not Considered	Considered
Multi-disciplinary coordination	Not Considered	Not Considered	Partly Provided	Not Considered	Partly Provided	Not Considered	Not Considered	Partly Provided
Structured method	No	No	Yes	No	No	No	Yes	No
Covers the gaps	Partly Provided	Not Considered	Not Considered	Partly Provided	Not Considered	Not Considered	Not Considered	Partly Provided

Criteria	M1	M2	M3	M4	M5	M6	M7	M8
Flexibility	No	No	No	Yes	No	No	Yes	No
Step-by-Step Guideline	Partly Provided	No	Partly Provided	No	No	No	Partly Provided	Partly Provided
Easy to understand	No	No	No	No	No	Yes	No	Yes
Support Tools	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided	Not Provided

According to Table 2.3, the selected methods mostly lack supporting tools in terms of evaluation practices and management. Flexibility, covering the gaps, and theory-based are other criteria not supported by the aforementioned methods. Easy to learn and implement, and step-by-step guideline are also not fully supported by the methods, which leads to difficulties with applying evaluation practices.

Completeness, which relates to providing the practices required to evaluate all aspects of EA evaluation, is also not considered in the aforementioned methods.

2.6 Evaluation Theory

Shadish (1998) described the evaluation theory as "who we are." The uniqueness of evaluation is "our willingness to attack value questions by studying merit and worth, our understanding about how to make results more useful than most other social scientists can do, or the strategies we have developed to choose which methods for knowledge construction to use depending on the need of the evaluating client" (Baskerville & Wood-Harper, 2016; Vasilecas et al., 2015).

The evaluation theory reflects "our thinking about how and why we engage in evaluation." It is the purpose of evaluation validation, accountability, monitoring, improvement and development (Mayne, 2015; Rog, 2015). Theories provide guidance in determining the purposes of evaluations, as well as in defining what we consider to be acceptable evidence for making decisions in an evaluation (Brousselle & Champagne, 2011; DeLone & McLean, 2016; Mertens & Wilson, 2012).

The evaluation theory assesses specific causal contributions of activities to results, examines the implementation process, explores unintended results, provides lessons, highlights significant accomplishments or program potential, and offers recommendations for improvement (Pearlson et al., 2016; Venkatesh, Brown, & Bala, 2013). The evaluation looks at the relevance, effectiveness, efficiency and sustainability of an intervention. It provides evidence of why targets and outcomes are or not being achieved and addresses issues of causality (DeLone & McLean, 2016; Garud & Gehman, 2016; Venkatesh et al., 2013).

Theory plays multiple roles in evaluation (H. T. Chen, 2014). The concept of the evaluation theory is exploring what we say we do when doing an evaluation. Evaluation theories are used both to inform of decisions regarding an evaluation practice and to inform of programmatic decisions (Garud & Gehman, 2016; Gawronski & Bodenhausen, 2015).

2.7 Program Theory

The program theory was introduced by Chen & Rossi (1983)(H.-T. Chen & Rossi, 1983; H. T. Chen, 2014). This theory is based on attempts to identify and quantify those variables that would have an impact on project implementation outcomes (H. T. Chen, 2014; Fox, Grimm, & Caldeira, 2016; Smith, 2013). The program theory is one of the most promising evaluation approaches for producing cumulative knowledge and

enlightening various stakeholders about the problems of concern (Alkin, Vo, & Hansen, 2013; Brousselle & Champagne, 2011; H. T. Chen, 2014; Funnell & Rogers, 2011). It specifies feasible practices that can be used across a wide range of program settings (H.-T. Chen & Rossi, 1983; Stewart I Donaldson, 2012).

The program theory in evaluation is defined as "a specification of what must be done to achieve the desired goals, what other important impacts may also be anticipated, and how these goals and impacts would be generated" (Bradbury, 2015; Mertens & Wilson, 2012; Posavac, 2015). Program theory uses are as follows:

- Clarifying project intentions
- Enhancing communication among team members
- Managing project evaluation
- Designing evaluation/determining questions
- Documenting a project implementation evaluation
- Examining a project or constellation of projects

Use of the program theory has become commonplace in evaluation practice and has been diffused or incorporated into the most popular approaches or theories of evaluation practices (H. T. Chen, 2014; Stewart I Donaldson, 2012; Funnell & Rogers, 2011). EA evaluation concentrates on the achievement of intended objectives, proper governance and stakeholders' satisfaction (Vasconcelos et al., 2015; Wolff, 2016). The program theory helps to explain mechanisms believed to influence the achievement of desired outcomes. It is an explicit theory of how an intervention, such as EA artefacts, a developed IS, a strategy, or a governance policy, contributes to achieving the intended objectives and stakeholder satisfaction (Brousselle & Champagne, 2011; Stewart I Donaldson, 2012; Foorthuis et al., 2015; Gill, 2015).

The program theory in EA evaluation is the systematic use of substantive knowledge about the EA implementation under investigation and scientific methods to improve, produce knowledge and feedback about, and determine the merit, worth and significance of the EA project implemented in an enterprise (P Andersen, 2015; Choi, 2016; Garud & Gehman, 2016). The program theory can also serve for strategic planning and the entire governance approaches in the implemented EA. Without the program theory, it is impossible to know if the right aspects of implementation quality and quantity were measured (Foorthuis et al., 2015; Garud & Gehman, 2016; Löhe & Legner, 2014).

An evaluation that employs the program theory can help identify gaps and inconsistencies in the developed EA artefacts or future changes that have occurred since and need to be addressed (Alkin et al., 2013; H. T. Chen, 2014; Funnell & Rogers, 2011; Stevahn & King, 2016). Therefore, in developing a method, the "program theory" is utilized in this thesis as the theoretical foundation for the components and processes of the proposed method.

Program Theory is logical linkage between what expected (outcomes) is and what was done to whom (outputs) with what resources (inputs) by following the arrow from right to left. From left to right, the arrow indicates what resources are needed to conduct what activities to whom in order to expect what outcomes. Each box (inputs, outputs, outcomes) has an accompanying evaluative activity.

2.8 Research Gap Analysis

By reviewing the relevant literature, it has become evident that post-implementation of EA evaluation poses several problems.

A critical issue in existing evaluation methods of EA post-implementation is that no current structured evaluation method exists that covers effectiveness and functionality (Jahani, Javadein, & Jafari, 2010; Vasconcelos et al., 2015). Consequently, the evaluators may face a lack of information regarding the achievement of the defined EA objectives and governance of the developed EA artefacts for better decision-making (Brosius et al., 2016; Chorafas, 2016; Kotusev et al., 2015).

Existing evaluation methods do not cover all aspects of EA implementation and mostly concentrate on the alignment of business and IT within EA projects in terms of development processes and maturity models (De Vries, 2016; Niemi & Pekkola, 2013; Wissotzki & Koc, 2013). Moreover, they do not cover architectural artefacts and implementation solutions (Kotusev et al., 2015; Niemi & Pekkola, 2015; G Plataniotis & Kinderen, 2015)

Existing EA evaluation methods do not represent structured and easy-to-understand practices for evaluating implemented EA artefacts (Kotusev et al., 2015; Medini & Bourey, 2012; Niemi & Pekkola, 2015; Leo Pruijt et al., 2012).They provide a list of practices but neither describe means of using the provided practices nor provide metrics for evaluation (Matthias Lange et al., 2015; Morganwalp & Sage, 2015; R. Schmidt, Wissotzki, Matthias-Jugel, Dirk-Mohring, Michael-Sandkuhl, Kurt-Zimmermann, Alfred, 2014)

In can thus be concluded that the reviewed methods are mainly deficient in the ability to provide comprehensive, useful functionality or make use of the developed EA artefacts effectively (Foorthuis et al., 2015; Kotusev et al., 2015; Löhe & Legner, 2014; Zarvić & Wieringa, 2014). Moreover, they lack the ability to relate business requirements to IT capabilities or specifically provide structured approaches to facilitate further future change analysis (Brosius et al., 2016; Simon et al., 2014). Very few EA

evaluation methods offer comprehensive approaches for evaluating all aspects of EA implementation (Chun, 2012; Franke, Johnson, & König, 2013; Gill, 2015; Per Närman et al., 2014; Henk Plessius, Raymond Slot, & Leo Pruijt, 2012).

An appropriate evaluation method should provide effective practices to support the evaluation of implemented EA artefacts and represent the processes of applying evaluation practices. It should also provide step-by-step and easy-to-implement structures supported by well-defined theories. Consequently, this thesis is directed toward addressing such deficiencies. It is intended to develop a method for EA evaluation that supports the implemented EA artefacts. The method is equipped with the mechanism of focusing on the evaluation of functionality and effectiveness of EA artefacts.

This thesis is aimed to develop an evaluation method for the post-implementation of EA by considering the effectiveness of the provided functionalities as well as evaluating the process of EA implementation.

2.9 Justification for Developing an Evaluation Method

The evaluation process of EA post-implementation involves various types of matters from different categories, like effectiveness, functionality and financial matters. The analysis of related studies showed that the majority of existing studies partly deal with such issues and provide partial solutions. Moreover, no study covers comprehensive evaluation aspects of EA implementation within EA projects. Most studies are not supported by the structured theory or do not provide step-by-step guidelines for evaluating the functionality and effectiveness of implemented EA projects. Besides, many experts that we interviewed have confirmed the problems and concerns that exist in organizations which implement EA projects.

As a result, this work is intended to address the concerns discussed by developing a method to assist with the process of evaluating EA project implementation. Besides, this thesis applies the program theory as the main foundation for providing the skeleton of the proposed method. Moreover, in order to develop an appropriate and effective method, this thesis uses empirical investigation to identify the evaluation practices that can be employed in the process of evaluating EA project implementation.

2.10 Summary

This chapter presented a literature review by dividing related works into the following categories: EA implementation, EA implementation evaluation, EA post-implementation evaluation, effectiveness in EA post-implementation evaluation, functionality in post-implemented EA evaluation, and the evaluation theory, which form the basis for developing the proposed method. Research gaps were also identified, justifying the development of a method to address frequently occurring problems in EA evaluation. On account of the gaps mentioned in this chapter, the researcher believes there is an urgent need to propose an evaluation method to address EA evaluation deficiencies. The research methodology is presented in the next chapter.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Overview

This chapter focuses on research methodology that has been used for this research. It describes the selected approach and research methods used in order to achieve the defined research objectives. Secondly, it describes the research operational framework and the research tools used. This chapter is organized according to Figure 3.1.

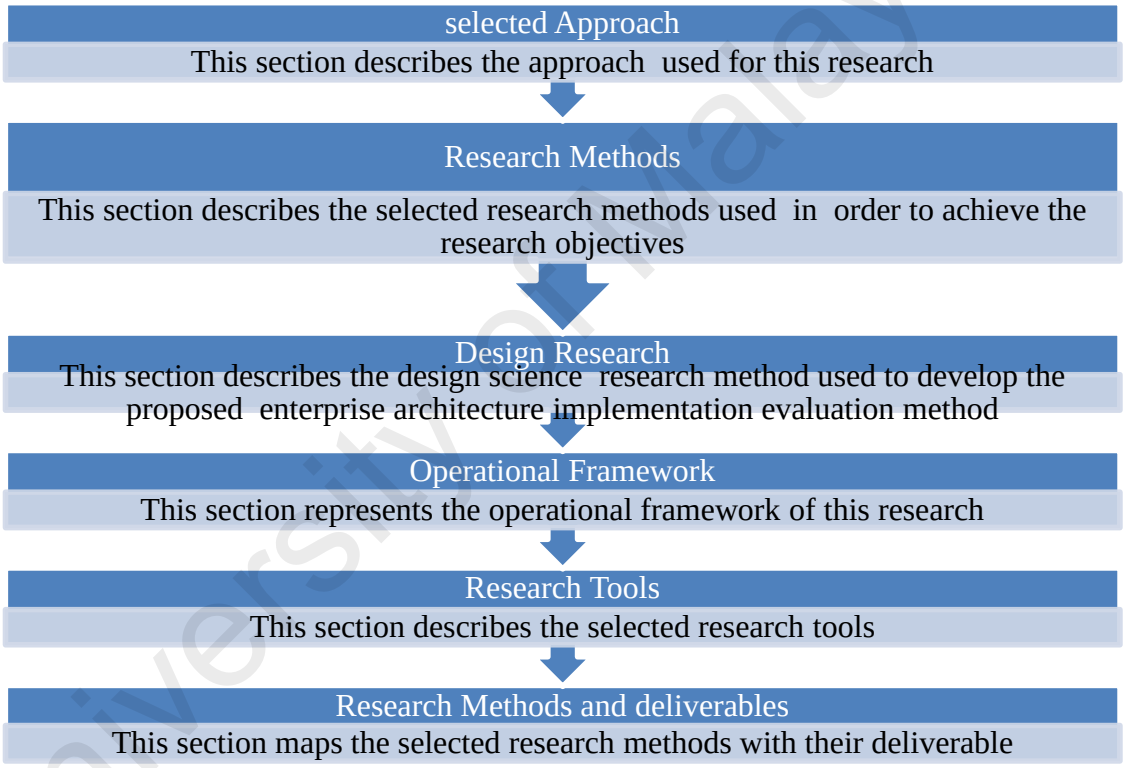

Figure 3.1: Organization of Chapter 3

3.2 Selected Approach

To fulfill research objectives and answer research questions, mixed method approach utilizes data collection and analysis technique's ally with both quantitative and qualitative data (Venkatesh et al., 2013). The 'mixing' might be within one study, by

using multiple data collection techniques, or among several studies(Easterbrook, Singer, Storey, & Damian, 2008).

The goal of mixed method research is not to replace both quantitative and qualitative approaches but rather to draw from the strengths and minimize the weaknesses of both in single research studies and across studies (J. Creswell, 2013; R. B. Johnson & Onwuegbuzie, 2004). Mixed-Method strongly emphasizes the use of evidence from both quantitative and qualitative data (J. Creswell, 2013; Easterbrook et al., 2008).

The 'mixing' might be within one study, by using multiple data collection techniques, or among several studies. Key decisions involve the strategy for data collection, and the sequence in which different methods are employed (J. Maxwell, 2012; P Runeson & M Höst, 2009). While mixed method research is a powerful approach to inquiry, the researcher is challenged with the need for extensive data collection, the time-intensive nature of analyzing multiple sources of data, as well as the requirement to be familiar with both quantitative and qualitative forms of research(P Runeson & M Höst, 2009; Venkatesh et al., 2013).

Mixed methods research strongly emphasizes the use of evidence from both quantitative and qualitative data. Therefore, mixed methods research is more often associated, where the emphasis is on using those methods that most effectively address the research problem (J. Maxwell, 2012; Venkatesh et al., 2013).

Qualitative methods allow for identification of previously unknown processes, explanations of why and how phenomena occur, and the range of their effects Mixed methods research, then, is more than simply collecting qualitative data from interviews, or collecting multiple forms of qualitative evidence or multiple types of quantitative evidence (e.g., surveys and diagnostic tests). It involves the intentional collection of

both quantitative and qualitative data and the combination of the strengths of each to answer research questions(J. Maxwell, 2012; Myers, 2013).

Researchers may seek to view problems from multiple perspectives to enhance and enrich the meaning of a singular perspective. They also may want to contextualize information, to take a macro picture of a system and add in information about individuals(Myers, 2013; Sembiring et al., 2011b). Other reasons include to merge quantitative and qualitative data to develop a more complete understanding of a problem; to develop a complementary picture; to compare, validate, or triangulate results; to provide illustrations of context for trends; or to examine processes/experiences along with outcomes.

The mixed method approach has been selected for this thesis because we have to gather as much information as possible to ensure that our proposed method will be more usable across organizations (J. Creswell, 2013).

Moreover, Design science research is used in this thesis.it focuses on the development and performance of (designed) artifacts with the explicit intention of improving the functional performance of the artifact. Design science research is typically applied to categories of artifacts including algorithms, computer interfaces, design method (including process models) and languages(Alan, March, Park, & Ram, 2004; A Hevner & S Chatterjee, 2010). Its application is most notable in the Engineering and Computer Science disciplines, though. In design science research, as opposed to explanatory science research, academic research objectives are of a more pragmatic nature. Main goal of design science research is to develop knowledge that the professionals of the discipline in question can use to design solutions for their field problems(S. Gregor & A. Hevner, 2013). The design science research paradigm is highly relevant to information systems (IS) research because it directly addresses two of

the key issues of the discipline: the central, albeit controversial, role of the IT artifact in IS research and the perceived lack of professional relevance of IS research(Alan et al., 2004; A Hevner & S Chatterjee, 2010).

3.3 Research Method

This section describes the selected research methods, which are employed in this research.

3.3.1 Systematic Literature Review

In order to achieve the first research objective, this thesis make used of the Systematic Literature Review (SLR). SLR is one of the ways of identifying, evaluating and interpreting all available research relevant to a particular research question (Brereton, Kitchenham, & Budgen, 2007), or topic area, or phenomenon of interest (Barbara Kitchenham et al., 2009; Barbara Kitchenham et al., 2010). The main reason for selecting SLR is that, it allows the researcher to develop a cumulative knowledge based on their research questions and ensure that the research work is relevant. It also builds on previous achievements (Barbara Kitchenham et al., 2009; Barbara Kitchenham et al., 2010; Stapić, López, Cabot, de Marcos Ortega, & Strahonja, 2012).

In order to get initial exploration of issues and to identify key features to be addressed in EA implementation evaluation, Preliminary study and Interview with EA experts were done.

3.3.1.1 SLR Research Questions

This research is intended to identify the current issues with EA evaluation, existing methods and practices that affect desired EA deliverables.

SLR-RQ1: What are the existing methods for EA implementation evaluation?

SLR-RQ2: What are the practices applied for EA implementation evaluation?

SLR-RQ3: What are the current issues with EA implementation evaluation?

In this study, the word 'practice' refers to a set of activities and processes in EA implementation evaluation. The motivation behind SLR-RQ1 is to have a current methods for EA implementation evaluation. The motivation for SLR-RQ2 is to identify the practices that have certain effect on EA implementation evaluation. The motivation behind SLR-RQ3 is to investigate issues with current methods. The EA implementation refers to developed EA artefacts based on defined EA objectives.

3.3.1.2 Search Process

This SLR concentrates on searching several electronic sources and digital database libraries, as it is assumed that the main research results from books and reports are also usually described or referenced in scientific papers. The selected electronic databases have been listed in Table 3.2 for the SLR search process:

Table 3.1: Electronic Databases

Identifier	Database	URL
DB1	Springer	http://www.springerlink.com
DB2	IEEE Xplore	http://www.ieee.org/web/publications/xplore/
DB3	Science Direct	http://www.elsevier.com
DB4	ACM Digital Library	http://portal.acm.org
DB5	Taylor and Francis	www.tandfonline.com
DB6	Google Scholar	www.scholar.google.com

These databases were chosen as they provide the most significant and highest impact full-text journals and conference proceedings published between 2006 and 2014. They

are also in the field of EA implementation evaluation and EA evaluation methods in general. Following an initial search of these databases, an additional reference scan and analysis is added in order to find out whether anything was missed and to guarantee that a representative set of studies was selected. The search results are also checked against a core set of studies to ensure confidence in search result comprehensiveness. The following search keywords were used to find relevant studies from titles, keywords and abstracts:

"enterprise architecture implementation evaluation" OR "evaluation of enterprise architecture" OR "evaluation model of enterprise architecture implementation" OR "evaluation framework for enterprise architecture implementation" OR "evaluation approach for enterprise architecture implementation" OR "evaluation method for enterprise architecture implementation" OR "enterprise architecture implementation evaluation framework" OR "enterprise architecture implementation evaluation model" OR "enterprise architecture implementation evaluation method" OR "enterprise architecture evaluation" OR "enterprise architecture implementation evaluation approach".

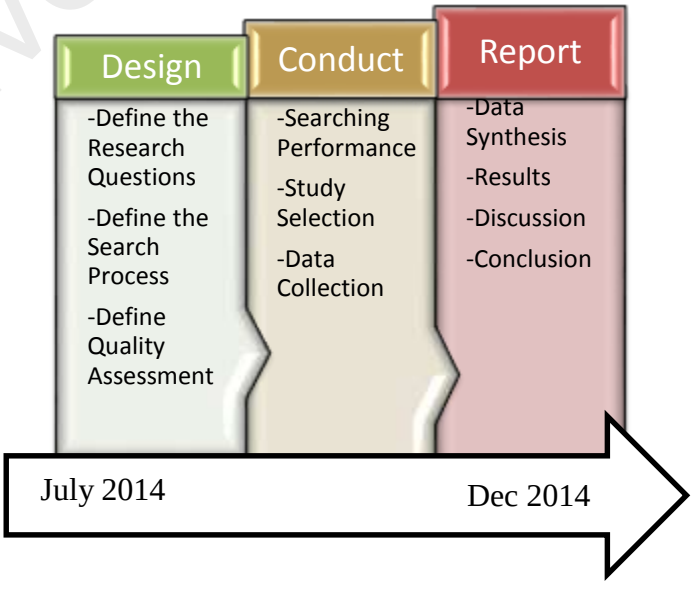

Figure 3.2: Research Process

3.3.1.3 Review Process

This section defines the review protocol for conducting the SLR. The review protocol of this thesis is defined based on the structure and rules of conducting reviews.

3.3.1.4 Inclusion and Exclusion Criteria

Table 3.2 lists the inclusion and exclusion criteria for the conducted SLR. The intentions for inclusion and exclusion criteria are to select potentially relevant studies for review from data sources to answer research questions and avoid any irrelevant studies base on kitchenham guidelines for criteria(BA Kitchenham, 2007; Barbara Kitchenham et al., 2009).

Table 3.2: Inclusion and Exclusion Criteria

Inclusion	
IC1	English peer-reviewed studies, including conference proceedings, journal papers and book chapters
IC2	Studies that focus on EA implementation evaluation and/or EA implementation assessment
IC3	Studies that introduce any procedures/techniques for EA evaluation
IC4	Studies published after 2006
Exclusion	
EC1	Studies that are not in English
EC2	Studies that are not related to the research questions
EC3	Duplicate studies (by title or content)
EC4	Short papers (e.g. posters)

3.3.1.5 Study Selection

The study selection process contains 5 main parts as shown in Figure 3.2. To prevent bias, another researcher was allocated to check and review the primary studies selected. Furthermore, the selected studies were randomly re-evaluated after the initial screening to check the consistency of our inclusion/exclusion decisions.

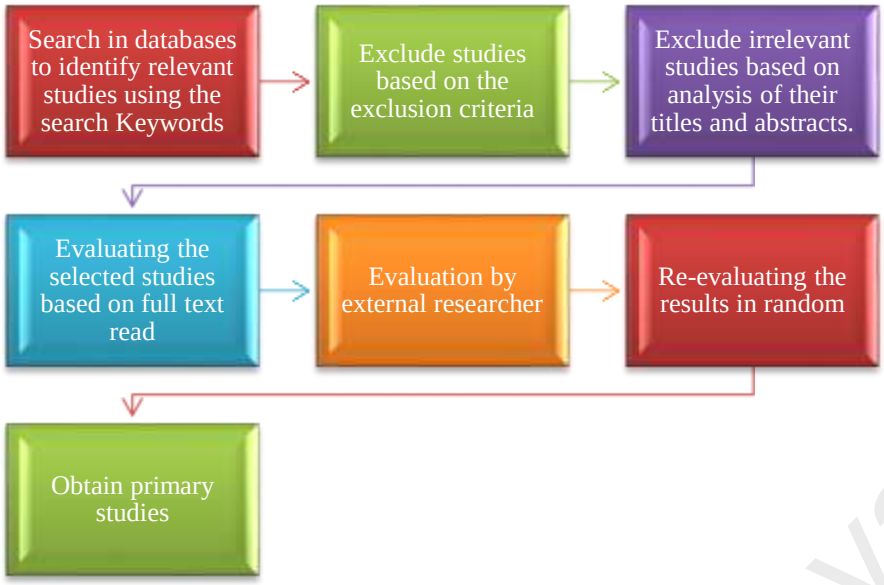

Figure 3.3: Study selection process

3.3.1.6 Quality Assessment

Studying quality assessment helps researchers interpret findings and determine the strength of the elaborated inferences (Brereton et al., 2007). Upon selecting a number of primary studies based on inclusion and exclusion criteria, it becomes possible to assess their quality. According to the SLR guidelines proposed by Kitchenham (BA Kitchenham, 2007), four Quality Assessment (QA) questions were defined in order to assess the quality of this study for each question and to facilitate a quantitative comparison between them ,each QA are derived from kitchenham guideline criteria. (BA Kitchenham, 2007). The scoring used was Yes (Y) = 1, Partly (P) = 0.5 or No (N) = 0. Table 3.3 shows the defined quality assessment questions. These questions can help check for bias, and external and internal review validation:

Table 3.3: Quality Assessment Criteria

Assessment Criteria	Response Option
QA1- How well are the practices or factors defined?	Yes (Y) = 1, Partly (P) = 0.5 or No (N) = 0 Yes: they are explicitly and clearly described Partly: only a few descriptions are mentioned No: they are neither described nor mentioned
QA2- How clearly are the work limitations documented?	
QA3- Is there a clearly defined statement of the challenges in EA evaluation?	
QA4- How well are the evaluation methods defined?	

3.3.1.7 Data Extraction Form

The desired information was extracted from the selected papers based on the paper selection form shown in Table 3.4. Data extraction allows gathering desired information from selected papers to answer the defined research questions. Table 3.4 presents the data extraction employed for the primary studies selected in order to carry out an in-depth analysis.

Table 3.4: Data Extraction Form

No	Extracted Data	Description	Type
1	Identity of study	Unique identity of the study	General
2	Bibliographic reference	Authors, year of publication, title and source of publication	General
3	Type of study	Book, journal paper, conference paper, workshop paper, white paper	General
4	Research method used for data collection	Techniques included in the study design, e.g. case study, survey, experiment, interview to obtain data, observation	General
5	EA evaluation methods	Methods for EA implementation evaluation	SLR-RQ1
6	EA Evaluation Practices	Description of practice and activities applied in EA implementation evaluation	SLR-RQ2
7	Current issues	Issues of EA implementation evaluation	SLR-RQ3
8	Findings/Contribution	Indicate the study findings and contributions	General

3.3.2 Case Study

This thesis uses case study to evaluate the usability and applicability of proposed evaluation method as the third research objective. Case study is an appropriate and useful research method for both software engineering and Information System (IS) because it investigates contemporary phenomena in its real-life context (Darke, Shanks, & Broadbent, 1998; P Runeson & M Höst, 2009). Case study could provide appropriate data analysis on quantitative research (Michael D. Myers, 1997; Per Runeson & Martin Höst, 2009). Five major processes are required for conducting a case study (Per Runeson & Martin Höst, 2009):

- Case study design: the objective is defined and the case study is planned.
- Preparation for data collection: procedures and protocols for data collection are defined.
- Collecting evidence: execution with data collection on the studied case.
- Analysis of collected data
- Reporting

3.3.2.1 Case Study Design and Planning

This thesis collects the required data in the performed case study by using interviews and questionnaires. In particular, semi-structured interviews have been selected for case study data collection. In a semi-structured interview, questions are planned, but they are not necessarily asked in the same order as they are listed. Additionally, semi-structured interviews allow for improvisation and exploration of the objects studied. The participants of the interview include case's enterprise architects, business architects, IT architects, top management, and some external enterprise architects. The closed

questions by seven-point Likert scale is selected and design for data collection (M. Myers & M. Newman, 2007).

Multiple cases and methods increase the robustness of results (Kaplan & Maxwell, 2005; Michael D Myers, 1997). Using more than one case study and more than one method of data collection allows findings to be strengthened by cross-validating them. This process is generally known as "triangulation" (Kaplan & Maxwell, 2005). Since the triangulation provides strong conclusion and prevents the biasness, this thesis used this approach. Triangulation is a method used by qualitative researchers to check and establish validity in their studies by analyzing a research from multiple perspectives is to arrive at consistency across data sources or approaches.

We used triangulation in order to increase the precision of this thesis (P Runeson & M Höst, 2009). Triangulation means taking different angles towards the studied object and thus providing a broader picture (M. Myers & M. Newman, 2007; Yin, 2013). The following triangulations were used in the current thesis to validate the proposed method:

- Data triangulation: two case studies were considered in order to obtain data from more than one resource and cross-case analysis was applied
- Methodological triangulation: qualitative and quantitative methods were combined for data collection

A case study protocol defines the detailed procedures for collection and analysis of the raw data (Per Runeson & Martin Höst, 2009). Table 3.5 shows the design of the case study protocol for this thesis.

Table 3.5: Case study protocol

Section	Description
Objective	To evaluate the usability and applicability of proposed method
General Procedure	Using the proposed method for evaluating the Enterprise Architecture (EA) implementation in selected case
Case Selection Criteria	Familiar with EA Having Enterprise Architects, Business Architects, IT Architects, and so on Plan for conducting EA evaluation Invest on EA implementation Supporting EA project by top managements
Research Instrument	Interview and questionnaire
Data Collection	Semi-structured interview and closed questions were asked from selected case's enterprise architects, business architects, and systems' stakeholders
Data Analysis	Editing and Quasi-Statistical approaches used for coding, calculation of frequencies of words and phrases. Besides, the cross case study was done for generalizing the results
Validity	Validity threats analysed based on the checklists, which proposed by Runeson (2009). It would also have been possible to analyse threats according to construct validity, internal validity, external validity, and reliability.

Furthermore, the following items were considered during the conducting of case study:

- In order to gain permission for access to the right people the required correspondences were done with the case.
- Adequate resources such as time, paper, and others have been prepared, and during the project the resources needed were added.
- The appropriate schedule for collecting the required interview was set before the project starts with mutual consent.

Data analysis was done by coding the transcription of interviews by means of qualitative data analysis software Atlas.ti. In other words, firstly the data is coded, which means that parts of the text can be given a code representing a certain theme, area, construct, etc. One code is usually assigned to many pieces of text, and one piece of text can be assigned to more than one code. Codes can form a hierarchy of codes and sub-codes. In addition, the descriptive statistical analysis was provided for questionnaire's data by using SPSS.

3.3.2.2 Ethical Consideration

Conducting case studies in software engineering and information system regularly comprise dealing with confidential information of an organization. It is advisable that we are clear from the beginning on how the confidential information is handled to avoid having problems later on (Per Runeson & Martin Höst, 2009).

In this thesis, we validate with the participant on all the information given to ensure the reliability and validity of the data. Firstly, all transcripts of interviews were sent back to the participants to enable them to verify the validity of the data. Secondly, the resulting analyses were also presented to them in order to ensure that we maintain their trust in the research. Participants may not necessarily agree with all the outcome or resulting analysis that made, however, feeding back the analysis results always increases the validity of the study.

3.4 Design Science Research

The design-science paradigm has its roots in engineering. It is fundamentally a problem solving paradigm (Vaishnavi & Kuechler, 2015). It seeks to create innovations that define the ideas, practices, technical capabilities, and products through which the

analysis, design, implementation, management, and use of information systems can be effectively and efficiently accomplished (von Alan, March, Park, & Ram, 2004).

Design science research creates and evaluates IT artifacts intended to solve identified organizational problems. Such artifacts are represented in a structured form that may vary from software, formal logic, and rigorous mathematics to informal natural language descriptions. A mathematical basis for design allows many types of quantitative evaluations of an IT artifact, including optimization proofs, analytical simulation, and quantitative comparisons with alternative designs (von Alan et al., 2004). The further evaluation of a new artifact in a given organizational context affords the opportunity to apply empirical and qualitative methods. The rich phenomena that emerge from the interaction of people, organizations, and technology may need to be qualitatively assessed to yield an understanding of the phenomena adequate for theory development or problem solving (Carlsson, 2006; Alan Hevner & Samir Chatterjee, 2010).

In the development of the proposed method for the EA implementation evaluation, we used design science because the proposed method needs to be revised and enhanced from the participants and experts in order to make it usable and effective. Hence, this research follows the guidelines of Henver and Chatterjee (2010) to ensure its rigorousness.

3.5 Research Operational Framework

A thesis is a huge undertaking that requires you to have a strong idea of the subject matter. Outlines and notes are an important part of this process, but it is even more important that you have a clear sense about what the underlying connections between these ideas and notes are. These connections and the network that they form are your

thesis' "operational framework," the elements that underly how your ideas work together as a whole. Figure 3.3 illustrates the steps that we take to perform the research and we present it as a research operational framework. The research framework consists of three phases: preparation, development, and evaluation.

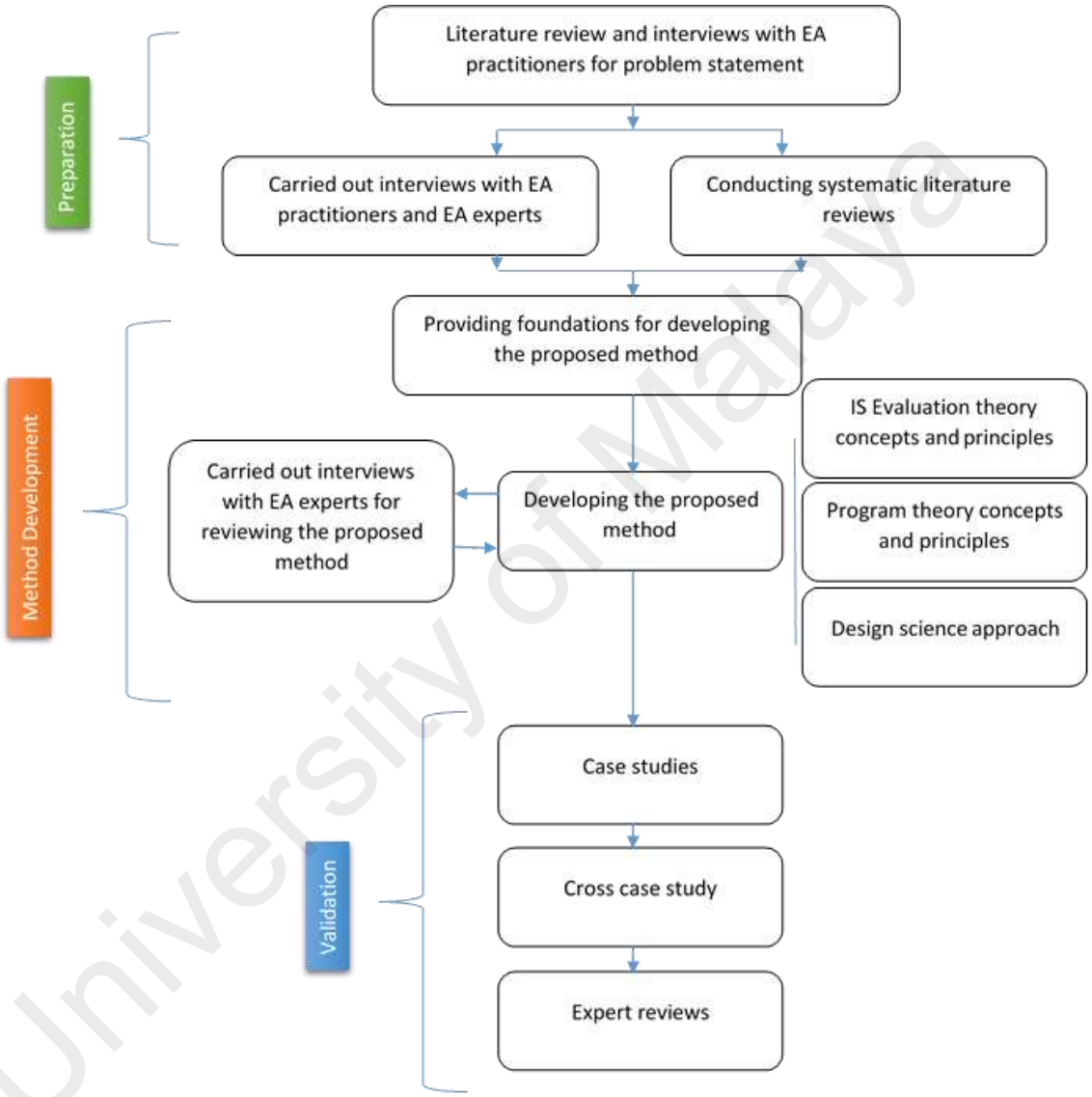

Figure 3.4: Research Operational Framework

3.5.1 Preparation Phase

This phase contains three main sections; literature review, interview with EA practitioners and SLR. First of all, literature review and interview with EA practitioner were done to Identify research problem, which describes the research questions and objectives, are reported. Next the SLR report, which provides broad information on EA evaluation's practices, methods and issues are produced. Next, the result of interview with EA practitioners and experts in order to obtain their perspectives on EA implementation evaluation is noted as the third outcome. Based on these three outcomes, the requirements for developing an evaluation method are gathered.

3.5.1.1 Secondary Data

In this thesis secondary data has been gathered from the literature review for providing appropriate understanding of the concepts of the research and using SLR for providing comprehensive information of EA evaluation. In short, the required secondary data were collected from public databases, indexed journals, and accomplished theses.

3.5.2 Development Phase

In this phase as the second phase of the research phase, three major steps have to be performed. Based on the results of the previous phase, the proposed method components, levels, and practices are described. Besides, in order to validate the main

concepts and practices, the proposed method is evaluated by EA experts. By doing this, the proposed method is revised iteratively based on the comments of EA experts.

Program Theory is the theoretical foundation theory for developing the proposed method. Component and process of proposed method is derived from program theory (Stewart I. Donaldson, 2012; Funnell & Rogers, 2011; Rey, 2012).

In order to improve the quality of the system and enhance the possibility of success of EA implementation, IS system evaluation methodology should be carried out in EA evaluation projects. Nonetheless, it should be highlighted that the selection of the use of either approach is related to actual stages of the IS lifecycle. That is, the use summative evaluation is closely related to when evaluation is post implementation of EA project.as described in section 2.5.3.Design Science guidelines is another approach to use in proposed method development.as described in section 3.4

3.5.3 Validation Phase

In this phase, three steps have to be taken into consideration. The first step is related to defining the case study design and planning. Case study have been done to evaluate usability and applicability of the proposed method. For usability, System Usability Scale (SUS) is considered (Kortum & Bangor, 2013; Lewis & Sauro, 2009), for applicability questionnaire with Likert scale is considered. In addition, data collection protocol is defined in the first step. The required data are extracted in accordance with defined case study protocol as the second step. The analysis results of the case studies are reported in the third step.

3.6 Selected Research Tools

This section represents the list of tools that are needed for this thesis. The items below entail analyzing the qualitative and quantitative data.

3.6.1 Analyzing Tools

SPSS version 19 is employed in order to analyze quantitative data and Atlas.ti version 7 and Text analyser are employed in order to analyse qualitative data (Arbuckle, 2010; Friese, 2013).

3.6.2 Mapping Research Methods and Deliverables

Table 3.6 shows step by step research strategy of selected research methods.

Table 3.6: Mapping Research Methods and Deliverables

Objective	Method/Activities	Deliverables
To identify the requirements for developing the EA evaluation method (RO1)	SLR method which it consists of the following activities is carried out for this objective (B. A. Kitchenham & Charters, 2007): I. Review Design a. Search question b. Search strategy II. Review Conduction a. Inclusion and exclusion criteria b. Quality assessment c. Data extraction form d. Synthesis III. Result a. Finding b. Discussion Interview with EA Practitioner(Myers-2007) - Semi –Structured - General context of EA evaluation - understanding of EA evaluation method - understanding of EA evaluation Issues - understanding of EA evaluation Practical	SLR reports and Interview analysis

Objective	Method/Activities	Deliverables
	Practices	

Table 3.6: Continued

To propose an evaluation method for post implementation EA (RO2)	To propose the proposed evaluation method, this research provided the following activities (Iivari & Rudy Hirschheim, 2000): I. Define the proposed method concepts and principles II. Describe the proposed method's components III. Describe the proposed method's practices IV. Describe the proposed method deployment o Deliverables	The proposed method
To evaluate applicability and usability of the proposed evaluation method (RO3)	For evaluating the usability and applicability of the proposed method, this research conducted a case study based on the following activities (Per Runeson & Martin Höst, 2009): I. Case Study Preliminary a. Research question b. Research objective II. Case Study Design a. Case and subjects selection b. Data collection procedure c. Analysis procedure d. Validity procedure III. Result a. Case and subject description b. Analysis and interpretation issues c. Evaluation of validity	Case study report

3.7 Summary

This chapter describes the roadmap that was used in the remainder of this thesis in order to achieve the mentioned research objectives. In this thesis, mixed method is used (quantitative and qualitative) and the use of contemporary methods which are SLR and case study. We selected these research methods to be able to achieve our research objectives. The next chapter concentrates on the investigation for methods that affect enterprise architecture evaluation, practices and issues of EA evaluation

CHAPTER 4: INVESTIGATION ON EA EVALUATION METHOD

4.1 Overview

This chapter concentrates on the investigation of existing methods that affect Enterprise Architecture (EA) evaluation, practices and issues of EA evaluation. The Systematic Literature Review (SLR) method has been chosen in order to perform systematic investigation on the practices and method that effect on EA evaluation in order to answer the research questions. The SLR's design represented in Section 3.3.1 and this chapter represent the report of conducted SLR, including: the findings and discussion on defined SLR research questions (Section 3.3.1.1) are discussed in this chapter.

This chapter also discusses the practitioners' perspective on EA implementation evaluation methods, issues and practices. Figure 4.1 outlines all activities in each phase, which will be described in detail in the following sub-sections.

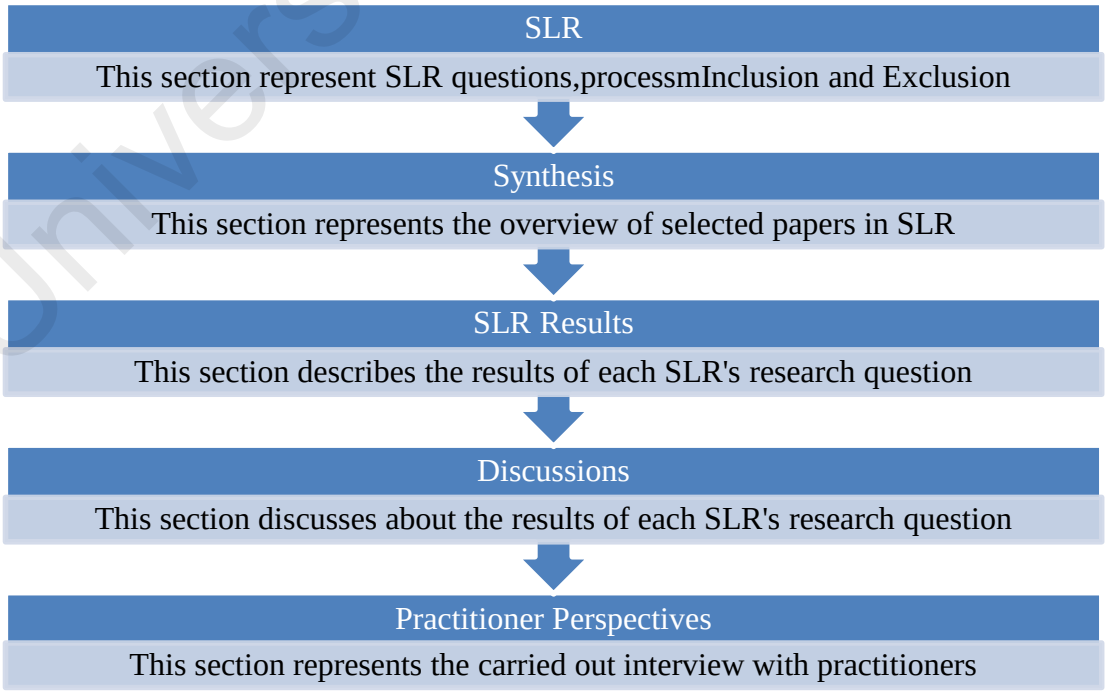

Figure 4.1: Organization of Chapter 4

4.2 Synthesis

Table 4.1 shows the number of papers found per source based on the keyword searches in the selected databases. The second column shows the results of the initial screening of papers found in each source. Each phase represents the number of papers selected after elimination according to the exclusion criteria. The numbers of papers are those selected from each source after the inclusion process. The significant gap between studies found and candidate studies from Google Scholar constitutes papers that were duplicates, short, irrelevant or inappropriate.

Table 4.1: Studies Retrieved Through Search Engines

No.	**Source**	**#Papers**	**Phase 1**	**Phase 2**	**Phase 3**
DB1	Springer Link	43	32	30	14
DB2	IEEE Xplore	35	25	22	8
DB3	Science Direct Elsevier	17	10	10	5
DB4	Taylor and Francis	9	6	5	1
DB5	Google Scholar	314	44	30	8
	Total	**418**	**117**	**97**	**36**

Figure 4.1 shows the number of studies after each defined process. Table 4.1 presents the number of selected studies based on study type. Two papers were eliminated in the re-evaluation section because they did not contain sufficient information in their title or their context was similar to other papers.

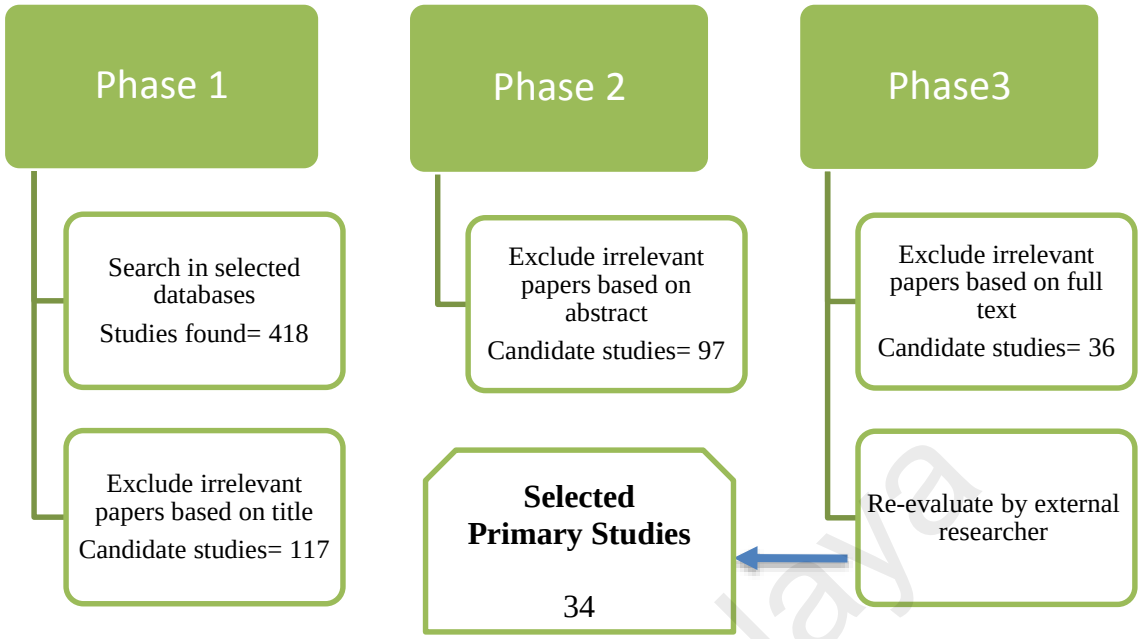

Figure 4.2: Procedure of Finding the Primary Studies

Table 4.2: Numbers of Selected Studies per Study Type

Study	Count	Percentage
Journal Papers	11	32%
Conference Proceedings	12	36%
Book Chapters	11	32%

The conference proceedings, comprising 36% of the total papers selected contribute the most to this study. Book chapters and journal papers stand in second and third places with contributions of 32% each. Figure 4.2 shows the number of primary studies according to publication year. Among 34 studies, 26 were published in the last five years.

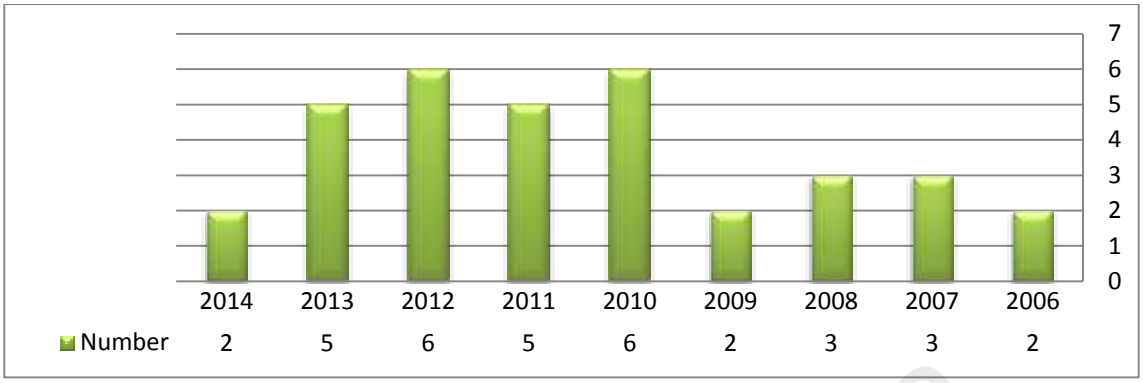

Figure 4.3: Number of Studies by Year of Publication

4.3 SLR Results

Once the primary studies are identified, data can be extracted based on the extraction form defined earlier. The purpose of extracting data from the primary studies selected is to answer the formulated research questions. Thus, in accordance with the meaning of each question and the extraction form, the findings of this SLR are obtained. This section represents the findings and a discussion of this review in order to answer the defined SLR research questions. In addition, a general discussion on the primary studies selected based on the defined data extraction form is expressed. As a result, this section contains findings and a discussion on the SLR research questions.

4.3.1 What Are the Methods for EA Implementation Evaluation?

In order to answer this question, the data collected from the fifth row of the extraction form (Table 3.5) is analyzed. Table 4.3 lists the categorization of the identified methods.

Table 4.3: Numbers of Methods Addressed in Primary Studies

#	Method Categories	Studies Identified	Number of Papers
1	Study with IT management-based evaluation	S16	1
2	Studies that include effectiveness methods	S5,S19,S10,S24	4
3	Studies that focus on metric-based evaluation methods	S9,S8,S6,S7,S22,S30	6
4	Studies that include maturity methods	S23,S20,S18,S31	4

As shown in Table 4.3, four method groups have been extracted from the selected studies, including IT management-based methods, effectiveness methods, metrics-based methods and maturity methods. Metrics methods are addressed most frequently, in 6 selected studies. On the other hand, IT management-based methods are addressed the least, in only 1 selected study. Figure 4.6 shows the frequency methods were addressed in selected primary studies between 2006 and 2014.

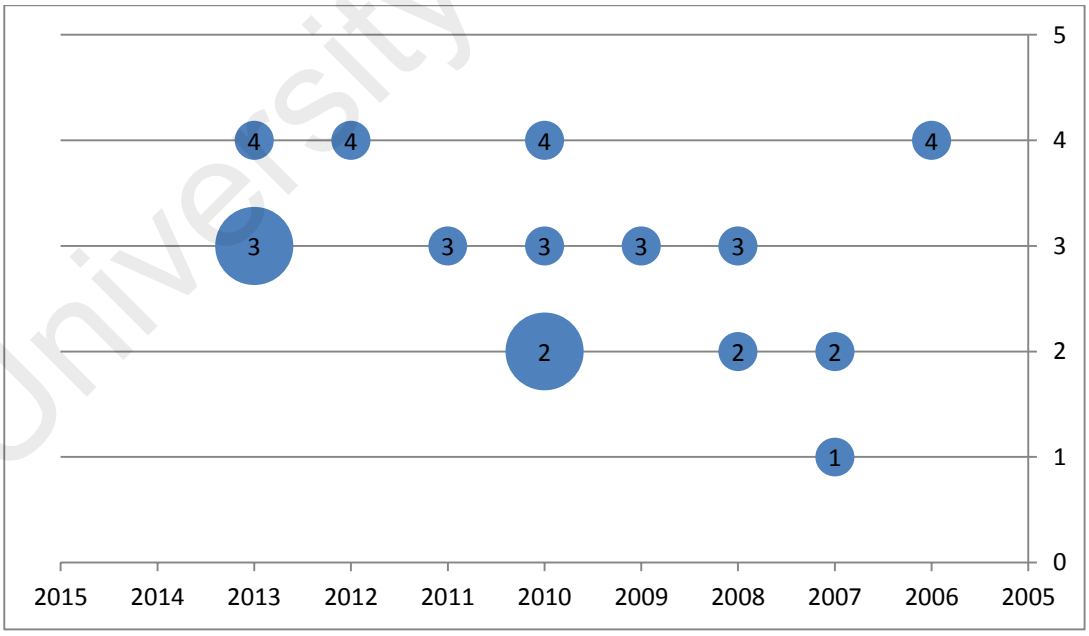

Figure 4.4: Frequency of Methods Addressed

The vertical axis in Fig 4.4 shows the number of methods in accordance with the first column of Table 4.3, and the horizontal axis represents the years of publication. Papers

published in 2010 mostly addressed all identified methods. Selected studies published in 2010 and 2013 addressed 4 and 3 EA evaluation methods, respectively. Besides, in 2014 no paper addressed any method, because this search process was carried out in the middle of 2014 and not all of 2014; moreover, some papers were accepted in 2014 but were not published during the present search process. Metric-based evaluation methods were addressed in 6 selected studies in recent years. This indicates the importance of using metrics in evaluating EA implementation. Moreover, method effectiveness and maturity were covered by four selected studies between 2006 and 2014. On the other hand, IT management is an evaluation method addressed in only one selected study published in 2007.

4.3.2 What Are the Existing Practices of EA Implementation Evaluation?

In order to answer this question, data collected from the sixth row of the extraction form (Table 3.4) are analyzed. Table 4.4 presents the purpose of the identified practices.

Table 4.4: Purpose of Identified EA Evaluation Practices

Practice	Purpose
Business strategy	Is employed to define enterprise business plans by considering the business environment and competitiveness
Alignment	Is employed in order to - ensure the needed IT is used in accordance with the business strategy - support the management in developing and deploying EA
Risk Management	Is employed to: - improve planning processes by enabling the key focus to remain on core business and IT to ensure service delivery continuity - improve efficiency and general performance for desirable outcomes - improve accountability, responsibility, transparency and governance in relation to both decision-making and outcomes.
Maintenance	Is employed for operational consistency while the enterprise continues to evolve the architecture
Integration	Is employed to integrate processes and applications across an enterprise
Continuity	Is employed to identify whether enterprise operations are maintained in spite of system interruptions
Management	Is employed to support EA development and deployment
Architectural Technique	Is employed to define sets of technical requirements into an acceptable

Table 4.4: Continued

Practice	Purpose
	architectural design solution that fulfils the technical requirements for EA implementation
Governance	Is employed to ensure the intended guiding effect of EA on development activities
Planning	Is employed to ensure the initial determination of all processes, goals and visions and to validate whether IT investment meets all technical requirements and business goals
Stakeholder Satisfaction	Is employed to provide input to EA decision-making or to conform to the EA products
Architectural Method	Is employed to check the selection of an EA implementation method

As a result, 12 practices are identified based on data extracted from primary studies. To provide further information relating to the identified practices, the primary studies and identified practices are categorized. In this regard, Table 4.5 shows the numbers of studies based on practices extracted from primary studies.

Table 4.5: Numbers of Primary Studies Addressing the Identified Practices

#	Practices	No. of papers	Papers
1	Defining business strategy	8	S1,S3,S5,S6, S9,S10, S34, S31
2	Architectural method	5	S2,S7,S15,S23, S28
3	Risk management	4	S2,S4,S11,S19
4	Alignment	7	S4,S5,S13,S16,S22,S23,S25
5	Maintenance	5	S4,S10,S23,S29,S32
6	Integration	5	S4,S17,S25,S26,S27
7	Planning	15	S5,S6,S7,S10,S11,S12,S16,S19,S20,S22,S24,S25,S28, S30,S33
8	Governance	8	S9,S10,S11,S15,S16,S19,S22,S25
9	Continuity	2	S19,S34
10	Architectural technique	3	S19,S25,S27
11	Management	9	S19,S20,S23, S24,S25,S28,S31,S32,S34
12	Stakeholder satisfaction	2	S20,S28

Planning is the most frequently addressed practice (15 papers). On the other hand, continuity and stakeholder satisfaction are the least frequently addressed (2 papers).

There are significant differences among the practices addressed in the selected studies. Only one practice (planning) is addressed in more than 10 selected studies and the remaining practices are mentioned in less than 10 studies. Management, defining business strategy and governance, and alignment are addressed by 9, 8 and 7 selected studies, respectively. Besides, 3 practices, including maintenance, integration and identifying an architectural method are addressed by 5 selected studies.

Figure 4.4 shows the frequency with which practices are addressed in the primary studies selected between 2006 and 2014.

Figure 4.5: Frequency of Addressed Practices

The vertical axis of Figure 4.5 shows the number of practices in accordance with the first column of Table 4.9, and the horizontal axis shows the years of publication. Papers published in 2010 mostly address all identified practices. 17, 12, 9 and 9 selected studies published in 2010, 2012, 2007, and 2011, respectively, address practices. Although we carried out the search for this SLR in mid-2014 and not all of 2014, 7 practices were identified that were addressed in the selected studies in 2014. Planning is the practice addressed in 15 selected studies in recent years. This signifies the importance of planning activities in effective EA implementation evaluation. Moreover,

management, governance, business strategy and alignment are addressed in 9, 8, 8 and 7 selected studies, respectively, from 2006 to 2014. On the other hand, continuity is addressed in 2 papers, because it is correlated with another practice or one of the practices has the potential to cover it by technicality and meaning. Planning is the practice addressed in selected studies published in all recent years of the selected period (2007-2014).

4.3.3 What Are the Current Issues with EA Implementation Evaluation?

In order to answer this questions, Table 4.6 lists the current issues or challenges in evaluating EA implementation through the selected studies collected from the seventh row of the data extraction form.

Table 4.6: Number of Papers Addressing the Identified Issues

#	Current Issues	Papers	Number of Papers
1	Lack of patterns for qualitative evaluation	S1,S3,S31	3
2	Focus only on EA delivery function	S1,S31	2
3	Not all aspects of EA implementation are covered	S3,S7,S10,S13,S17,S19,S21,S26,S27	9
4	No proposed structured approach	S2,S7,S21,S22,S28,S31,S33	7
5	Lack of methodologies in EA evaluation	S13,S17,S21,S22,S23,S26,S27,S31	8
6	Lack of considering various perspectives of evaluation	S10,S22,S30	3
7	Existing evaluations are immature in practice	S14,S17	2
8	No evaluation of the technology layer	S1,S27	2
9	Lack of considering decision-making	S2,S6,S7	3
10	Lack of considering alignment in evaluation	S7	1
11	Difficulties in implementation	S4,S5,S7,S17,S19,S23	6
12	No appropriate and holistic metrics	S7	1
13	Time and resource wasting	S4,S5,S6,S7	4
14	Limited understanding of EA evaluation	S11	1

As seen in Table 4.6, "Not all aspects of EA implementation are covered" is the most addressed challenge (9 papers). Meanwhile, "Lack of considering alignment in evaluation," "No appropriate and holistic metrics "and "Limited understanding of EA evaluation" are the least addressed challenges (1 paper). Besides, almost 5 challenges that rank as the top 5 addressed in papers include: " Not all aspects of EA implementation are covered" (9 papers), "Lack of methodologies in EA evaluation" (8 papers), "No proposed structured approach" (7 papers), "Difficulties in implementation" (6 papers) and "Time and resource wasting" (4 papers). Figure 4.8 shows the frequency of issues addressed in the primary studies selected between 2006 and 2014.

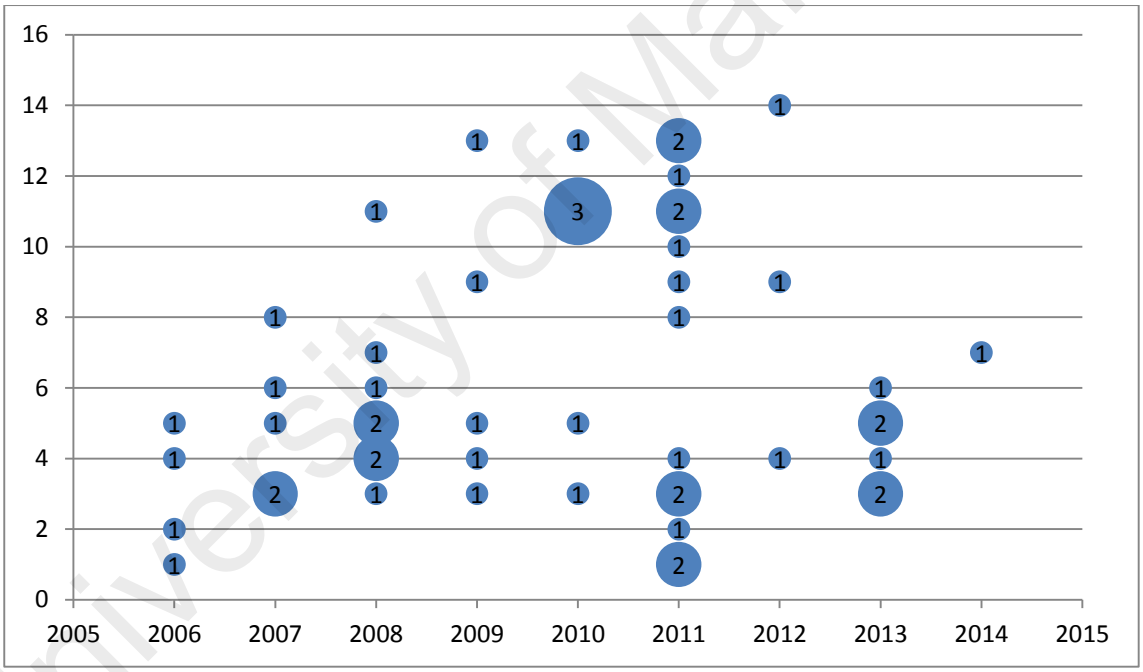

Figure 4.6: Frequency of Issues Addressed in Primary Studies

The vertical axis of Fig 4.6 shows the number of current problems in accordance with the first column of Table 4.10, and the horizontal axis shows the years of publication. Most papers published in 2011 address all identified challenges, while 14, 8 and 6 of the selected studies published in 2011, 2008, and 2013, respectively, address limited understanding of EA evaluation, no evaluation of the technology layer, and lack of considering various perspectives of evaluation challenges. Besides, the reason in

2014 only few challenges were identified is that this search was carried out in the middle of 2014 and not the whole 2014; thus, some papers were accepted in 2014 but were not yet published during this search process. Covering all aspects of EA implementation is a challenge addressed by 9 papers in recent years. This shows the importance of supporting all aspects of EA implementation in effective EA implementation evaluation methods. Moreover, a lack of methodology for evaluating EA, not using a structured approach, and difficulties in implementing and controlling resources are addressed in 8, 7, 6 and 4 of the selected studies, respectively between 2006 and 2014. On the other hand, although not considering alignment and limited understanding are addressed in 1 selected study, these can be regarded as new issues in EA implementation evaluation. A structured approach is a challenge addressed by selected studies published in the last five years of the selection period (2006-2014).

4.4 Quality Assessment

The 34 primary studies were evaluated in terms of the four quality assessment questions listed in section 3.3.1.6. The score assigned to each study for each question is shown in Table 4.8. The row "% total score" shows the percentage of points regarding the total number of points obtained by all selected studies for all Quality Assessment questions. Moreover, the last row "% max QA" corresponds to the percentage of points collected by the values assigned to a given Quality Assessment question over the points that would be collected if every selected study got the highest score. These questions are achieved from Kitchenham guideline(BA Kitchenham, 2007). The primary studies including S1-S7, S10, S11, S13, S16, S17, S20, S22-S26, and S29-S34 obtained the highest score of 4, which represents about 100% of the maximum possible. In contrast, S9, S12, S14, S15, S19, S21, S27 obtained a score of 3.5, which represents 87.5% of the maximum score that one primary study could get. Others obtained a score of 3, or 75%

of the maximum score. We evaluated each study according to the quality assessment questions presented in Table 4.3. The first question (QA1) was answered positively for 93% of the studies. The second question (QA2) was properly addressed and described, and it was answered positively for 99% of the studies. The third question (QA3) was answered positively for 94% of the studies. The last question (QA4) was answered for 96% of studies. Table 4.7 shows the number of quality assessment questions according to the number of studies. For the first question on quality assessment (QA1), 29 studies explicitly describe the challenges with EA evaluation, and 5 studies partially do so.

Table 4.7: Quality Assessment for the Selected Papers

ID	QA1	QA2	QA3	QA4	Total Score	% by Max S
S1	Y	Y	Y	Y	4	100
S2	Y	Y	Y	Y	4	100
S3	Y	Y	Y	Y	4	100
S4	Y	Y	Y	Y	4	100
S5	Y	Y	Y	Y	4	100
S6	Y	Y	Y	Y	4	100
S7	Y	Y	Y	Y	4	100
S8	P	Y	P	Y	3	75
S9	P	Y	Y	Y	3.5	87.5
S10	Y	Y	Y	Y	4	100
S11	Y	Y	Y	Y	4	100
S12	P	Y	Y	Y	3.5	87.5
S13	Y	Y	Y	Y	4	100
S14	Y	Y	P	Y	3.5	87.5
S15	P	Y	Y	Y	3.5	87.5
S16	Y	Y	Y	Y	4	100
S17	Y	Y	Y	Y	4	100
S18	P	Y	P	Y	3	75
S19	Y	Y	Y	P	3.5	87.5
S20	Y	Y	Y	Y	4	100
S21	Y	Y	P	Y	3.5	87.5
S22	Y	Y	Y	Y	4	100
S23	Y	Y	Y	Y	4	100
S24	Y	Y	Y	Y	4	100
S25	Y	Y	Y	Y	4	100
S26	Y	Y	Y	Y	4	100
S27	Y	P	Y	Y	3.5	87.5
S28	Y	Y	Y	N	3	75
S29	Y	Y	Y	Y	4	100
S30	Y	Y	Y	Y	4	100
S31	Y	Y	Y	Y	4	100
S32	Y	Y	Y	Y	4	100
S33	Y	Y	Y	Y	4	100
S34	Y	Y	Y	Y	4	100
Total	31.5	33.5	32	32.5	129.5	
%Total	24%	26%	25%	25%		

Table 4.7: Continued

ID	QA1	QA2	QA3	QA4	Total Score	% by Max S
Score	93%	99%	94%	96%		
% By max QA						

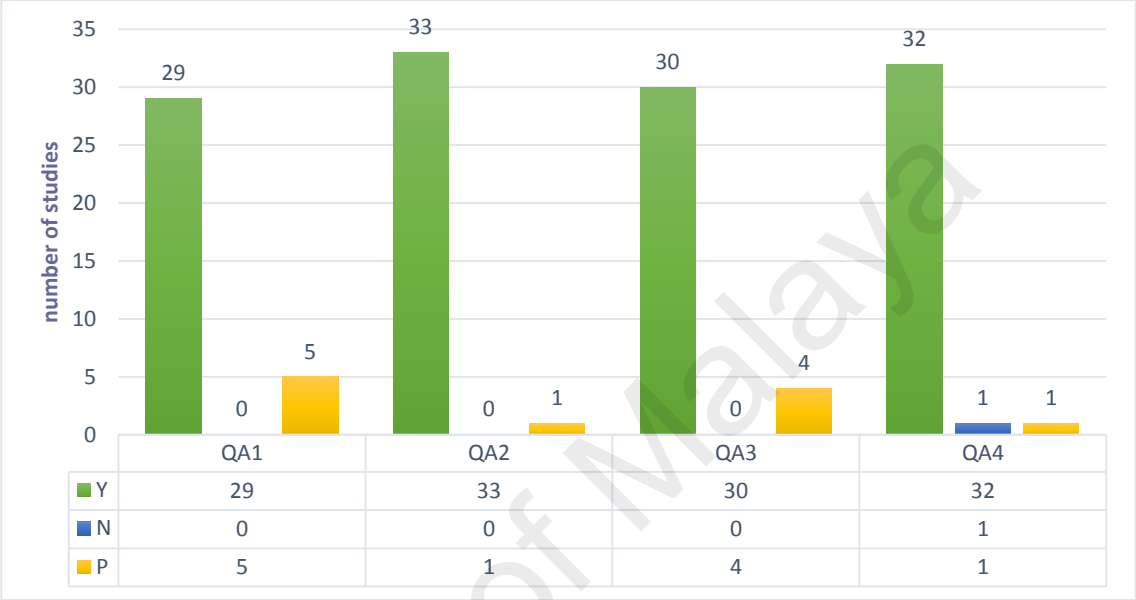

Figure 4.7: Quality Assessment Questions Result

In view of these results, it can be concluded that the quality of research presented by the proposals evaluated is generally good, since all achieved a minimum quality score of 75%.

4.5 Discussion

This section provides three discussions about this SLR: discussions on RQ1, RQ2, and RQ3 thoroughly explain the findings for RQ1, RQ2, and RQ3 respectively. Finally, a general discussion refers to the entire SLR, including conducting the review, overall findings and directions for future work as well as limitations of this SLR.

4.5.1 Discussion on SLR-RQ1

The evaluation provides information for supporting critical organizational and project business and technical decisions. This information is useful in the area of EA development and increasing EA capabilities (Abdulrazak & Malik, 2014; Dillman, 2013). Most studies analyzed gave the impression there are several types of EA evaluation methods concerning different aspects of EA implementation(Fatemeh Nikpay, Ahmad, Rouhani, & Shamshirband, 2016). At higher levels of architecture maturity where the continuous use of EA is supported, specialized EA evaluation is worth implementing and using. At lower maturity levels, the focus should be on stakeholders. IT management-based, metrics-based, effectiveness, and maturity methods are categorized into names of identified evaluation methods based on the selected studies. These methods relate to the evaluation of implemented EA from different perspectives but there is no comprehensive evaluation method. This section expresses some identified methods that introduce the procedure of EA implementation evaluation.

Magnus and Marten (2007) identified three dimensions for an evaluation method, which consist of the IT organization, IT system and business organization. They indicated that existing EA frameworks cannot encompass all EA methods and it is difficult for IT management to control all areas. The responsibility of IT management can be enterprise IT business alignment, IT investment decisions, and IT system quality assessment and improvement. Magnus and Marten's IT management method is a guide for determining EA evaluation and scenarios(Gammelgård et al., 2007). There is neither a structure behind this method for EA implementation evaluation nor a proposed method for application in EA projects.

Bas van der Raadt (2010) proposed an effectiveness method for EA implementation evaluation through an empirical study and investigating EA stakeholder satisfaction and

EA alignment. They presented an EA effectiveness measurement method by proposing a set of quality attributes of an EA function in order to evaluate EA implementation. Alignment and agility are principal components of the mentioned effectiveness method (Van der Raadt et al., 2010). The study focused on the output of EA implementation in terms of agility and alignment but did not present a step-by-step method for implementing evaluation practices.

Rather similar to Vander Raat (2010), Steenbergen and Brinkkemper (2010) introduced an architecture effectiveness method that considers Key Performance Indicators (KPIs) for EA effectiveness. The proposed method has a graphical representation including cause and effect relations. Effects are divided into three types: architectural results, organizational performance effects and business goal effects(Steenbergen & Brinkkemper, 2010) . The range of their study was limited to a business perspective and did not explain EA functions entirely.

Schelp and Stutz (2007) acknowledged that evaluating EA is one of the main issues in the EA area. They proposed an evaluation method based on Kaplan and Norton's Balanced Scorecard (BSC). The BSC perspectives of Schelp and Stutz' (2007) evaluation method contain services, processes, assets and finance. The proposed method is based on the Goal Question Metric (GQM) approach (Schelp & Stutz, 2007). The paper presented a framework for EA performance from a business perspective to solve governance challenges.

Pruijt et al. (2012) developed the Enterprise Architecture Realization Scorecard (EARS), which is aimed at improving EA effectiveness measurement. EARS uses five EA activities: define vision, develop sub-architectures, plan migration, supervise implementation projects and exploit the architecture in operation. Moreover, it argued that the results of these activities should be scored based on three aspects: product,

acceptance and scope (L Pruijt, Slot, Plessius, & Brinkkemper, 2013; Leo Pruijt et al., 2012). Their research focused on EA management function. Moreover, the most wide-spread approaches were maturity methods. They primarily addressed the EA and development process but not the evaluation of architectural decisions and solutions concerning the achievement of enterprise goals.

In general, although there are several methods for evaluating EA implementation, EA implementation suffers from a lack of comprehensive methods that support whole aspects of implemented EA artefacts. Planning, modeling, managing, maintenance and governance are major aspects of EA implementation, which require appropriate and effective methods to facilitate the progress of evaluation. Current EA projects handle evaluation by utilizing several types of evaluation for each project aspect, which makes projects more complex.

4.5.2 Discussion on SLR-RQ2

This section represents a discussion on the findings for RQ2. First, the significant points of the primary studies selected that relate to EA evaluation practices are discussed, and second, the identified practices are categorized based on meanings and purposes.

EA projects mostly start with understanding the business requirement of the enterprise, after which the enterprise architects seek to find appropriate IT artefacts in order to prepare the business requirements based on the capability of the enterprise. In this regard, business strategy and risk management are employed in the first part of the project to provide an appropriate foundation for the remainder of EA activities. In the evaluation, understanding the foundation of EA implementation is very important.

Therefore, the business strategy, planning and risk management are considered practices that need to be employed before other practices.

Management, integration, alignment, architectural methods and architectural techniques are practices related to controlling the developed EA artefacts. These practices are employed within the evaluation in order to evaluate the EA artefacts developed including ISs and to check the required interconnectivity. Maintenance, continuity, governance and stakeholder satisfaction are practices used for the continual improvement of the developed EA artefacts based on the latest changes.

The identified practices can be classified into three categories: practices employed to evaluate the initiation of implemented EA artefacts, practices employed to evaluate the management of and conducting EA artefact development, and practices employed to evaluate the control of future changes to the developed EA artefacts. Figure 4.8 lists the identified practices after considering the aforementioned categories.

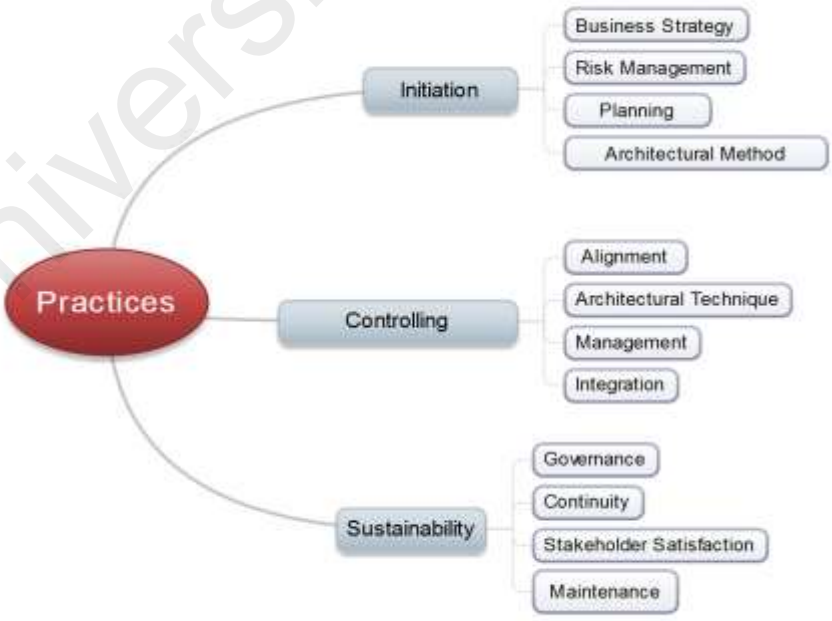

Figure 4.8: Categories of Practices

Current evaluation methods focus on evaluating the achievement of predefined EA implementation goals(M Lange et al., 2015; Matthias Lange & Jan Mendling, 2011), with the main focus of the reviewed studies being on certain types of effective evaluation practices, especially initiation. Moreover, stakeholder satisfaction is mostly neglected, while continuity and architectural techniques are addressed in few of the selected studies. Although several practices are addressed in the selected studies, most studies highlight planning and management more. Besides, using alignment for architectural design and development is the practice that needs more elaboration in the evaluation process.

4.5.3 Discussion on SLR-RQ3

This section highlights the current issues with EA evaluation, which are addressed or mentioned in the selected primary studies. In this regard, similarities between the mentioned problems are first identified, and second, current issues with existing EA evaluation methods are discussed in more detail. The scope of EA evaluation may contain the baseline "as-is" architecture, the target "to-be" architecture and the EA roadmap. The evaluation stresses on evolution from the baseline to the target architecture. Many enterprises intend to investigate what value they will gain from developing an EA, so effectiveness plays an important role in EA implementation where the indented EA goals are achieved (Raadt & Vliet, 2008; Sembiring et al., 2011a). There is a lack of methodologies or frameworks for enabling EA evaluation by considering the entire EA; moreover, evaluating EA is rather challenging because there seems to be no coherent view on EA. EA evaluation methods typically concentrate on EA results and there are insufficient methods/evaluation frameworks for the whole EA (Henk Plessius et al., 2012; Sobczak, 2013), and in most cases, they do not contain all EA function elements. Besides, most existing EA evaluation methods particularly

concentrate on one aspect of EA implementation, such as financial benefits. Moreover, there are complexities in achieving a comprehensive method or evaluation framework for EA implementation. There is a dearth of structured methods for EA evaluation. Investigations on existing evaluation frameworks for EA implementation show they are mostly inconsistent and disunity is currently the highest characteristic in this area. Some existing evaluation methods are utilized through multiple practical EA implementation projects and there is no appropriate theoretical and scientific foundation behind them. Moreover, there is no integral evaluation approach that covers all processes comprehensively. Figure 4.9 shows the percentage of each current issues based on each selected study.

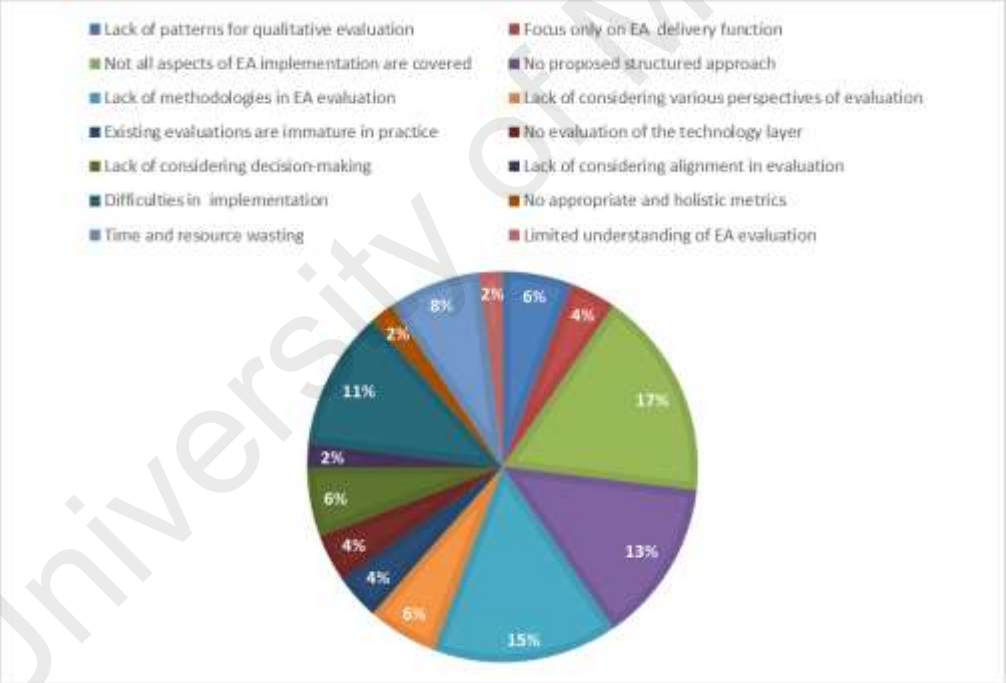

Figure 4.9: Percentages of Issues based on Selected Studies

There are some meaningful relations between current issues identified in EA implementation evaluation. A number of selected papers, such as S3, S7, S10, S13 and S17 define existing EA evaluation but do not cover all aspects of EA implementation. Current EA evaluation methods focus on business and IT alignment or architecture maturity. They cover other challenges, including: lack of patterns for qualitative

evaluation, focus only on the delivery function, lack of considering various perspectives of evaluation, do not evaluate the technology layer, lack of considering decision-making, and lack of considering alignment in the evaluation; thus, there is potential to combine these six challenges under "not covering all aspects of EA implementation." According to S2, S7, S21, S22 and S28 there is a lack of structural foundation behind existing EA evaluation methods. A structured evaluation method should provide a set of methods and activities to evaluate EA implementation step by step. This challenge can cover and contain "lack of methodologies in EA evaluation" and "existing evaluations are immature in practice." Thus, these two challenges can be combined into "structured methods." S4, S5, S7, S17, S19 and S23 highlight some difficulties with EA implementation evaluation. These difficulties are rooted in guidelines, learning, metrics and resources. Therefore, "no appropriate and holistic metrics," "time and resource wasting" and "limited understanding of EA evaluation" are related to "difficulties in EA evaluation." Figure 4.10 indicates the mentioned classification.

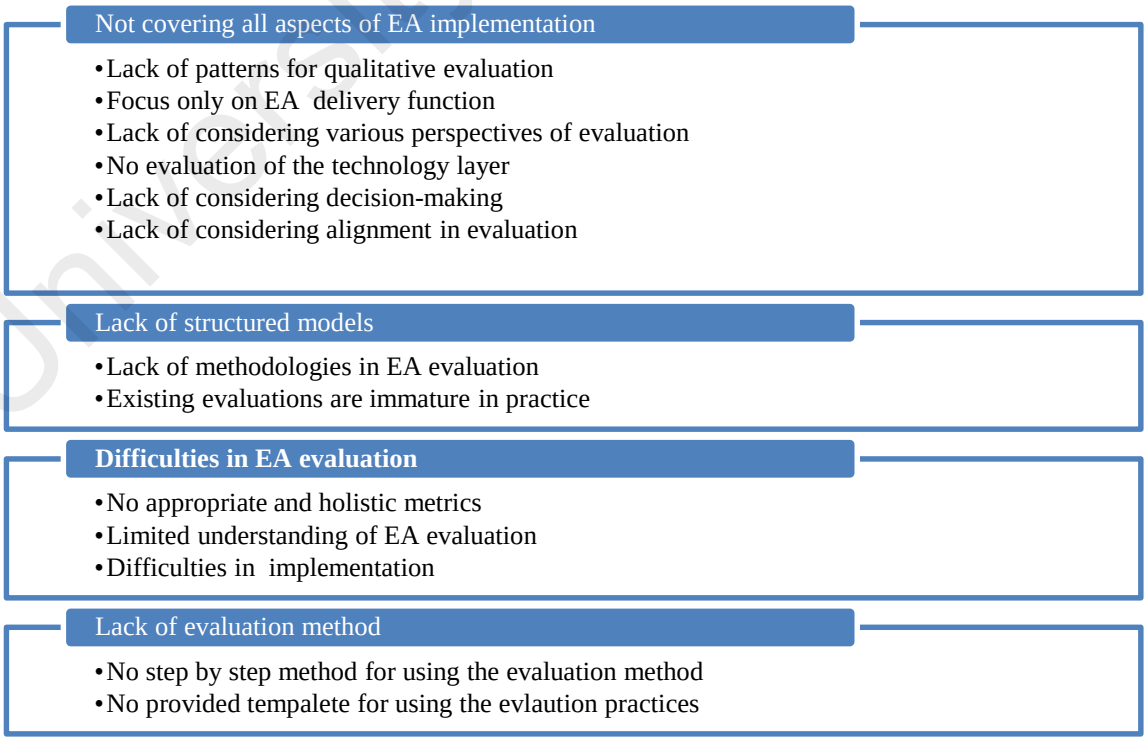

Figure 4.10: Current Classification of Issues based on Concept

The results indicate that the main concern with the current evaluation methods is fulfilling the EA evaluation domain in order to cover all aspects of EA, and the main focus of the reviewed studies is on certain types of quality factors, especially effectiveness. Alignment, metrics and understanding EA are mostly neglected and only three problems are addressed by less than half of our selected studies. Although several problems are identified in the selected studies, which cover all aspects of EA, using structured methods, considering the technology layer and alignment are significant issues that should be employed in evaluation methods.

4.6 Practitioners' Perspectives

This section expresses the unstructured interview with practitioners in order to understand current situation of EA evaluation based on practical point of views. Appendix F shows summary of the interviews with some expert people with banking experience and presenters of TOGAF conference that carried out on August 2014, at Cyberjaya, Malaysia.

Furthermore, additional interviews have been conducted from Maybank's EA department. This department responsible to manage and control the requirement of all IT and business project inside the Bank. The main activity of this department is to advise and consult the project team members in order to provide appropriate information system for the project stakeholder. Appendix G represents the summary of unstructured interview of departments of EA.

All practitioners highlight alignment, architectural tool, management, governance, continuity, integration and maintenance which already achieved in SLR results, however there are some practices such as adaptability management, project prioritization, support which mention by some practitioners.

There are meaningful relation among those practices which mention by practitioners and identify practices from SLR and majority of practitioners, therefor this thesis use comprehensive meaning of selected practices for using in the proposed method in order to cover more related concepts.

4.7 Summary

This chapter represented the results and discussion of SLR on EA evaluation implementation and carried out interview with practitioners in order to identify the issues practices and methods of EA evaluation. Selected papers in accordance with designed selection processes were analyzed and finding of each SLR research question was presented.in the next chapter the proposed method will be investigated.

CHAPTER 5: PROPOSE A POST IMPLEMENTATION EVALUATION METHOD FOR ENTERPRISE ARCHITECTURE

5.1 Overview

This chapter describes the proposed Post-Implementation Method for the Evaluation of Enterprise Architecture (PEAR). In this regard, this chapter is divided into the following sub-sections: concepts and principles; components; and management plan. For each mentioned sub-section the required information are stated. Figure 5.1 depicts the overall structure of the Chapter 5.

The practices that have been described in the Chapters 4 (section 4.3.2), along with the semi-structure interview with EA practitioners (section 4.6) have been used to develop the proposed Method. To do this, the identified practices are the basis of the method's activities. Figure 5.1 delineate the explanation of the proposed method.

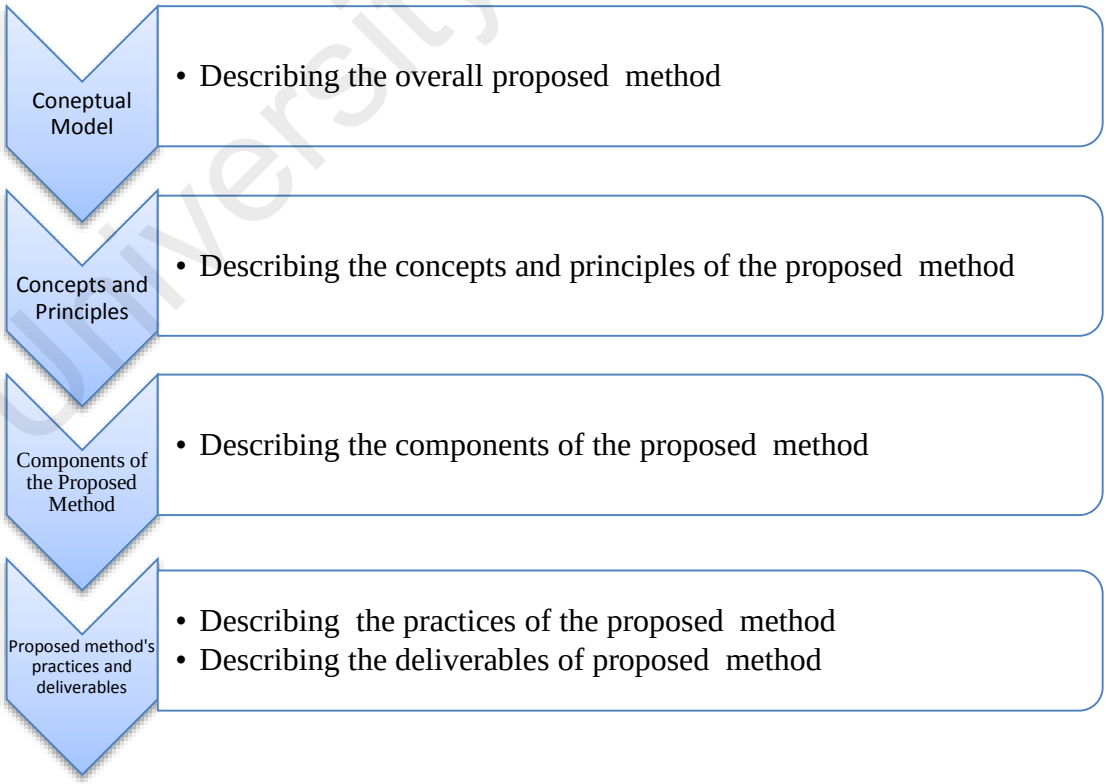

Figure 5.1: Structure of Chapter 5

5.2 The Proposed Method

This proposed method is intended to evaluate the objectives, products and the outcome of the EA implementation that usually has been implemented by organizations. The evaluation of the process of the implemented EA project is important because it enables the organization to make sense and understand the outcome of the EA project and to be able to improve it to ensure that the overall objectives will be achieved. Performing or implementing EA project incur huge resources and cost. Hence, having an effective way to evaluate the outcome and achievement of the implemented project will be a massive benefit to ensure that the EA can be improved further and also to reap full benefits from the EA projects. In this context that this thesis intend to fill up the gap by proposing an evaluation method that is based on solid theory and practices which can be performed by organization after their EA implementation project.

The fundamental process of the proposed method is a combination of the Information Systems (ISs) evaluation theory (Dwivedi, Wade, & Schneberger, 2011; Vasilecas et al., 2015), design science in the ISs theory (Alan et al., 2004)and Program Theory(Stewart I. Donaldson, 2012; Funnell & Rogers, 2011). The concepts and principles of the proposed method are from the ISs evaluation theory. At the same time, the components of proposed method are based on program theory. The means used to develop the proposed method is based on design science research. This thesis is intended to deliver practices as a basic component of evaluation. In short, since, this thesis is dealing with a development of a method for evaluating the post-implemented EA and covering the unaddressed problems of the effectiveness and the functionality of EA evaluation, this thesis can be considered as a case for a design science research because the process of building the method is an iterative process of applying, getting feedback, enhancing and re-applying until the method is logically to be acceptable.

The proposed method was developed using the practices identified from the Systematic Literature Review (SLR) and interview sessions conducted with EA practitioners. Moreover, to make the proposed method more effective and appropriate, we obtained EA experts' points of view on the proposed method practices and procedures during the method development.

In this regard, we get feedback from three EA experts to be able to refine the existing practices and procedures. There are some modifications based on the experts' comments on naming the practices and components. The experts also suggested providing a sufficient metric scale for the proposed method. All comments were applied to the current method. Table 5.1 shows the essential practices that have derived from the performed SLR and Interview with practitioners.

Table 5.1: Derived Practices from SLR and interview

Practice	Description	SLR/Interview
Business strategy	Is employed to define enterprise business plans by considering the business environment and competitiveness	SLR- Interview
Alignment	Is employed in order to ensure the needed IT is used in accordance with the business strategy and support the management in developing and deploying EA	SLR
Risk Management	Is employed to improve planning processes by enabling the key focus to remain on core business and IT to ensure service delivery continuity and to improve efficiency and general performance for desirable outcomes.	SLR
Maintenance	Is employed for operational consistency while the enterprise continues to evolve the architecture	SLR- Interview
Integration	Is employed to integrate processes and applications across an enterprise	SLR - Interview
Continuity	Is employed to identify whether enterprise operations are maintained in spite of system interruptions	SLR
Management	Is employed to support EA development and deployment	SLR
Architectural Technique	Is employed to define sets of technical requirements into an acceptable architectural design solution that fulfils the technical requirements for EA implementation	Interview
Governance	Is employed to ensure the intended guiding effect of EA on development activities	SLR- Interview
Planning	Is employed to ensure the initial determination of all processes,	SLR

Table 5.1: Continued

Practice	Description	SLR/Interview
	goals and visions and to validate whether IT investment meets all technical requirements and business goals	
Stakeholder Satisfaction	Is employed to provide input to EA decision-making or to conform to the EA products	SLR
Architectural Method	Is employed to check the selection of an EA implementation method	Interview

Figure 5.2 illustrates the component model of the proposed method. This method is intended to evaluate the objectives and the products of EA implementation projects. By doing this, an enterprise will be able to understand the achievement of the defined EA objectives and EA implementation deliverables. In order to generate comprehensive and in-depth results, evaluators may always apply a method that mixes two criteria in practice. The method contains three main components: input, process, and output.

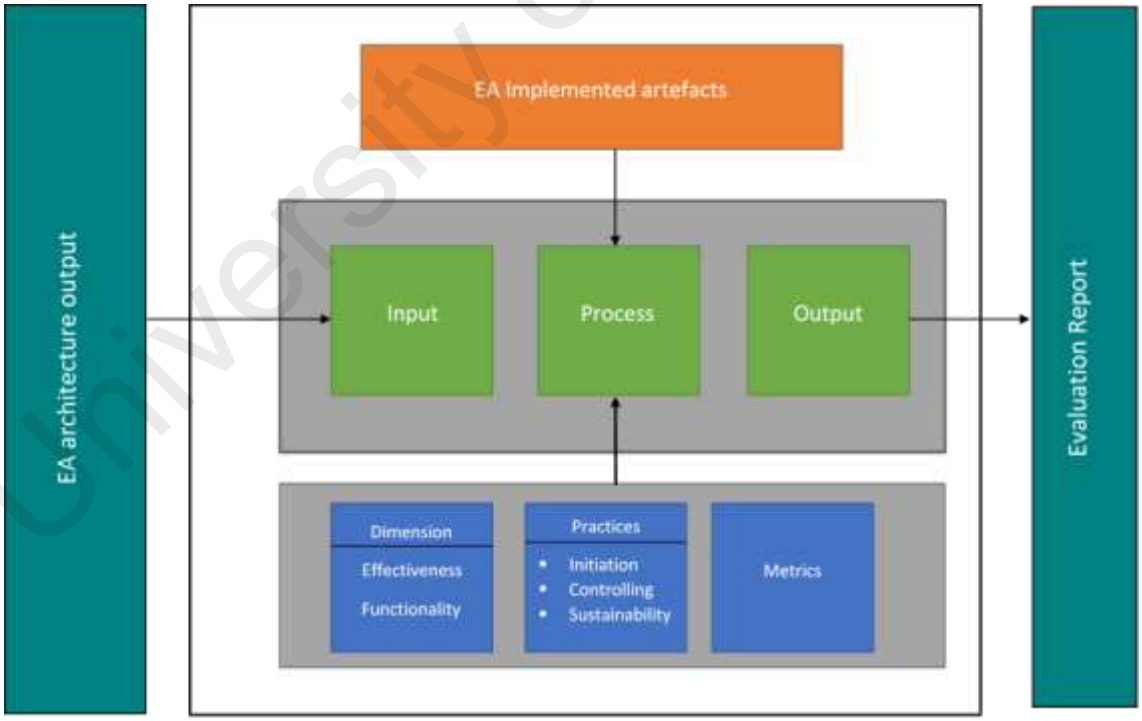

Figure 5.2: The Proposed Method

The purposes of the proposed method's components are as follows:

- *Input* refers to the developed EA artefacts, which are considered the output of an EA implementation project
- *Process* refers to the conducting and developing the evaluation of EA implementation by means of practices.
- *Output* refers to the deliverables of this proposed EA evaluation method

5.3 Key Concepts of the Proposed Method

This section describes the technical and general concepts that are used in the proposed method. The key purpose of this section is to providing appropriate definition of concepts that have been used. Table 5.2 represent the definition of used concepts in the proposed method.

Table 5.2: Definition of Used Concepts

Concept	Definition
Practice	The *practice* refers to the set of activities and processes for developing and applying a consistent set of rules and models to guide the design and implementation of processes, organizational structure, information flow, and technical infrastructure within an enterprise(Bente et al., 2012; Bernard, 2012) .
Architect	The *Architect* is a person whose responsibility is the design of the architecture and the creation of an architectural description(Bernard, 2012).
Architectural artefact	The *Architectural artefact* is a specific document, report, analysis, model, or other tangible asset that contributes to an architectural description(Bernard, 2012; Kotusev et al., 2015; Niemi & Pekkola, 2015).
Architectural description	The *Architectural description* is a collection of artefacts in order to document the architecture (Bernard, 2012; Kotusev et al., 2015).
Framework	The *framework* is a skeletal structure that defines suggested architectural artefacts, describes how those artefacts are related to one another, and provides generic definitions for what those artefacts might look like.

Concept	Definition
Process	The *process* is a defined series of actions directed to the goal of producing either an architecture or an architectural description (Bernard, 2012) .
Architecture	The *Architecture* is the fundamental organization of a system embodied in its components and their relationships to one another, the environment, and the principles guiding its design and evolution(Bernard, 2012).
Enterprise Architecture	The *Enterprise architecture* is an architecture in which the system in question is the whole enterprise, especially the business processes, technologies, and information systems on the enterprise.
Deliverable	A *deliverable* is a work product that is contractually specified and in turn formally reviewed, agreed, and signed off by the stakeholders. Deliverables represent the output of projects and those deliverables that are in documentation for m will typically be archived at completion of a project, or transitioned into an Architecture Repository as a reference model, standard, or snapshot of the Architecture Landscape at a point in time(Bernard, 2012).
EA Evaluation	Evaluation is defined as a form of "disciplined inquiry," which "applies scientific procedures to the collection and analysis of information about the content, structure and outcomes of programs, projects and planned interventions." (Vasconcelos et al., 2015; Walton, 2014).
Functionality of EA implementation	Functionality of enterprise architecture explains how all information technology elements in an organisation – systems, processes, organisations, and people – work together as a whole (Azevedo et al., 2015; Chorafas, 2016).
Effectiveness of EA implementation	Effectiveness is defined as the degree to which the objectives (i.e. the purpose of organizational performance improvement) that organizations have set with EA are being attained (Stephan Aier, 2014; Morganwalp & Sage, 2015; L Pruijt et al., 2013).
EA artefacts	The Architectural artefact is a specific document, report, analysis, model, or other tangible asset that contributes to an architectural description. An artefact is an architectural work product that describes an aspect of the architecture. Artefacts are generally classified as catalogues (lists of things), matrices (showing relationships between things), and diagrams (pictures of things)(Bernard, 2012; Schekkerman, 2004; Zachman, 1996).
Metrics	A standard of measurement, especially one that evaluates a complex process or system(Bernard, 2012; DeLone & McLean, 2016)
Method	A systematic Steps involved that could apply specific technique/algorithms to complete tasks to reach certain objective (Baskerville & Wood-Harper, 2016; Phillips & Phillips, 2016).

5.4 Architectural levels

One of main roles of EA implementation is to describe the architectural levels of an enterprise. According to Zachman (1992), architectural levels should take into account four aspects of an enterprise, including business, data, application, and infrastructure. The proposed method contains these four architecture levels as follows:

- ***Business Architecture*** depicts the business dimensions (business processes, service structure, and organization of activities) (Bernard, 2012; Ronald E. Giachetti, 2012; M.-E. Iacob, Quartel, & Jonkers, 2012).
- ***Data Architecture*** captures the EA information dimension, high-level structures of business information, and at a more detailed level, the data architecture (Bernard, 2012; Holm, Buschle, Lagerström, & Ekstedt, 2014; Lakhdiss & Bounabat, 2012) .
- ***System Architecture (application architecture)*** contains the system dimensions, or the ISs of the enterprise. In some conventions it is called Applications Architecture or Portfolio, the latter stressing the nature of ISs as a business asset(Bernard, 2012; Matthias Lange & Jan Mendling, 2011) .
- ***Technology Architecture*** covers the technologies and technological structures used to build information and communication systems in enterprises (Bernard, 2012; Närman, Holm, & Höök, 2012; Quartel, Steen, & Lankhorst, 2012).

5.5 Detail description of each component of the Proposed Method

5.5.1 Input Component

This section provides the specification of the input as a first component of the proposed method. In short, the resulting outputs of EA implementation architectural levels or things that have been produced from EA projects are considered as the inputs

of this proposed EA evaluation method. The EA project outputs were derived from the architecture layers comprising business, data, application and technology architecture. This input component provides appropriate categorizations for applying the evaluation practices. The evaluator may consider most of inputs of EA projects during the application of this proposed method's practices. In essence, the evaluator will assess answer the effectiveness and functionality of each practice based on the inputs which are available from the EA projects.

Table 5.3 represents the categorization of EA project outputs based on the Enterprise Architecture Realization Scorecard (EARS) model (L Pruijt et al., 2013; Leo Pruijt et al., 2012). The listed outputs can be considered as the main input that can be used when applying this proposed method. EARS offers an architecture development cycle that covers all lifecycle aspects required in EA evaluation.

Table 5.3: Categories of EA Outputs which can be used as Input

Input Items For the method	Description
Architecture vision	Having EA goals within the architecture iteration scope to develop a high-level, integrated and approved solution direction towards matching these goals and creating a concise plan to realize them.
Architecture design	Defining sets of technical requirements into an acceptable architectural design solution that fulfils the technical requirements for EA implementation.
Migration plan	Providing an appropriate implementation and migration strategy, relationship to target architecture and any transition architecture and architecture requirements specification
Governance plan	Essentially about ensuring that the business and IT strategy is conducted properly. It is also about overt control and strict adherence to rules, guidelines, and effective and equitable usage of resources to ensure the sustainability of an organization's strategic objectives.
Continual improvement plan	The Enterprise Architecture defines the components that comprise the enterprise system and their interrelationships, and the principles and guidelines governing the design and evolution. It provides the thinking tool to understand, validate and verify the relevance, usability and continual improvement of the strategy, systems and technology of the enterprise. This plan entails the implementation and continual improvement of the enterprise's architecture that aligns people, processes, information, technology and culture towards achieving the organizational performance goals.

As mentioned in Table 5.3, the proposed method entails five main input items, which were derived from the EA implementation outputs.

5.5.2 Process Component

The proposed method contains two criteria for evaluating EA implementation, namely functionality and effectiveness which actually have been identified from the unaddressed problems discussed in section 5.2. Functionality and effectiveness are the proposed method dimensions which are based on (Rouhani et al., 2015; Brosius et al., 2016), whose features are used as the basis for the evaluation practices.

5.5.2.1 Evaluation Practices

This section describes the proposed method practices in details. The following activities are done for each practice. Evaluation has to be performed on the implemented practice looking at the objective, its functionality and its effectiveness.

- Evaluating the Objective of the practice
- Evaluating the Functionality of the practice
- Evaluating the Effectiveness of the practice

The proposed method employs the evaluation practices identified from the SLR and interviews with practitioners. Figure 5.3 illustrates the proposed method's structure of the process component. To make the practices more usable, the practices are divided into the initiation, controlling and sustainability groups. Suitable metrics for each practice are derived from papers in literature review after revision (Brosius et al., 2016; Buschle et al., 2013; Gama et al., 2013; M.-E. Iacob et al., 2012; Matthias Lange et al.,

2015; Montilva et al., 2014; Per Närman et al., 2014; Van der Raadt et al., 2010; Zarvić & Wieringa, 2014)

- ***Initiation***, which refers to preparing the enterprise to begin EA implementation.
- ***Controlling***, which refers to conducting and developing the EA implementation within the enterprise.
- ***Sustainability***, which refers to controlling and governing the EA implementation and taking appropriate action to cope with future changes.

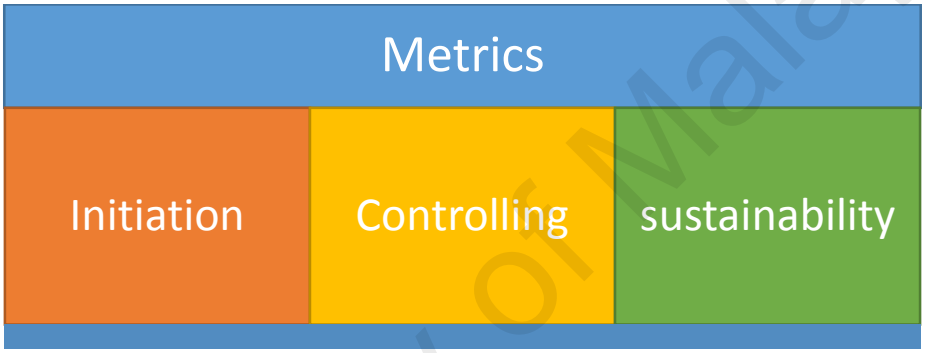

Figure 5.3: Structure of the Process Component

(a) **Initiation**

This section regards the evaluation practices related to the initiation of EA implementation. There are four identified practices, including business strategy, risk management, initiation, and EA framework. Table 5.4 represents the specifications of these practices.

Table 5.4: Specifications of Initiation's Practices

Practice	Specifications	
Business strategy	Objective	• To assess the business strategy in accordance with the business trend of the enterprise. • To develop a strategy that gives a coherent view of the enterprise business strategy.
	Functionality metrics	• Does the development of EA artefacts supported by the business strategy? • Is the business strategy sufficient for defining the EA objectives? • Does the business strategy support the implementation of the EA artefacts? • Does the business strategy cover all aspects of the enterprise's business?
	Effectiveness metrics	• Does the business strategy support the achievement of the EA objectives? • Is the business strategy based on the enterprise target? • Does the business strategy provide the business requirements for EA implementation? • Does the business strategy explicitly provide the scope of the business requirements?
Risk management	Objective	• To assess the risk management practices • To monitor the risk management processes • To prioritize risks for subsequent further analysis • To track identified risks, monitor residual risks and identify new risks, execute risk response plans, and evaluate their effectiveness throughout the project lifecycle
	Functionality metrics	• Does EA implementation control the risk of developing EA artefacts in terms of end user acceptance? • Does EA implementation control the risk of developing EA artefacts in terms of system integration? • Does EA implementation control the risk of developing EA artefacts in terms of external aspects? • Does EA implementation control the risk of developing EA artefacts in terms of organization culture?
	Effectiveness metrics	• Is risk management developed based on supporting the EA objectives? • Does risk management provide an appropriate environment for EA implementation? • Does risk management cover the EA implementation practices? • Does risk management support the alignment of business and IT?

Practice	Specifications	
Planning	Objective	• To assess the quality of the process for EA implementation • To identify gaps between the baseline and target states and recommend a sequencing plan to bridge the gaps
	Functionality metrics	• Does planning of EA implementation provide appropriate information regarding business and IT requirements? • Is the enterprise vision developed based on the enterprise's business strategy and business analysis? • Does the EA implementation project team members include both business and IT experts?
	Effectiveness metrics	• Does the enterprise vision include reachable EA objectives based on the enterprise's business and IT capability? • Is the EA implementation project based on top management commitment? • Are the EA objectives defined based on optimized business and IT requirements?
Architectural method	Objective	• To assess the appropriateness of the implemented EA method • To define the EA implementation procedure • To define the EA implementation structure • To utilize methods for developing appropriate ISs and IT infrastructure for the enterprise
	Functionality metrics	• Was the EA implementation method selected based on its capabilities in EA implementation? • Does the EA implementation method consider the integration of EA artefacts? • Does the EA implementation method provide an adaptation plan for the enterprise? • Does the EA implementation method provide an appropriate transition plan?
	Effectiveness metrics	• Does the EA implementation method provide step-by-step guidelines for EA implementation? • Does the EA implementation method support the definition of EA objectives? • Does the EA implementation method have capabilities for implementation? • Does the EA implementation method provide value for the enterprise?

(b) **Controlling**

This section focuses on the evaluation practices related to EA implementation management. There are four identified practices, including alignment, technology function, management and stakeholder satisfaction. Table 5.5 represents the specifications of these practices.

Table 5.5: Specifications of Controlling's Practices

Practice	Specifications	
Alignment	Objective	• To assess the quality process of business and IT alignment. • To define the process of aligning business with IT in an enterprise • To describe the condition of IS/IT being in harmony with the business needs • To define the compatibility between business and IT
	Functionality metrics	• Does the EA implementation consider business and IT at the same level? • Does the EA implementation cover the alignment between business and IT of the enterprise? • Does the EA implementation provide the requirements of business and IT? • Do EA artefacts respond to the requirements of business based on IT capabilities?
	Effectiveness metrics	• Are the EA objectives defined based on the business strategy and IT capabilities of the enterprise? • Does the EA implementation apply the business and IT requirements in developing the EA artefacts?
Architectural tools	Objective	• To create a prevalent taxonomy for the definitions of solutions within an enterprise
	Functionality metrics	• Does the EA implementation develop the target data architecture? • Does the EA implementation develop the target application architecture? • Does the EA implementation develop the target infrastructure architecture? • Does the EA implementation develop the target business architecture?
	Effectiveness metrics	• Do the technical aspects of EA implementation support the EA objectives? • Do the technical aspects of EA implementation provide value for the enterprise?

Practice	Specifications	
Management	Objective	• To assess the management process of implementation • To define the management practices/process in order to manage the implementation • To provide an appropriate foundation and information for developing, managing, implementing, and maintaining the EA • To reduce the risk of the EA project • To provide resources and power for successful implementation • To define a process to execute the project plan and coordination in all implementation phases
	Functionality metrics	• Does the EA implementation develop appropriate information systems in response to the business requirements? • Does the EA implementation develop information systems based on the to-be architecture? • Does the EA implementation provide appropriate practices for the deployment of EA artefacts? • Does the EA implementation provide an integration plan for developing EA artefacts?
	Effectiveness metrics	• Do the integrated information systems support the EA objectives? • Does the EA implementation use practices that have the capability to develop the EA artefacts?
Stakeholder satisfaction	Objective	• To assess the EA function and artefacts based on the EA objectives
	Functionality metrics	• Does the EA implementation cover stakeholder decisions?
	Effectiveness metrics	• Does the EA implementation satisfy the stakeholders?

(c) **Sustainability**

This section addresses the evaluation practices related to the maintenance of EA implementation. There are four evaluation practices, including governance, continuity, integration, and maintenance. Table 5.6 represents the specifications of these practices.

Table 5.6: Specifications of Sustainability's Practices

Practice	Specifications	
Governance	Objective	• To define the governance policies • To monitor the method of reducing the risk of failure with EA implementation • To define guidelines to guarantee the consistency and timeliness of the EA implementation process • To ensure that all stakeholders cooperate in the main phase of EA implementation
	Functionality metrics	• Does the EA implementation provide an appropriate governance plan? • Does the EA implementation monitor the implementation practices? • Does the EA implementation define the governance policies? • Does the EA implementation provide an adaptability plan for the enterprise?
	Effectiveness metrics	• Does the provided governance plan support the EA objectives? • Does the provided governance plan add value to the enterprise?
Continuity	Objective	• To ensure that the business and IT process can continue to deliver its objectives in the event things go wrong
	Functionality metrics	• Does the EA implementation have an updated repository with the latest EA artefacts? • Does the EA implementation provide an iterative approach for implementing EA artefacts? • Does the EA implementation provide appropriate requirement management to support future changes? • Does the EA implementation provide direction to support future changes and requirements?
	Effectiveness metrics	• Are the required changes supported by the EA implementation? • Can the enterprise become more flexible?
Integration	Objective	• To define a plan for disparate applications to be effective and provide a holistic view of an organization's systems • To promote the management of integration at the business process level and allow for real-time and historical analysis of business conditions and performance
		• Does the EA implementation provide an appropriate plan for integration? • Can the developed EA artefacts respond to the

Practice	Specifications	
	Functionality metrics	business strategy? • Do the target architectures support each other? • Do the provided integrated applications use the appropriate technology to support competitiveness of the enterprise?
	Effectiveness metrics	• Does the enterprise have a dynamic environment for future changes? • Does the integration plan support the EA objectives?
Maintenance	Objectives	• To address tensions between the continuum of operations and the introduction of changes or new systems • To control and govern the EA implementation and take appropriate actions in order to cope with future changes
	Functionality metrics	• Does the EA implementation provide a change management plan? • Is an appropriate organizational chart provided based on the EA implementation? • Is the transition plan applied appropriately? • Do non-functional requirements apply?
	Effectiveness metrics	• Did the enterprise achieve the EA objectives? • Can the enterprise respond to the business requirements?

5.5.2.2 Evaluation Procedure

This section describes the process component procedure based on the selected evaluation criteria. The proposed method uses the score for each defined metric of the aforementioned practices according to the selected criteria. The following steps provide guidelines on the application of the proposed evaluation method:

- The evaluation should be carried out based on the available inputs
- For each input, only relevant practices should be evaluated
- For each practice, there are two sets of possible metrics to be used which are effectiveness and functionality

- For each practice's metric, there are five criteria with corresponding weightage scores
- The enterprise architect is recommended to be the evaluator based on his knowledge on the enterprise EA implementation project.
- Table 5.7 provides the description for the score.
- For each practice, the main score considered is the average of all the scores
- The outcome of the evaluation process will provide the cumulative score for the two dimensions which are the functionality and the effectiveness.
- The cumulative score is considered acceptable if it is between 24 and 36.
- the maximum cumulative score is 48

Table 5.7: Metric Scores

Score	Description
0	No consideration to the design of EA artefacts
1	Semi-consideration to the design of EA artefacts and development of input concepts
2	Full consideration to the design of EA artefacts but not implementation
3	Full consideration to the design of EA artefacts and semi-implementation
4	Full consideration to the design of EA artefacts and full implementation

The proposed method was developed in line with practices identified from the SLR and interviews with EA practitioners. Besides, to make the proposed method effective and appropriate, we obtained EA experts' points of view on the proposed method practices and procedures during development.

In this regard, we asked three experts in the field of EA about their opinions of earlier versions of this method's practices and procedures. There are some modifications based

on the experts' comments on naming the practices and components. The experts also suggested providing a sufficient metric scale for the proposed method. All comments were applied to the current method.

5.5.3 Output Component

The output of the proposed method for evaluating post-implementation EA contains effectiveness and functionality evaluation reports. These reposts comprise a summary of the practices applied in the proposed method as EA outputs of each EA implementation project.

The output reports are the evaluators' score results, and they fully relate to the evaluators' points of view about the EA implementation artefacts. Therefore, the proposed method offers an appropriate plan for evaluating the EA implementation. Nonetheless, selecting worthy evaluators is a very important matter that needs to be considered by EA stakeholders.

5.5.3.1 Deliverables

Table 5.8 represents the deliverables of the proposed method. Some or all listed deliverables in Table 5.8 may apply in evaluation based on the EA evaluators point of view, however the enterprise architect may merge some reports together as one deliverables.

Table 5.8: Deliverable of Proposed method

Components	Deliverables
Input	List of inputs EA artefacts
Process	List of applied practices
Output	Report of effectiveness and report of functionality

5.5.4 Evaluation Supporting Tool

A software supporting tool has been developed in order to support the application of the proposed method's practices and metrics and to make it easy to be used. This tool considers the designed procedure for giving the scores to the functionality and effectiveness metrics and presents the evaluation output of the proposed method.

Figures 5.4, 5.5, 5.6 illustrate some samples screenshots of the proposed method support tool.

Figure 5.4: First Page of Evaluation Support Tool

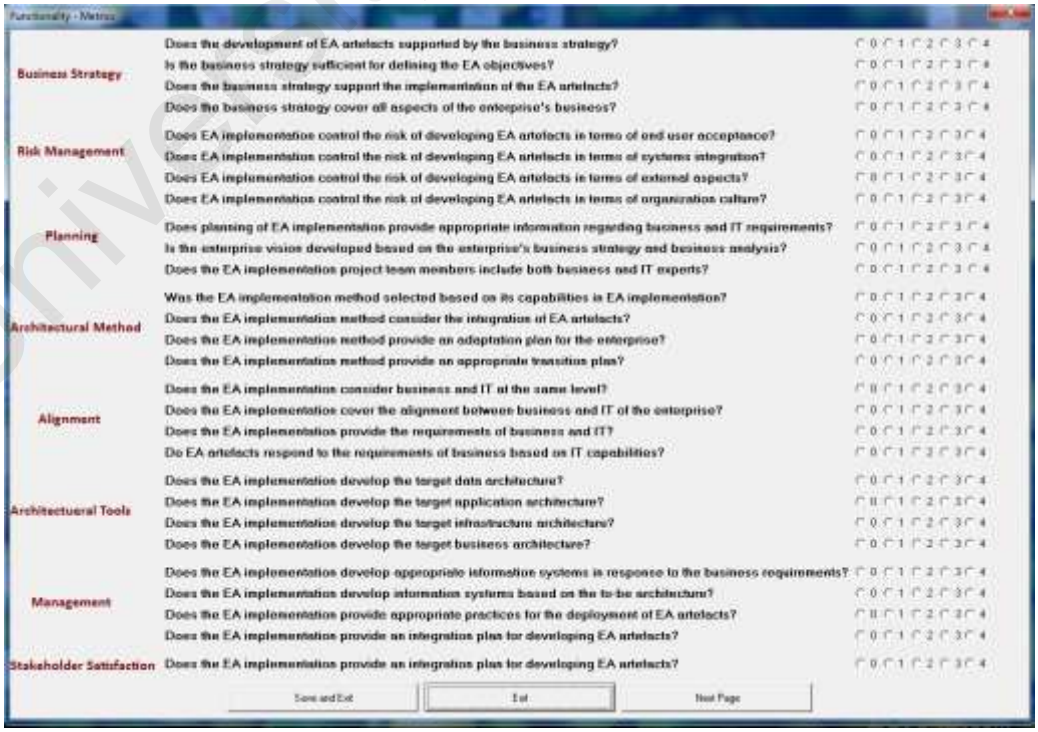

Figure 5.5: Sample of Metric Page

Figure 5.6: Sample of Report Page

5.6 Interactions of the Proposed Method's Components

During the evaluation of EA post-implementation understanding the interactions of the proposed method's components is essential for enterprise architects. Figure 5.8 illustrates the interactions of the proposed method's components.

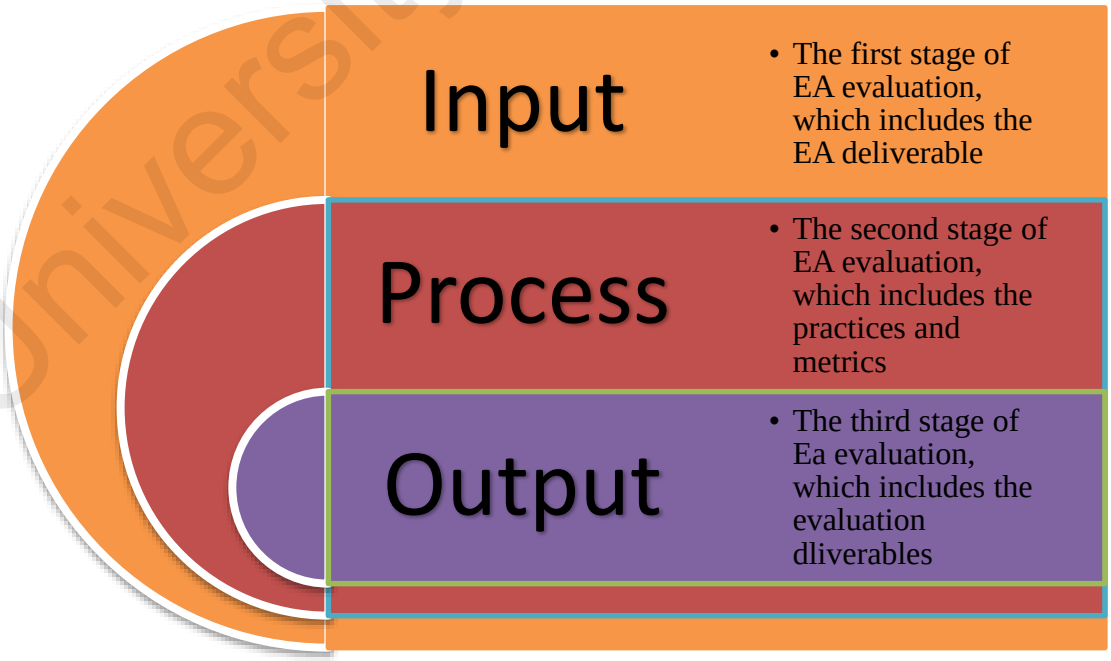

Figure 5.7: The Interaction of the Proposed Method's Components

The summary of interactions between the proposed method's components are:

- *Input* uses the resulting outputs or produced outputs of EA implementation artefacts as **inputs** of this proposed EA evaluation method
- *Process* refers to the conducting and developing the evaluation of EA implementation by means of practices
- *Output* is the quantitative score of the evaluation for each applied practice

5.7 Checklists

Table 5.8 represents the checklists, which need to be considered for the three main components of the proposed method. Maturity is defined as the degree in which all practices of EA implementation are fully employed in an EA project. Hence, this checklist can be used to evaluate the maturity of the EA implementation in an enterprise. It has been adapted based on Vieira, Ricardo Vieira, and (Ricardo Elsa Cardoso, and Christoph Becker 2014; Hauder, Matheus, et al. 2014; Andersen, Peter, Andrea Carugati, and Morten Grue Sørensen)

Table 5.9: Phase's Checklist of the Proposed Method

Phase	Checklist
	• Are clear architectural vision and mission of enterprise defined in advance? • Is the business strategy clear? • Do business entities describe? • Is desired architectures considered to support the agreed architecture vision? • Do transition plan well monitor? • Does architectural design of ISs well describe? • Do comprehensive system catalogue of implementation create? • Does the implementation of ISs prioritize? • Do the transition plan for implementing target architecture ISs and infrastructure define? • Do the business requirement considered on business strategy?

Table 5.9: Continued	Checklist
Input	• Do the IT requirement well identify and describe? • Does prioritize on IT and business requirement? • Do EA goals define clearly? • Does the future of enterprise well planned?
Process	• Does practices clearly describe? • Does metric clearly describe? • Does effectiveness metrics clearly describe? • Does functionality metrics clearly describe?
Output	• Does the result of functionality well described? • Does the result of effectiveness well described? • Does the overall EA evaluation result represented?

5.8 Main Feature of the Proposed EA evaluation Method

Figure 5.8 illustrates the main components of the proposed method.

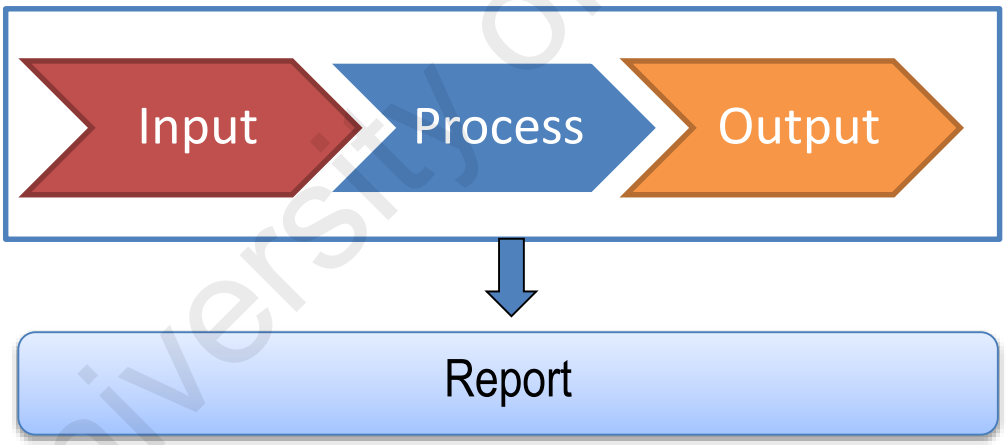

Figure 5.8: Overview the Proposed method

The proposed method supports the implemented EA's functionality and effectiveness; provides practices that are easy to use and learn, consistent and with different perspectives; provides step-by-step guidelines for applying in the evaluation project and supports maintenance and continual improvement; and supports all EA implementation practices. Additional features of the proposed method include:

- ***Completeness:*** The proposed method supports most of the important aspects of an enterprise. The practices provided by the proposed method support the initiation, control, and sustainability of EA projects.
- ***Support for decision making***: The proposed method may provide great impact to the enterprise by allowing choosing and selecting one amongst other programs to improve enterprise performance. The output of the proposed method represents the current practices and may help the enterprise architects and stakeholders in decision making.
- ***Multi-disciplinary coordination***: The proposed method may assist in coordinating the set of disciplines that exist in an enterprise in order to make more effective decision to achieve common objectives.
- ***Structured analysis***: The proposed method considers the overall enterprise and includes several views. Technological, information, organization and human aspects are considered along with the relationships between them and their external elements. Hence, the process component practices also offer such consideration for evaluating EA implementation.
- ***Covering the gaps***: The proposed method covers the gap between the EA implementation objectives and stakeholders' perspective without leaving further gaps. This means that both stakeholders and enterprise architects' perspectives are taken into account in evaluating EA implementation.
- ***Flexible:*** The proposed method provides a set of dynamic practices that are flexible in addressing new changes based on requests for updates and changes.

5.9 Summary

This chapter represented the proposed method. It firstly, describes the concepts and principles which the proposed method developed based on them. Secondly, it provided

the method of the proposed method along with the description and purposes of each component. Next, it elaborated the practices and metrics with two dimensions of the proposed method phases. The list of products, check list, and template of each phase are stated respectively. The evaluation of the proposed method is described in the next chapter.

CHAPTER 6: VALIDATION AND DISCUSSION

6.1 Overview

This chapter describes the proposed Post-Implementation Method for evaluation of Enterprise Architecture (EA) validation processes, validation results and discussion. The proposed method validated from i) the industrial perspective through the practitioners from EA industry by conducting two case studies, ii) EA expert review , iii) cross case study. For validation ‘applicability ‘and ‘usability ‘are the two criteria. To validate the method from industrial view point two cases have been selected with different field of works by using a 7-point Likert Scale. For ‘usability” criteria “SUS model” have been done. The chapter presents the analysis of the case study and expert review results and analysis of each case are described in sequence in this chapter.

Chapter 6 fulfills the research objective 3 and answer research question 3. Figure 6.1 shows the overall structure of this chapter.

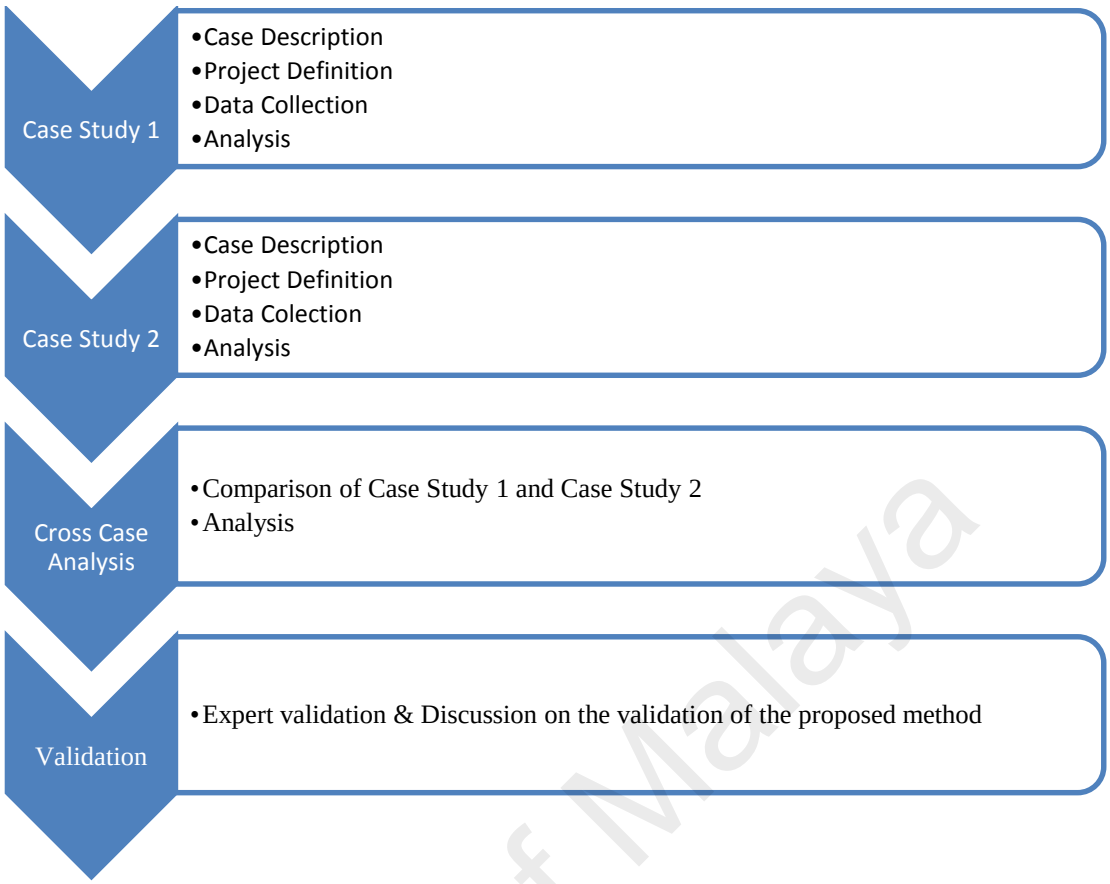

Figure 6.1: Structure of Chapter 6

6.2 Validation Procedure

The case studies were conducted between the 10th February 2016 and the 10th July 2016. However, project scoping and definition took place over several weeks preceding these dates, and the initial contact and meetings with the CIO, in order to garner support for the project, took place in the last quarter of 2015.figure 6.2 summarize the validation of proposed method.

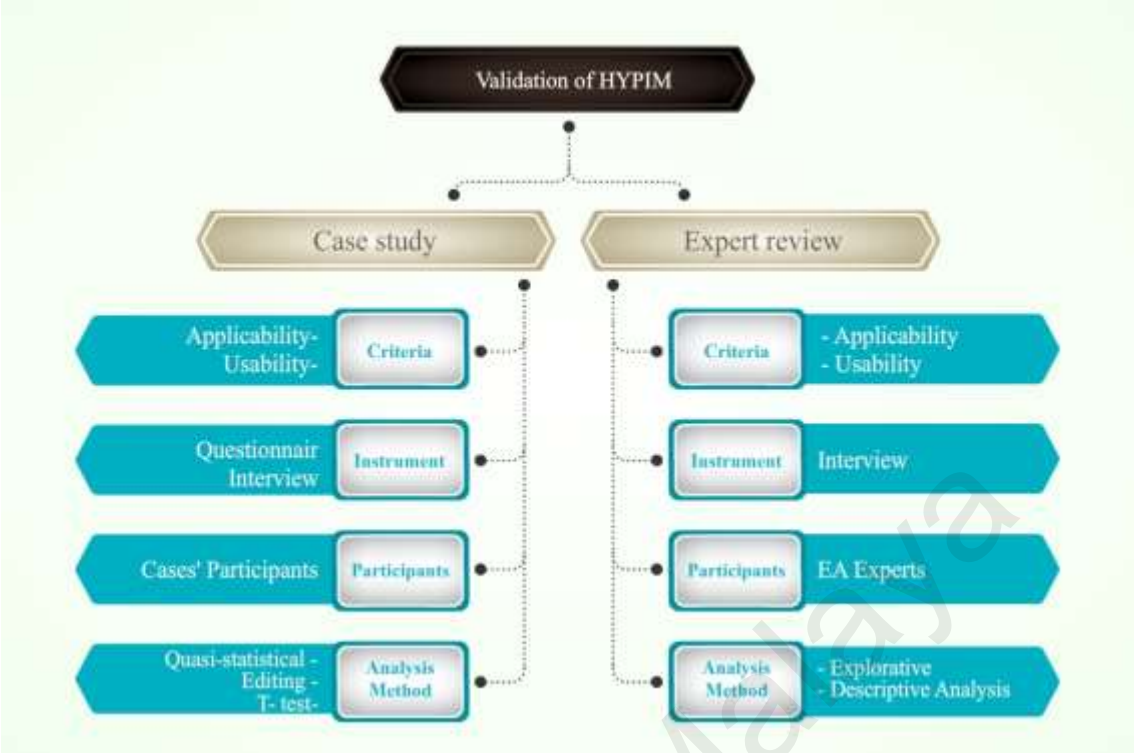

Figure 6.2: Validation Processes of METHOD

6.3 The Proposed Method Validation

Proposed method has been validated from:

I) Industrial perspective through the EA practitioners from the industry by conducting two case studies.

II) EA's expert review

The participants, including EA's experts and practitioners have relevant experience on EA implementation and effective evaluation. Therefore, experienced EA practitioners and experts with varied backgrounds have been engaged for evaluation of the method.

6.4 Case Study

This thesis make use of case study as the way to validate the proposed method because we would like to validate the method in real world setting. Moreover, the proposed method can be validated in term of its usability and applicability. The main benefits that can be gained using case study are as follows:

- Real world experiences
    - The method should be usable in real world and industrial projects.
- Variety of experiences
    - The method should be applicable in EA project in enterprises.

The case study took place in industry; however, the audiences of the case study were EA experts and the objectives for the case study reflected that audience. The overall objectives were as follows:

- To support the achievement of EA's goals
- To implement the practices of the proposed method
- To use metrics for evaluating the effectiveness and functionality of implemented EA
- To provide dynamic environment for evaluating the developed EA artefacts
- To get the satisfaction of EA project stakeholders

6.4.1 Case Study Procedure

We provided guidelines for conducting an EA evaluation project based on the proposed method and submitted to the EA managers in each case. The procedure is as follows:

- Arrange the meeting to explain the proposed method to the participants in each case, including a presentation on implementing the step-by-step method's practices.
- Provide manual for proposed method that explain all the method's components
- Provided the online version for further support. The project participants could also ask questions via the email address given.
- Define all EA evaluation activities for each case defined at the beginning of the evaluation
- Describe the activities required to achieve the defined objectives based on the proposed method
- The chief enterprise architect manages the EA evaluation and controls the EA artefact development
- Chief enterprise architects use the practices and instructions from the proposed method in their EA implementation projects. They have to consider the following activities (some or all activities may be applied in selected cases):

    - Understanding the business structure and strategy of the enterprise
    - Understanding the concept of effectiveness in EA evaluation
    - Understanding the concept of functionality in EA evaluation
    - Providing a list of implemented EA artefacts
    - Providing a list of developed EA artefacts
    - Providing a list of alternative EA artefacts
    - Having a high perspective of EA implementation procedures
    - Familiarity with EA implementation evaluation methods

6.4.2 Case study selection

Two case studies are used to validate the method in this thesis, In order to select case studies, three parameters were considered:

- *Number of EA projects*: number of EA projects that enterprises performed
- *Number of experience*: number of experience that enterprise have in EA implementation
- EA Team size: number of people involved in a EA team

Enterprises with more experience in EA implementation and containing EA or business strategy structure were selected. Team diversity in such companies causes various states in case studies. Hence, two enterprises with variety dimension were selected.

The selected cases were a private bank (Company A) and an e-health operator (Company B), which are famous in their sectors in the Middle East. The proposed METHOD was developed and applied through a six-month project starting in September 2015. The project was aimed to enhance and improve the EA implementation of EA artefacts, and in terms of its usability in supporting the enterprise, the aim was to achieve the intended goals. The projects started with the following objectives:

- Investigate the IT and business alignment in the developed EA artefacts
- Check the achievement of the predetermined EA objectives
- Check the developed EA artefacts' effectiveness and functionality in response to the EA objectives
- Check the developed EA artefacts' adaptability to future changes
- Check the developed EA artefacts' usability

- Check the developed EA artefacts' applicability

6.4.2.1 Company a Description

The first selected case is a private bank- Company A-, which established in 2001. It has more than 800 branches. Moreover, it has employed about 4000 staffs, clerks, managers, tellers, and the others. Since 2011 it has utilized Core Banking Systems in order to integrate all required banking transactions. In this regards, the bank's board decided to identify the view of EA for future changes. The bank's IT Department is responsible to perform needed actions for employing EA within bank. The IT department includes five divisions, including: E-banking, software, hardware, network and infrastructure, and card and new service (E-payment). This department contains more than 100 employees, which divided within aforementioned divisions. Within these employees, there are 5 software architects, 4 project manager, 4IT manager, 3 business manager, 3 business analyzer and3 enterprise architect. Figure 6.3 illustrate the organizational chart of IT department.

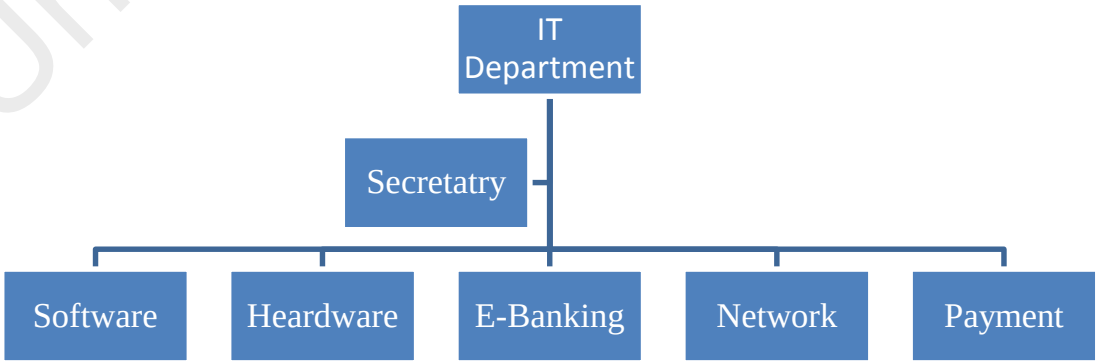

Figure 6.3: Company A- IT department's organizational chart

6.4.2.2 Company B Description

Case two is the company which working in the health sector (Company B). This section describes company B.

The second selected case is an electronic health company -Company B-. This company mission include: covering very wide domain of health, considering comprehensive and different aspects of human social, personal, and mental life, using the communication and information technology infrastructure for providing health services, makes accurate and accessible service, and decreases the cost of health.

The selected case is trade association of Electronic Health, Tele e-health and Mobile health, which works as health operator in order to create interoperable, fast, accessible and accurate health services. This company operates on the premise that the rapid, widespread adoption of Electronic health service will help improve the quality of patient care as well as the productivity and sustainability of the healthcare system.he business innovation department of company B decided to employ the EA in order to provide appropriate environment for expanding and developing electronic health, tele e-health and mobile health services. Moreover, they are looking to answer the future demands of business changes. Figure 6.4 illustrates the organizational chart of Company B.

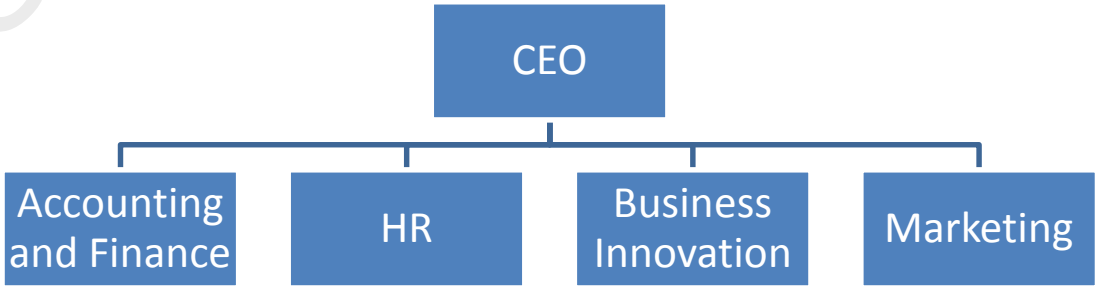

Figure 6.4: Organizational Chart of Company B

The Company B's business innovation department has four IT divisions, including: Software, business development, Network, and Infrastructure. Moreover, business innovation department use two Enterprise Architect consultants.

6.4.3 Data Collection

Once the chief enterprise architects announced EA implementation completion, we started collecting data from EA project participants from each selected case based on the defined protocol to validate usability and applicability of method. Table 6.1 shows the user groups who participated in the selected cases' EA projects.

Table 6.1: Participants

User Group	Roles
Enterprise architects	Creating design and architecture artefacts with direct interaction
Business architects	Structuring the enterprise in terms of its governance structure, business processes, and business information
Strategy solution makers	Creating business architecture models demonstrating how products, operations and systems interoperate within the organization
Technology architects and governance standard members	Eliciting, analyzing, specifying and validating existing standards of EA implementation, and reviewing solutions
Innovation team	Investigating innovative technology

We used triangulation in order to increase the precision of this thesis (P Runeson & M Höst, 2009). Triangulation means taking different angles towards the studied object and thus providing a broader picture (M. Myers & M. Newman, 2007; Yin, 2013). The following triangulations were used in the current thesis to evaluate the proposed method:

- Data triangulation: two case studies were considered in order to obtain data from more than one resource and cross-case analysis was applied

- Methodological triangulation: qualitative and quantitative methods were combined for data collection

The data collection procedures conducted in the meetings with the participants from each project entailed closed and open questions.

The questionnaires applied in this thesis were divided into two sections: closed questions and open questions for usability and applicability. For usability, this thesis were designed the closed and open questions based on the SUS model (Bangor, Kortum, & Miller, 2008; Lewis & Sauro, 2009). These questions cover the following points:

- A general understanding of the organizational profile, organizational structure, and the interviewees' roles in the organization
- The interviewees' understanding of EA implementation evaluation
- The interviewees' perception of the proposed method in terms of the SUS models
- The interviewees' general understanding of the proposed method.

6.4.4 Ethical Issues

In software engineering and information systems, case studies often include dealing with confidential information in an organization. This thesis tried to clear from the beginning how this kind of information is handled and who is responsible for accepting what information to publish in order to prevent the future problems. Key ethical factors of this thesis include:

- *Informed consent*: the researcher get the consent from the selected case

- *Confidentiality*: since the collected data from case can be sensitive when leaking outside of company, the consent on publishing the results get from cases based on using collected data as anonymous. The confidentiality issues were handled through Non-Disclosure Agreements and general project cooperation agreements between the companies and the researchers.
- *Feedback*: this thesis firstly, sent back the transcript of interviews to the participants to enable correction of raw data. Secondly, the analyses presented to them in order to maintain their trust in the research. Participants must not necessarily agree in the outcome of the analysis, but feeding back the analysis results increases the validity of the study.

6.4.5 The Questionnaires Format

The respondents consisted entirely of subjects who identified as having experience with EA, directly work in EA implementation and evaluation, and current responsibilities that include EA. These subjects were directly involved in the EA project and they have work in EA department. Due to their experience and knowledge on EA implementation, they have better view for validating the proposed method. All the questions were asked after the project had been completed. The respondents were selected based on the following criteria:

- They all perform roles that are critical to success of the IT Department
- They all represent typical stakeholders in project
- They directly work in the EA project
- They are professionals with wide variety of experience and exposure to EA evaluation methods and approaches.

The questionnaires applied in this study for usability are shown in Appendix A. moreover. The questionnaires applied in this study for applicability is broken into two sections: closed questions and open questions.

The respondents have been solicited to answer the survey questions by using the seven-point Likert Scale(Allen & Seaman, 2007) as follows : i) Strongly Agree (1), ii) Agree (2), iii) Somewhat Disagree (3), iv) Neither Agree nor Disagree (4), v) Somewhat Agree (5), vi) Agree (6), vii) Strongly Agree (7

6.4.6 Data Analysis

There are two types of data that were collected in Case 1 and Case 2, including: qualitative and quantitative data. In this thesis the quantitative data, which were collected from questionnaires were analyzed by means of statistical method by giving the weightage for each feedback of questionnaires. The seven Likert Scale has been selected for closed end questions. Figure 6.5 illustrates the structure of closed questions analysis.

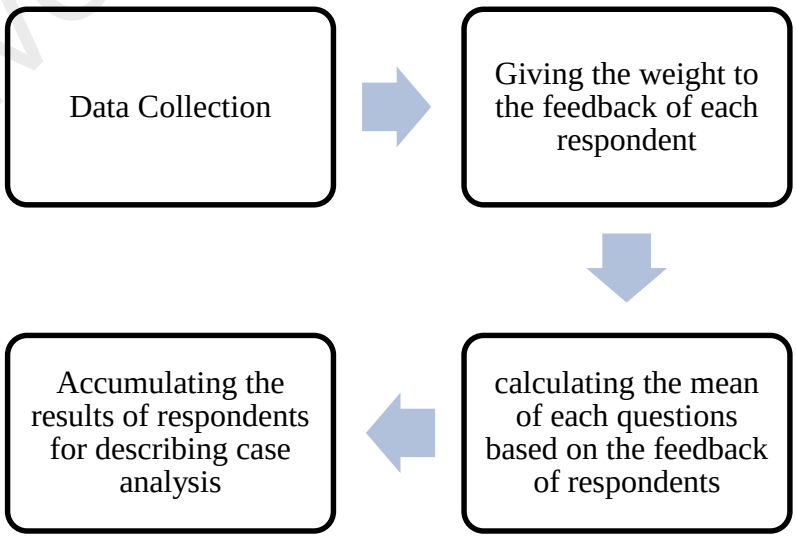

Figure 6.5: Quantitative Data Analysis Procedure

Qualitative data collected by means of interviews were analysed based on the case study protocol (Section 3.3.2.1). Figure 6.6 illustrates the procedure for qualitative data analysis.

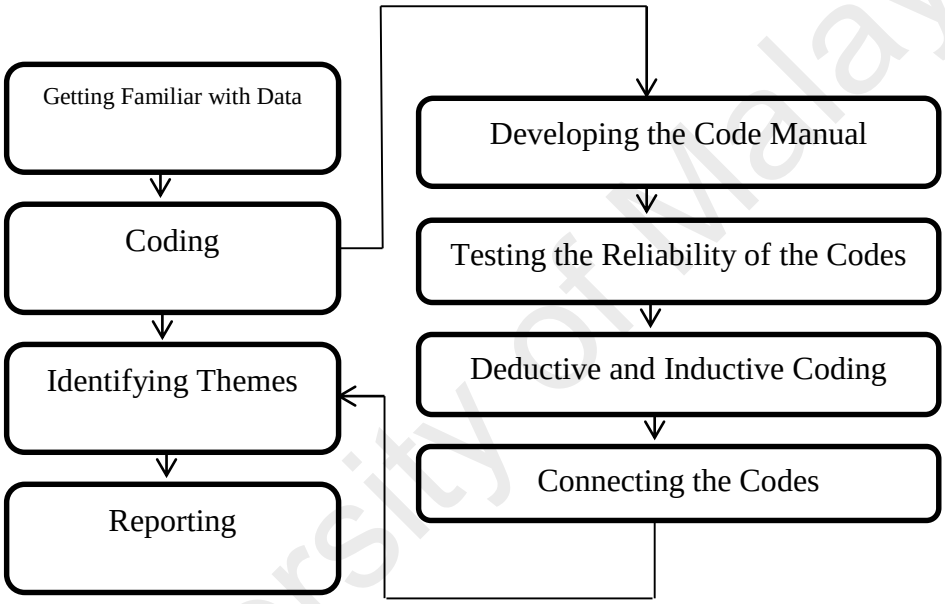

Figure 6.6: Qualitative Data Analysis Procedure

The coding procedure began after getting familiar with the collected data. In this regard, the collected data were imported to ATLAS.ti 7, and the predefined set of codes were deductively developed from the proposed method features and case study protocol (M. Myers & M. Newman, 2007; Yin, 2013).

Similarly, inductive coding was performed during the analysis to identify key thoughts and concepts relevant to the study questions. When new potentially relevant codes were identified, new codes were created and data were coded in ATLAS.ti 7. At

the same time, the codes and their definitions were added to the codebook (J. Maxwell, 2012).

The analysis process is iterative in nature; therefore, multiple passes were undertaken in order to code the data. Some codes were refined and extended during analysis, while others were merged with similar or redundant ones, or re-coded if necessary (J. Creswell, 2013; J. Maxwell, 2012). Table 6.2 shows the codebook of open questions.

6.4.7 Getting Familiar with Data

Maxwell (2012) proposed that the first step for qualitative analysis is reading and get familiar with the interview transcripts, notes, or documents to be analysed. In this thesis, every interview was transcribed in front of interviewee, and before using coding method it was read. Then, the material was imported to a qualitative analysis tool (Atlas.ti 7) to prepare it for coding.

6.4.8 Coding

The coding procedure begins after getting familiar with collected data. In this regards, the collected data imported to Atlas.ti 7, and the predefined set of codes were deductively developed from method features and case study protocol.

Similarly, inductive coding was performed during the analysis to identify key thoughts and concepts relevant to the study questions. When potential new relevant codes were identified, new nodes were created and data coded in Atlas.ti 7. At the same time, the code and its definition were added to the codebook (J. A. Maxwell, 2012).

The analysis process is iterative in nature; therefore, multiple passes were undertaken in order to code the data. Some codes were refined and extended during the analysis, while others were merged with similar or redundant ones, or re-coded if necessary

(Kaplan & Maxwell, 2005). Table 6.2 shows the codebook of open questions. Besides, the screenshots of coding in Atlas.ti are in Appendix.

Table 6.2: Codebook of Open Question Analysis

Code Name	Description
Practices	Phrases used by the interview participants, which relate to the proposed method practices.
Deliverables	The proposed method outputs, which are considered for the evaluation of EA artefacts.
Approach	The plan provided for evaluating the EA artefacts by practices of the proposed method.
Supporting tools	The tools provided by the proposed method in order to support the EA evaluation.
Guide process	The guidelines and deliverable plans provided by the proposed method for guiding practitioners to evaluate the EA within an enterprise by means of the proposed method's practices.
Simplified process	The simplification process of EA evaluation by means of the proposed method's practices.
Customizability	The ability of the proposed method to allow practitioners to use some parts or add other parts to the proposed method in order to evaluate the EA artefacts.
Compatibility	The ability of the proposed method to be compatible with other EA evaluation methods.
Completeness	The ability of the proposed method to implement EA within an enterprise.
Conciseness	The ability of the proposed method to provide concise practices and activities for EA evaluation.

6.4.9 Themes

Theme identification provides a high level analysis of data to identify themes rather than codes. The codes used in the previous step are now grouped into the possible themes that describe them collectively. It is an iterative back-and-forth process. Table 6.3 lists the themes identified from the open questions and Figure 6.7 illustrates the structure of the themes.

Table 6.3: Themes of Open Questions Analysis

Theme Name	Description	Code
Applicability	The components of the proposed method that support EA evaluation processes and activities. These components are the basic elements that represent the building blocks of the method.	Practices, deliverables, approach, and supporting tools
Usability	The intent of what the proposed method claims and what practitioners expect to achieve. It reveals the inherent qualities of the proposed method and is useful in identifying potential strengths and weaknesses.	Guide process, simplified process, completeness, compatibility, conciseness, customizability

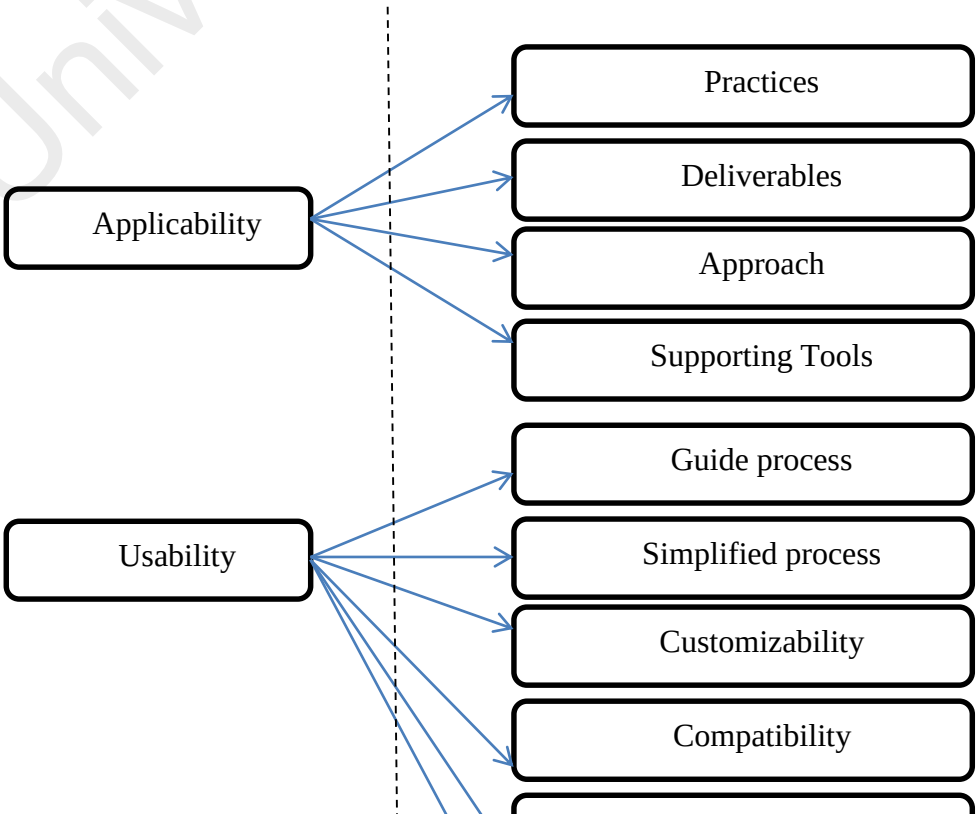

Figure 6.7: Structure of Themes

6.4.10 Reporting

After identifying the themes the reporting begins to represent the collected data in meaningful way (i.e., a way that would improve understanding of the research problem). It is important to provide a logical, coherent, and exciting story from the data.

6.4.11 Case Study Results

This section describes the qualitative and quantitative data analysis results. Regarding quantitative data, the following sections represent the SUS scores of Case 1 and 2 participants based on the data collection and analysis procedure (Sections 5.3 and 5.4).

6.4.12 Applicability Validation

This section concentrates on analyzing the results of applicability of the proposed method based defined questionnaires.

6.4.12.1 Closed and Open Questions Results

This section presents the results of interview and closed questions from defined sets of respondents of Company A and Company B (kept anonymous due to confidentiality reasons).

The "Weighted Average" column shows the weighted average for all responses. Responses to the open questions are provided verbatim (including grammatical errors). A single dash "-" means that no answer was provided to an open questions. Table 6.4 shows summary of the closed questions and Table 6.5 shows the summary of open questions of respondents of Case 1.

Table 6.4: Summary of Closed Questions Case1

Question No	Questions	1-Strongly Disagree	2-Disagree	3-Somewhat Disagree	4- Neither agree nor disagree	5-Somewhat Agree	6- Agree	7-Strongly Agree	Weighted Average
1	I found the proposed evaluation method easy to implement					2	5	2	6
2	The proposed EA evaluation method can be used with other EA method				1	2	6		5.55
3	The proposed EA evaluation method is an effective method for EA evaluation					3	4	2	5.88
4	The proposed EA evaluation method is an effective method for evaluating the functionality of EA implementation						7	2	6.22
5	The proposed EA evaluation method captures information across the technical domains						7	2	6.22
6	Proposed EA evaluation method captures information across the business areas					2	7		5.77
7	The proposed EA evaluation method leads the EA stakeholders to make better decision about the implemented EA					4	5		5.55
8	The proposed method convey more meaning than the evaluation method I previously used.					3	4	2	5.88

Question No	Questions	1-Strongly Disagree	2-Disagree	3-Somewhat Disagree	4- Neither agree nor disagree	5-Somewhat Agree	6- Agree	7-Strongly Agree	Weighted Average
9	The proposed method provide appropriate environment for evaluating the developed EA artefacts.					3	4	2	5.88
10	I would use this EA evaluation method again for EA evaluation						7	2	6.22
11	I would recommend this method for use by other practitioners						7	2	6.22
12	The proposed EA evaluation method is value-driven					1	7	1	6
13	The proposed EA evaluation method provides appropriate step by step guidelines						7	2	6.22
14	There is appropriate tool for supporting EA implementation by means of the proposed method					4	5		5.55
15	The proposed method support the evaluation of functionality appropriately					1	6	2	6.11
16	The proposed method support the evaluation of effectiveness appropriately						7	2	6.22
17	The proposed EA evaluation method provides efficient and effective metrics for effectiveness						7	2	6.22
18	The proposed EA evaluation method provides efficient and effective metrics for functionality					1	7	1	6
19	The proposed EA evaluation method appropriately linked the practices to their metrics					3	5	1	5.77
20	The proposed EA evaluation method use effective and efficient practices					2	5	2	6
21	The proposed EA evaluation method provides useful and optimal output for decision makers					3	4	2	5.88
22	The proposed EA evaluation method provides consistency among practices					3	6		5.66
23	The proposed EA evaluation method is applicable method in evaluation project						7	2	6.22
24	The proposed method consists of usable and effective practices					2	6	1	5.88
25	The Proposed EA evaluation method's components have appropriate capabilities for evaluating the developed EA artefacts						7	2	6.22
26	I find the proposed EA evaluation method useful to evaluate the developed EA artefacts						7	2	6.22

Table 6.5: Summary of Open Question of Case1

NO.	Questions	Feedback
1	What is your job title?	1-1. IT Manager
		1-2. Application Project Manager
		1-3. System Analyzer
		1-4. Business Analyzer
		1-5. Enterprise Architect
		1-6. Network Manager
		1-7. IT Consultant
		1-8. Enterprise Architect
		1-9. Enterprise Architect
2	How many years do you have experience in Enterprise Architecture?	2-1. Seven Years
		2-2. Four Years
		2-3. Three Years
		2-4. Three Years
		2-5. Three Years
		2-6. Ten Years
		2-7. Six Years
		2-8. Six Years
		2-9. Eight Years
3	How many Enterprise Architecture project have you been involved?	3-1. 5
		3-2. 4
		3-3. 3
		3-4. 3
		3-5. 4
		3-6. 14
		3-7. 6
		3-8. 6
		3-9. 8
4	Based on your experience with the proposed evaluation method, how do you assess it as an EA evaluation method?	4-1. It provides effective checklist for each phase along with deliverable plan, thus it supports the achievement of the intended goals by providing appropriate roadmap
		4-2.Since it provides specific metrics in each practice for supporting the evaluation of effectiveness and functionality, it adds more value on EA evaluation. Moreover I found it usable method
		4-3. There are valuable items for business side such as evaluating business strategy in this method
		4-4. It is suitable for post EA evaluation in terms of effectiveness and functionality

NO.	Questions	Feedback
		4-5. This is an effective method for evaluating the developed EA artefacts
		4-6. Useful because of considering two key dimension including effectiveness and functionality
		4-7. Providing effective strategy for evaluating the post implemented EA artefacts in order to validate the achievement of EA objectives
		4-8. It is applicable method for evaluation
		4-9. It can assist the stakeholders to realize the benefit of developed EA artefacts
5	In your opinion, what are the strengths of the proposed method?	5-1. Considering alignment, integration, business strategy, and governance as practices of evaluation make the evaluation report as usable and applicable plan for stakeholders
		5-2. Appropriate plan for evaluating effectiveness and functionality of developed EA artefacts within enterprise
		5-3. reasonable method for applying in EA evaluation project because of its metrics and practices
		5-4. Using related metrics for evaluating the effectiveness and functionality
		5-5. Definition and metrics of each practice in evaluation method are clear and make the workable method
		5-6. Efficient method for evaluating the achievement of EA objectives
		5-7. Determining the metrics of each practice
		5-8. Evaluating the integration and alignment along with business strategy are essential items which this method support them
		5-9. Appropriate strategy for input, process and output of method
6	In your opinion, how is the functionality supported in the proposed method?	6-1. It support the evaluation of functionality of developed EA artefacts by its practices
		6-2. By applying the defined metrics it could be achieved the evaluation results of functionality of post implemented EA within an enterprise
		6-3. Functionality appropriately supported in this evaluation method
		6-4. This method has optimized and usable plan for evaluating the functionality of EA implementation
		6-5. The roadmap of functionality of developed EA is defined and it is applicable in EA project
		6-6. The defined metrics for functionality are efficient and usable
		6-7. Effective and efficient plan for evaluating the functionality of business and IT in implemented EA
		6-8. Easiest plan for evaluating the functionality because of appropriate defined metrics
		6-9. This method provide appropriate environment for making the alignment by understanding business requirements and IT
		7-1. I believe this method support the evaluation of effectiveness of developed EA more than functionality because of paying more consideration on integration, alignment, and governance, however

NO.	Questions	Feedback
7	In your opinion, how is the effectiveness supported in the proposed method?	both dimension are in the acceptable level
		7-2. By applying the defined metrics it could be achieved the evaluation results of effectiveness of post implemented EA within an enterprise
		7-3. Like functionality, effectiveness also appropriately supported in this evaluation method
		7-4. Effectiveness presented appropriately in this method
		7-5- Metrics of effectiveness well described
		7-6. The defined metrics for effectiveness are efficient and usable
		7-7. Effectiveness is fully supported by this method because of defining effective and efficient metrics for evaluation
		7-8. Easy way for evaluating the effectiveness of developed EA by means of this method
		7-9. It support the evaluation of effectiveness of developed EA artefacts by its practices and it tools
8	Do you have any suggestion for improving the proposed method?	8-1. It is better to make the provided tool as online
		8-2. -----
		8-3. -----
		8-4. -----
		8-5. -----
		8-6. Add more standard on its value
		8-7. -----
		8-8. -----
		8-9. -
9	In your opinion, what are the possible areas for further development of the proposed method?	9-1. -----
		9-2. Considering other dimension like efficiency and cost
		9-3.-
		9-4. ---
		9-5. using the concepts other evaluation method in order to empower its capability
		9-6. -----
		9-7. -
		9-8. Developing a particular online tool for this method
		9-9.-
10	Are there any others comments you would like to	10-1.I find it useful and effective method
		10-2.-
		10-3.It leaded us to evaluate the achievement of defined and intended EA goals
		10-4.-
		10-5.-
		10-6.-
		10-7.-

NO.	Questions	Feedback
	add?	10-8. -
		10-9.-

Table 6.6 shows summary of the closed questions and Table 6.7 shows the summary of open questions of respondents of Case 2.

Table 6.6: Summary of Closed Questions of Case2

Question No	Questions	1-Strongly Disagree	2-Disagree	3-Somewhat Disagree	4- Neither agree nor disagree	5-Somewhat Agree	6- Agree	7-Strongly Agree	Weighted Average
1	I found the proposed evaluation method easy to implement					2	3		5.6
2	The proposed EA evaluation method can be used with other EA method					1	3	1	6
3	The proposed EA evaluation method is an effective method for EA evaluation					1	3	1	6
4	The proposed EA evaluation method is an effective method for evaluating the functionality of EA implementation				1	1	2	1	5.6
5	The proposed EA evaluation method captures information across the technical domains						3	2	6.4
6	Proposed EA evaluation method captures information across the business areas						3	2	6.4
7	The proposed EA evaluation method leads the EA stakeholders to make better decision about the implemented EA					1	2	2	6.2
8	The proposed method convey more meaning than the evaluation method I previously used					2	2	1	5.8
9	The proposed method provide appropriate environment for evaluating the developed EA artefacts.					2	2	1	5.8
10	I would use this EA evaluation method again for EA evaluation						4	1	6.2
11	I would recommend this method for use by other practitioners						4	1	6.2
12	The proposed EA evaluation method is value-driven					1	2	2	6.2
13	The proposed EA evaluation method provides appropriate step by step guidelines					1	3	1	6
14	There is appropriate tool for supporting EA implementation by means of the proposed method				1	1	2	1	5.6

Question No	Questions	1-Strongly Disagree	2-Disagree	3-Somewhat Disagree	4- Neither agree nor disagree	5-Somewhat Agree	6- Agree	7-Strongly Agree	Weighted Average
15	The proposed method support the evaluation of functionality appropriately						2	3	6.6
16	The proposed method support the evaluation of effectiveness appropriately						2	3	6.6
17	The proposed EA evaluation method provides efficient and effective metrics for effectiveness					1	2	2	6.2
18	The proposed EA evaluation method provides efficient and effective metrics for functionality					2	2	1	5.8
19	The proposed EA evaluation method appropriately linked the practices to their metrics					2	2	1	5.8
20	The proposed EA evaluation method use effective and efficient practices						3	2	6.4
21	The proposed EA evaluation method provides useful and optimal output for decision makers						3	2	6.4
22	The proposed EA evaluation method provides consistency among practices						3	2	6.4
23	The proposed EA evaluation method is applicable method in evaluation project						4	1	6.2
24	The proposed method consists of usable and effective practices						3	2	6.4
25	The Proposed EA evaluation method's components have appropriate capabilities for evaluating the developed EA artefacts						4	1	6.2
26	I find the proposed EA evaluation method useful to evaluate the developed EA artefacts						2	3	6.6

Table 6.7: Summary of Open Question of Case 2

NO.	Questions	Feedback
1	What is your job title?	1-1- Enterprise Architect
		1-2- IT Management
		1-3- Enterprise Architect
		1-4- Business Analyzer
		1-5- Enterprise Architect
2	How many years do you have experience in Enterprise Architecture?	2-1. Seven Years
		2-2. Fourteen Years
		2-3. Four Years
		2-4. Five Years
		2-5. Ten Years
3	How many Enterprise Architecture project have you been involved?	3-1. 6
		3-2. 6
		3-3. 7
		3-4. 9
		3-5. 12
4	Based on your experience with the proposed evaluation method, how do you assess it as an EA evaluation method?	4-1. Based on my experience, it is suitable for agile enterprise in order to check the achievement of EA objectives
		4-2.It is clear that the role of evaluation method is to evaluate the artefacts of each systems and in EA we are looking to realize whether the defined EA objectives achieved. I personally believe that this method can evaluate the EA artefacts
		4-3. It can be seen as holistic evaluation method as it provide deep analyses from effectiveness and functionality
		4-4. Although it presents appropriate solution for evaluating the EA artefacts, it requires more practices for evaluating functional and non-functional requirements
		4-5. This method is really workable in terms of getting the EA stakeholder satisfaction and achieving the EA objective achievements
5	In your opinion, what are the strengths of the proposed method?	5-1. It is lightweight and usable method for evaluation
		5-2. It provides values for evaluation particularly for effectiveness and functionality of developed EA artefacts
		5-3. I found it effective and efficient method for evaluating the implemented EA
		5-4. It provides an appropriate roadmap for implementing evaluation method practices
		5-5. It is easy to implement and use
		6-1. The defined metrics of each practice support the functionality
		6-2. Functionality is supported by appropriate practices of proposed method

NO.	Questions	Feedback
6	In your opinion, how is the functionality supported in the proposed method?	6-3. Functionality appropriately supported and it provides better understanding about developed EA artefacts
		6-4. The metrics of the proposed method provide the functionality and effectiveness of EA
		6-5. The level of functionality is acceptable and it clearly supported by the proposed method
7	In your opinion, how is the effectiveness supported in the proposed method?	7-1. The defined metrics of each practice support the effectiveness
		7-2. Effectiveness is supported by appropriate practices of proposed method
		7-3. Effectiveness appropriately supported in this evaluation method
		7-4. The metrics of the proposed method provide the functionality and effectiveness of EA
		7-5- Evaluating the effectiveness of EA is clearly described by its metrics
8	Do you have any suggestion for improving the proposed method?	8-1. Using other dimension of evaluation such as efficiency
		8-2. Developing the particular version for small and medium enterprises
		8-3. -----
		8-4. -----
		8-5. It is enough good for using in EA project
9	In your opinion, what are the possible areas for further development of the proposed method?	9-1. -----
		9-2. Describing the required role for evaluation
		9-3.-
		9-4. ---
		9-5. ---
10	Are there any others comments you would like to add?	10-1.--
		10-2.-
		10-3.Thanks for your efforts for developing such method
		10-4.-
		10-5.- I want to thanks for giving me the chance for participating in this project and using this method

6.4.12.2 Closed Questions Analysis

This section focuses on the results of closed questions from respondents of Case 1 and 2. The analysis is conducted based on the structure that mentioned in Section 6.11. Figure 6.8 depicts the results of closed questions of Case 1.

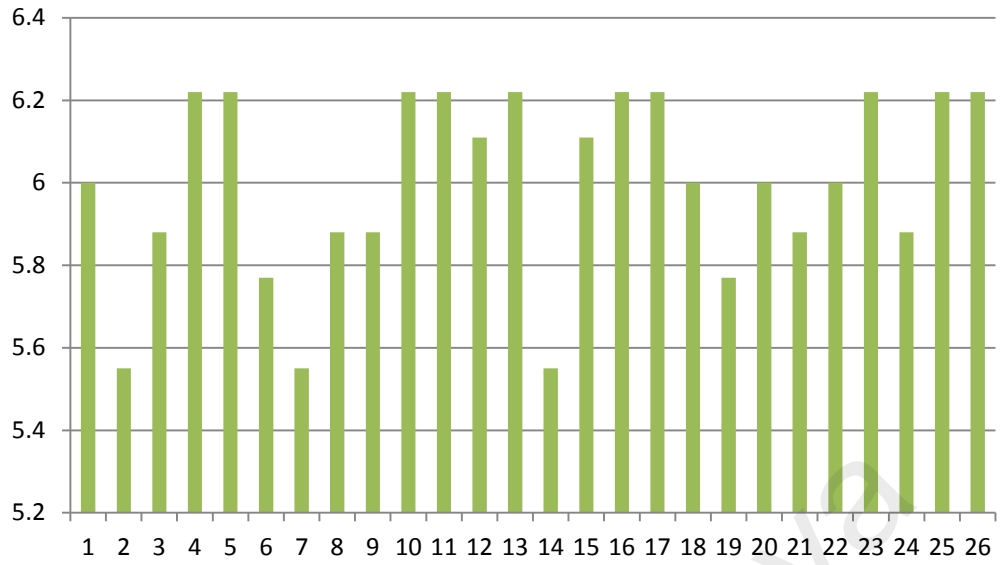

Figure 6.8: Average of Closed Questions- Case1

As shown in Figure 6.5 the minimum average of Case 1's respondents to the closed questions is 5.55 and the maximum average is 6.22. The total average of the closed questions of Case1 is 6.00 and it means that respondents agree by questions, which they related to the effectiveness, usability, and functionality of the proposed evaluation method. Figure 6.9 illustrates the results of closed questions of Case 2.

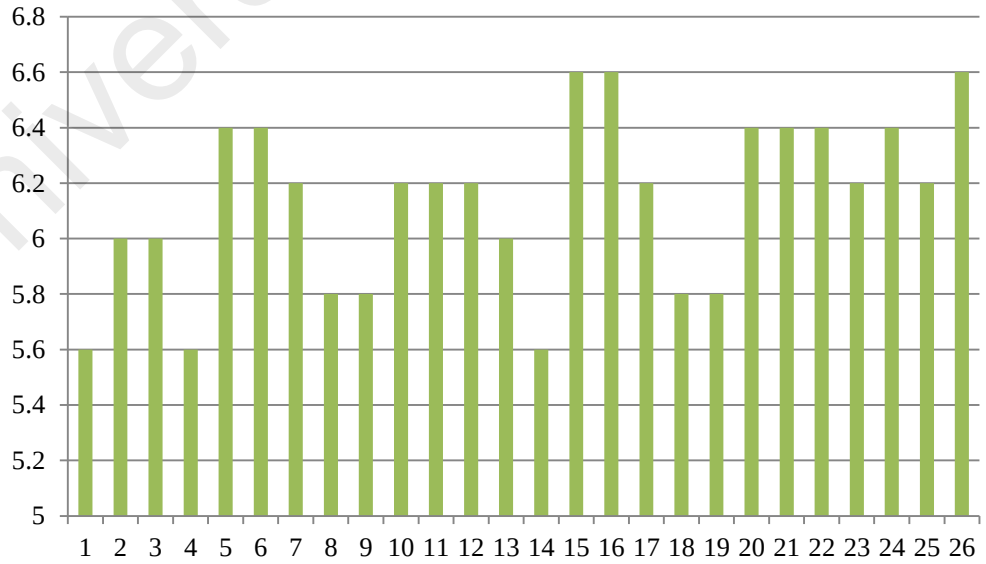

Figure 6.9: Average of Closed Questions- Case 2

As shown in Figure 6.9 the minimum average of respondents to the closed questions is 5.60 and the maximum average is 6.66. The total average of closed questions of Case 2 is 6.14it means that the business users agree by questions, which they related to the effectiveness, usability, and functionality of the proposed evaluation method. Table 6.8 represents the categorizing of the closed question based on the concepts and relationships.

Table 6.8: Categorizing the Closed Question

Section	Questions	Average of Case 1 Feedback	Average of Case 2 Feedback
Effectiveness	16, 17	6.01	6.33
Functionality	4, 15, 18	5.88	5.83
Applicability	1, 2, 3, 7, 9, 12, 13, 14, 19, 20, 21, 22, 23, 24, 25, 26	5.99	6.57
General	5, 6, 8, 10, 11	5.96	6.33

As shown in Table 6.8, the average of each Case is close or above of 6 and according to selected Likert Scale of the closed question it means that they agree with the following points:

- Proposed evaluation method supports effectiveness's factors.
- Proposed evaluation method supports functionality's factors.
- Proposed evaluation method support applicability's factors.
- Proposed evaluation method apply general's factors.

Text provided in answer to the open questions was analysed using ATLAS.TI 7 and Textalyser. Answers to all of the other open questions were included unless they consisted solely of the single word "no" or "yes". Misspelt words have been corrected

before analysis. Full stops were added to the end of each sentence if they were not already present and bullet points were removed.

Table 6.9 and 6.10 represent general information about the open questions of case 1.

Table 6.9: General Information of Open Question –Case 1

Total word count :	*313*
Number of different words :	121
Complexity factor (Lexical Density) :	38.7%
Readability (Gunning-Fog Index) : *(6-easy 20-hard)*	14.1
Total number of characters :	3824
Number of characters without spaces :	2609
Average Syllables per Word :	2.23
Sentence count :	43
Average sentence length (words) :	12.91
Max sentence length (words) :	33
Min sentence length (words) :	5
Readability (Alternative) beta : *(100-easy 20-hard, optimal 60-70)*	5.1

Table 6.10: Frequency of Top 10 Words

Word	***Occurrences***	***Frequency***	***Rank***
Method	20	6.4%	1
Evaluation	17	5.4%	2
Functionality	15	4.8%	3
Effectiveness	14	4.5%	4
Metrics	12	3.8%	5
Evaluating	11	3.5%	6
Developed	8	2.6%	7
Defined	7	2.2%	8
Effective	6	1.9%	9
Plan	6	1.9%	9

Table 6.11 and 6.12 represent general information about the open questions of Case 2.

Table 6.11: General Information of Open Question –Case 2

Total word count :	*180*
Number of different words :	98
Complexity factor (Lexical Density) :	54.4%
Readability (Gunning-Fog Index) : *(6-easy 20-hard)*	12.8
Total number of characters :	2244
Number of characters without spaces :	1529
Average Syllables per Word :	2.14
Sentence count :	27
Average sentence length (words) :	12.33
Max sentence length (words) :	31
Min sentence length (words) :	6
Readability (Alternative) beta : *(100-easy 20-hard, optimal 60-70)*	13.1

Table 6.12: Frequency of Top 10 Words

Word	***Occurrences***	***Frequency***	***Rank***
method	15	8.3%	1
evaluation	8	4.4%	2
effectiveness	8	4.4%	2
functionality	8	4.4%	2
artefacts	5	2.8%	3
proposed	5	2.8%	3
supported	5	2.8%	3
metrics	5	2.8%	3
evaluating	4	2.2%	4
practices	4	2.2%	4

As shown in Table 6.10 and Table 6.12 the frequency of word “Method” is 20 and 15, and it ranked as first word based on the feedback of case 1 and case 2 respectively.

6.4.12.3 Technical Analysis

This thesis uses statistical test (T-Test) by means of SPSS in order to provide further analysis on closed questions. The one sample t-test is a statistical procedure used to

determine whether a sample of observations could have been generated by a process with a specific mean (Leech, Barrett, & Morgan, 2005). T-Test is most commonly applied when the test statistic would follow a normal distribution if the value of a scaling term in the test statistic were known (Pallant, 2010). In this thesis, we want to examine applicability of method for case 1 and case 2. Table 6.13 shows the results of T-Test for applicability.

Table 6.13: T-test Result

One-Sample Test

	Test Value = 0					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
MEANQ	43.472	13	.000	6.03429	5.7344	6.3342

As shown in Table 6.13 all sig. are less than 0.05 and it shows that there is a significant difference in mean between the sample and the overall population, there is applicability in the proposed method. (Pallant, 2010). Besides, Confidence Interval of this results is positive which shows the applicability of the proposed method in case 1 and case 2.

6.4.12.4 Open Questions Analysis

Regarding qualitative data, the following sections provide a summary of the analysis based on the defined data analysis procedure (Section 6.8).

- The interview findings from Case 1 and 2 participants reveal that the proposed method contains effective components in terms of practices, plans, and deliverables. These components lead to a suitable evaluation of implemented EA artefacts in terms of functionality and effectiveness. They control the achievement of the intended EA goals suitably. Moreover, some participants also

suggested utilizing specific management tools in order to improve the evaluation procedure.

- The interview analysis shows that the proposed method offers an appropriate foundation for evaluating EA implementation. The proposed method also supports stakeholders and enterprise architects with checking the achievement of EA objectives by facilitating practices and procedure that are easy to learn and use. Moreover, the proposed method provides a simple environment for EA implementation by means of effective practices.
- The interview findings indicate that the proposed method is capable of supporting the customizability and compatibility of each EA project with its practices, and provides an appropriate environment for evaluating EA implementation. Besides, in terms of completeness, it is possible to evaluate the EA implementation via the proposed method's practices. Finally, the proposed method takes conciseness into account in its practices for supporting functionality and effectiveness of EA implementation.

6.4.13 Usability Validation

In order to validate the usability of the proposed method, this thesis used the System Usability Scale (SUS) models (Bangor et al., 2008; Kortum & Bangor, 2013). SUS provides a reliable tool for measuring the usability and give a global view of usability. The SUS has been widely used in the evaluation of a range of systems. The SUS questions used in the research consisted of ten questions with expected responses ranging from strongly agree, agree, normal, disagree to strongly disagree.

The questions asked for testing usability of the proposed method are as follows:

1. I think that I would like to use this method frequently

2. I found this method unnecessarily complex
3. I thought this method was easy to use
4. I think that I would need the support of a technical person to be able to use this method
5. I found the various functions in this method were well integrated
6. I thought there was too much inconsistency in this method
7. I would imagine that most people would learn to use this method very quickly
8. I found the this method very easy to use
9. I felt very confident using this method
10. I needed to learn a lot of things before I could get going with this method

The average SUS score is 68. If score is under 68, then there are probably serious problems with method usability which should address. If score is above 68, then method is usable. And will recommend to use with other cases. The five-point Likert Scale was selected for the closed-end questions, including strongly disagree (weight=1), disagree (weight=2), neither agree nor disagree (weight=3), agree (weight=4), and strongly agree (weight=5). Figure 6.10 illustrates the analysis structure of the closed questions based on the SUS structure.

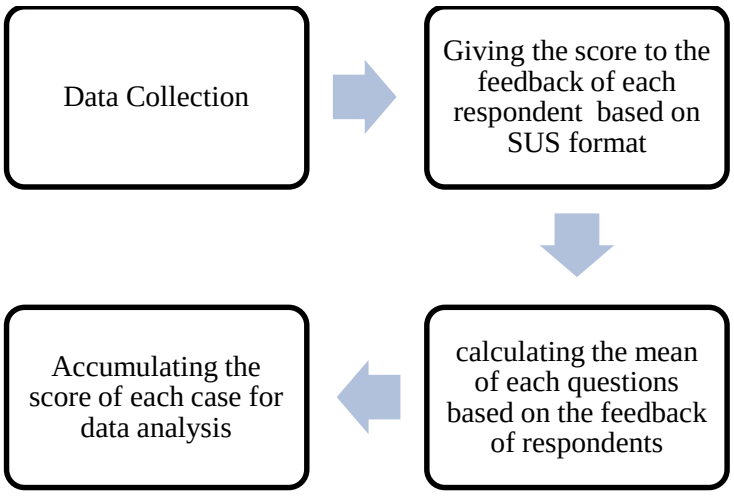

Figure 6.10: SUS Data Analysis Procedure

a) Data Collection

The questionnaire, provided in Appendix A has been used for the usability validation of proposed method from participants of two case studies. The questionnaire and relevant guidelines for performing evaluation have been emailed to 14 practitioner which 9 person was for case 1 and 5 person for case 2.

b) **Questionnaire Format**

The purpose of the questions is meant for usability validation of the proposed method. To improve the questionnaire layout, assess the language comprehension and estimate the time required to complete the questionnaire, the academic person that have knowledge in questionnaire making and statistical concept have been selected and his recommendations have been incorporated in questionnaire before beginning of interview. The questionnaire contained ten questions to validate usability criteria of propose method based on SUS models.

c) Sampling and Population

The Expert sampling which form of purposive is sampling that employed for obtaining a valid sample of respondents. Nine experts from case 1 and 5 experts from case 2 who have deep background in EA with at least 10 years' experience have been invited to participate in the method validation. All fourteen experts have shown their willingness to participate in the validation. Demographic information of those fourteen experts have been provided in Table 6.10.

d) Responses

The experts have been solicited to answer the ten closed questions related to usability of proposed evaluation method. All the fourteen experts have answered the questions.

Table 6.14: SUS Results

Case	q1	q2	q3	q4	q5	q6	q7	q8	q9	q10	SUS Score
1	4	2	3	2	5	1	5	2	4	1	**82.5**
1	5	2	4	2	5	5	5	2	4	2	**75.0**
1	4	2	3	2	4	1	4	2	4	2	**75.0**
1	5	2	2	4	4	1	5	2	4	1	**75.0**
1	4	2	3	2	4	1	4	2	4	2	**75.0**
1	5	2	4	2	5	5	5	2	4	2	**75.0**
1	4	2	3	2	5	1	5	2	4	1	**82.5**
1	4	2	3	2	4	1	4	2	4	2	**75.0**
1	4	2	3	2	5	1	5	2	4	1	**82.5**
2	5	2	2	4	4	1	5	2	4	1	**75.0**
2	4	2	3	2	5	1	5	2	4	1	**82.5**
2	4	2	3	2	5	1	5	2	4	1	**82.5**
2	4	2	3	2	5	1	5	2	4	1	**82.5**
2	5	2	4	2	5	5	5	2	4	2	**75.0**

All respondents scored usability of proposed method more than the expected Figure 6.13 Shows demographic results of SUS.

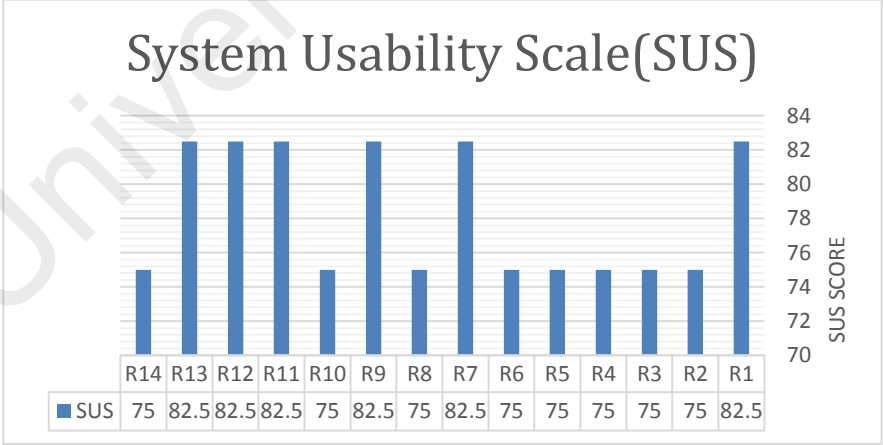

Figure 6.11: SUS Results

As a summary:

- In Case 1, the participants' SUS average score was 77.5.5. This score is greater than 68, which means that Case 1 participants were satisfied with the proposed method and they would recommend it for other EA projects.
- In Case 2, the participants' SUS score was 79.5.5. This score is greater than 68, which means that Case 2 participants were also satisfied with the proposed method and they would recommend it for other EA projects.

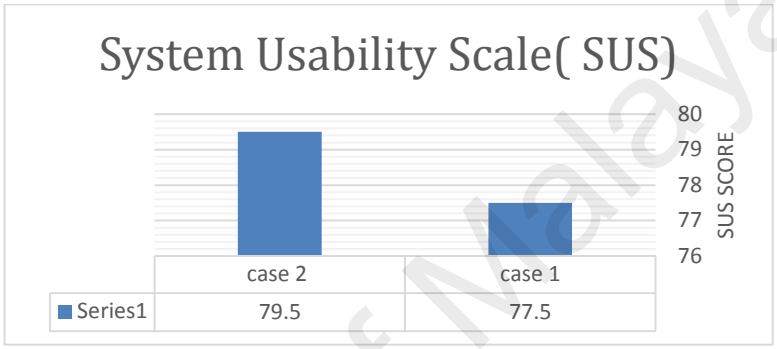

Figure 6.12: SUS Comparison Result of Case 1 and 2

Consequently, the accumulated results from the closed questions for Case 1 and Case 2 reveal that the proposed method supports the usability model. This means that the proposed method is usable and can be employed in future EA projects.

As a result, the qualitative and quantitative data analysis revealed that the proposed method supports the SUS model as well as the achievement of EA objectives through the method's practices and plans. Therefore it can apply in EA evaluation project and support the evaluation in terms of effectiveness and functionality for developed EA artefacts.

6.5 Cross-Case Analysis

This section would describe the comparative analyses of the findings from two conducted case studies in parallel to validate the usability and applicability of the

proposed evaluation method in these organizations. This section intends to obtain generalization by developing concepts based on the understanding of the empirical data from the cross-case analysis (M. D. Myers & M. Newman, 2007). The comparative analysis would identify the similarities (Runeson, Host, Rainer, & Regnell, 2012), differences between the case studies and also compare it to the literatures(Shanks, 2002). These criteria would then be further discussed (Kaplan & Maxwell, 2005).

6.5.1 Organizational Context Analysis

The data collection and organizational context of the two case studies sites are being compared in Table 6.15, Although both cases are more or less similar in terms of the types of implementation, IT policy and implementation and firm size, other contexts of the organization are quite different which may influence the different outcome of the implementation.

Table 6.15: Comparison of Context of Case 1 and Case 2

Criteria	Case 1	Case 2
Data Collection Period	February 2016 - July 2016	February 2016 - July 2016
Respondents being Interviewed	Business stakeholders and Enterprise Architects	Business stakeholders and Enterprise Architects
Main Activity	Banking	Health
Firm Size (Number of employees)	More than 5000	More than 100
IT Policy & Implementation	Particular department for IT and different divisions for IT sub-domains	Using IT, research and development department
EA understanding	Using specific team for EA	It does not have EA section, however it has expert consultants
Support from the top management	CEO and CIO fully support the project	It supported directly by CEO

6.5.2 Cases' Objectives

This section compares the EA evaluation's objectives of the architectural conditioning selected cases. Table 6.16 summarizes the two organizations' EA objectives.

Table 6.16: Comparison the selected Cases' Objectives

EA Objectives	Case 1	Case 2
Strategic	To align business and IT To identify gaps and build roadmaps	To support future changes
Operational	Developing EA artefacts and obtaining the defined EA goals	To develop EA artefacts
Governance	Change management and updating the repository	There were no explicit strategic objectives of EA
Business	Identifying business requirements and business trend	Identifying business demands and trends
IT	Providing IT requirements, infrastructures architecture, data architecture, and application architecture	Providing IT requirements, infrastructures architecture, data architecture, and application architecture

6.5.3 External Context Analysis

The external contexts that influence the EA implementation for two selected cases are being compared in Table 6.17.

Table 6.17: Comparison of External Context between Cases 1 and 2

Criteria	Case 1	Case 2
Market area	More than 20 governmental and private bank exist and it has to compete to them	The first health operator
Competitors status	There are some higher Bank in terms of customer, liquidity, and investment	There are competitor in neighbours countries
Market capability	National wide and international opportunity	National wide and international opportunity
Business growth	Based on growth of economy it grows fast	Several activities in accordance new technologies - There is good future for this market-
Exclusive rules	No	Yes

6.6 Expert Reviews

Additionally, the semi-structured interviews with seven external EA consultants have been done in order to validate the proposed method.These experts were not directly involved in the business project, however they work as consultants of Case1, which they support the EA evaluation. This set of subjects evaluated the results of the business project and made an assessment of the proposed method based on these results. Thus, these respondents provide an entirely independent view of the project's results. Table

6.18 shows the profile of expert respondents. All respondents had experience with how EA processes work in practice, although some more than others. The average years of work experience among the respondents exceeded 20 years. The criteria for selecting the experts were as follows:

- More than 10 years experiences in the field of EA and enterprise's information systems
- Direct participating in more than 10 EA project
- Having appropriate education level for managing the project – Over the bachelor-

Table 6.18: Demographic Information of EA Experts

Expert 1	
Characteristics	**Respondent**
Year of experience	20
Type of employer	IT consultant, Technology Provider, Enterprise Architecture consultant, Enterprise Information Design
Year with current employer	8
Highest level of education	PhD
Current job	Enterprise Architect
Number of EA project participation	18
Expert 2	
Characteristics	**Respondent**
Year of experience	25
Type of employer	IT Consultant, IS provider, Enterprise Architecture consultant
Year with current employer	8
Highest level of education	Master
Current job	Enterprise Architect
Number of EA project participation	Over 35
Expert 3	
Characteristics	**Respondent**
Year of experience	25
Type of employer	System Architecture, IT consultant, Enterprise Architecture consultant
Year with current employer	8
Highest level of education	Master
Current job	Enterprise Architect

Table 6.18: Continued

Number of EA project participation	Over 30

Expert 4	
Characteristics	**Respondent**
Year of experience	15
Type of employer	IT consultant, Technology Provider, Enterprise Architecture consultant, Enterprise Information Design
Year with current employer	6
Highest level of education	Master
Current job	Enterprise Architect
Number of EA project participation	16
Expert 5	
Characteristics	**Respondent**
Year of experience	23
Type of employer	System Architecture, IT consultant, Enterprise Architecture consultant
Year with current employer	15
Highest level of education	Bachelor
Current job	Enterprise Architect
Number of EA project participation	Over 20
Expert 6	
Characteristics	**Respondent**
Year of experience	21
Type of employer	IT Consultant, IS provider, Enterprise Architecture consultant
Year with current employer	15
Highest level of education	Master
Current job	Enterprise Architect
Number of EA project participation	30
Expert 7	
Characteristics	**Respondent**
Year of experience	11
Type of employer	System Architecture, IT consultant, Enterprise Architecture consultant
Year with current employer	3
Highest level of education	PhD
Current job	Enterprise Architect
Number of EA project participation	18

6.6.1 Validation from the EA Experts

This thesis firstly asked the experts to review the results of case study as they work as IT consultant of Case 1, and secondly response to our questions. In order to achieve accurate results from expert review, we designed open questions related to the effectiveness and functionality of the proposed method.

a) **Data Collection:** The questionnaire, provided in Appendix D, has been used for the method validation from EA experts. The method, link to survey-questionnaire and related information have been emailed to seven experts.

b) **Questionnaire Format**: The questionnaire contains open questions. The purpose of the questions is meant for validation of the proposed method. To improve the questionnaire layout, assess the language comprehension and estimate the time required to complete the questionnaire, the academic person that have knowledge in questionnaire making and statistical concept have been selected and his recommendations have been incorporated in questionnaire before beginning of interview. The questionnaire contained seven questions to validate ***applicability criteria*** of the propose method.

c) **Sampling and population:** The Expert sampling which form of purposive is sampling has been employed for obtaining a valid sample of respondents. Seven experts having deep background in EA with at least 10 years' experience have been invited to participate in the proposed method validation. All seven experts have shown their willingness to participate in the validation. Demographic information of those seven experts have been provided in table 6.18.

d) **Responses:** The experts have been solicited to answer the open questions related to the effectiveness and functionality of proposed method. All the seven experts have answered the questions. The responses of seven questions and seven experts is described as follows.

6.6.2 Discussions and Results of Expert Reviews

For the proposed method validation by expert review, seven open questions have been conducted, the results have been presented in table 6.19.

Table 6.19: Results of Expert Interviews

Q1- Based on your experience with the proposed evaluation method, what is your opinion about its value as a post-implemented EA evaluation method?	
Expert 1	"I think it is an efficient and easy to understand way of evaluating the business and IT requirements in developed EA artefacts. When included as a means of elaborating on the higher level views of the EA it proves very effective for drilling down and I thought it was excellent for evaluating the EA because it is quite efficient and effective at defining metrics for evaluation practices along with considering governance and future changes. Ultimately, I can say that it reduce the complexities of EA evaluation by its practices and metrics."
Expert 2	"I really have no experience with this method other than seeing the results presented. The outputs of this method was easy to understand and use. In compare of other evaluation methods, I can say that there is adequate foundation behind that and this makes the method usable. Other methods mostly present more activities with difficult procedures, but this method provides simple and effective practices."
Expert 3	"The proposed evaluation method provides a simple mechanism for describing evaluation procedures without using complex plan and presents effective way for describing the outputs of evaluation. Based on

	my experience, this method provides appropriate practices without the complexity for employing in evaluating the post-implemented EA due to sufficient metrics for each practice."
Expert4	"I think it is enough mature to be employed by enterprises as means of evaluation method for checking the achievement of EA objectives."
Expert5	"If we consider that the definition of value in EA project is the answering the business requirements, then I strongly believe that the proposed evaluation method is value driven because it provides appropriate foundation for evaluating the developed artefacts."
Expert6	"The key value of this method is to providing easy and effective way for evaluating the EA artefacts in terms of functionality and effectiveness."
Expert7	"The proposed method assist the enterprise's decision makers to realize the situation of enterprise after implementing the EA artefacts in an appropriate manner."
Q2- Based on your experience with the proposed evaluation method, what is your opinion about its value for evaluating the achievement of the intended EA goals?	
Expert 1	"The practices are well organized in order to evaluate the intended goals. Although there are some difficulties such as getting the consensus of main stakeholders, this method provides step by step plan for evaluating the EA artefacts."
Expert 2	"There are two perspectives on achieving intended goals in EA project including enterprise architects perspective and project business stakeholders. Enterprise architects looking for implementing all EA artefacts in accordance with migration plan, however business stakeholders focus on implemented information systems in order to check the business requirement. As an EA perspective, I would say that this method supports the evaluation of post-implemented EA in effective manner."

Expert 3	"If we consider the EA implementation from enterprise's goals definition until implementing EA artefacts based on business requirement and defined goals, this method support evaluating developed EA artefacts in effective and efficient way".
Expert4	"Achievement of defined EA objectives is the key issue of each EA project and the proposed evaluation method can be seen as appropriate evaluation means of this achievement."
Expert5	"The proposed method evaluate the functionality and effectiveness EA artefacts and of course by doing this the stakeholders are enable to understand the status of defined EA objectives achievement."
Expert6	"The value of the proposed method for evaluating the achievement of defined EA objectives in EA project is to providing appropriate supportive documents regarding the functionality and effectiveness of each developed EA artefacts."
Expert7	"It suggests an easy and efficient method for evaluating the implemented EA within an enterprise and assists the enterprise's stakeholders for understanding succeed of EA project"
Q3- Based on your experience with the proposed evaluation method, what is your opinion about its value in usability of EA evaluation?	
Expert 1	"It is value driven and theory based method. Evaluating the develop EA artefacts in order to check the achievement of defined EA objectives is the main concepts of usability of this method."
Expert 2	"The usability of the proposed method is clearly recognizable in terms of understandability and simplicity of the application of the proposed method. Since the proposed method is easy to understand and use it can be seen as usable method for evaluating the EA implementation."
Expert 3	"This method design an appropriate strategy for evaluating the developed EA artefacts based on some novel approaches. Usability is created in this method by providing effective practices, efficient metrics, and appropriate foundations."
Expert4	"There are effective and efficient metrics for each practice and it make the proposed method as consistent evaluation method."
Expert5	"It is difficult to easily evaluate the functionality of EA, but this method provides step by step and rational practice along with metrics for evaluate the functionality and effectiveness of developed EA artefacts."
Expert6	"The provided metrics make the proposed method sophisticated one for evaluating the developed EA artefacts."

Expert7	"It is an appropriate method for evaluating the implemented EA within an enterprise."
Q4- Based on your experience with the proposed evaluation method, what is your opinion about its value in appropriate capabilities for EA evaluation?	
Expert 1	"Easy to learn and implement are the most valuable items which used in this method. Besides, the role of planning and implementation are important in order to highlight the applicability of enterprise."
Expert 2	"This method enables enterprise's business and IT requirement and provide appropriate capability for EA evaluation in terms of developed EA artefacts such as: information systems and maintenance plan."
Expert 3	"It has usable plan for EA evaluation, so all metrics and practices can be seen as its capabilities".
Expert4	"It is possible to employ this method for EA evaluation project."
Expert5	"Easy to learn and use, using appropriate metrics, and applicable outputs are the capabilities of the proposed method."
Expert6	"It is easy to use the proposed method in EA project."
Expert7	"The key value of the proposed method is understandable for both stakeholders and project teams."
Q5- Based on your experience with the proposed evaluation method, what do you see as the strength aspects of the evaluation method?	
Expert 1	"Effective and efficient practices which used by this method provide appropriate way for evaluating the post-implemented EA within an enterprise."
Expert 2	"Easy to implement and learn is one of the good features of this method. Besides, adaptability in another key factor of this method."
Expert 3	"Appropriate metrics and practice for evaluating the effectiveness and functionality of the developed EA artefacts along with providing lightweight plan".
Expert4	"Using appropriate metrics for evaluating functionality and

	effectiveness of developed EA artefacts."
Expert5	"Evaluating functionality and effectiveness aspects of developed EA artefacts are key elements of the proposed method."
Expert6	"The strength part of the proposed method is the comprehensive consideration on practices for evaluation."
Expert7	"It is a light and acceptable method for evaluating EA."
Q6- Do you have any suggestions for improving the proposed evaluation method?	
Expert 1	"It would be better if you provide a diagrammatic representation of any interaction and practices for better transferring the method contents.".
Expert 2	"As an Enterprise Architect I would find it more helpful for supporting EA evaluation. It would be better if you provide a management tool for better managing the project."
Expert 3	"Nothing."
Expert 4	"Nothing."
Expert 5	"Nothing.".
Expert 6	"Nothing.".
Expert 7	"Nothing.".
Q7- Are there any other comments you would like to make?	
Expert 1	"A very good start, I could see this method developing and improving given user feedback of those developing projects as well as those utilizing the EA artefacts."
Expert 2	"I was very impressed with its capabilities on implementation practices. If you create the forum and online website in order to spread it, then other practitioners will use that and you will get more feedbacks from them."
Expert 3	"I would like to suggest a name for this method.'
Expert 4	"Nothing.".
Expert 5	"Nothing.".
Expert 6	"Nothing.".
Expert 7	"Nothing."

6.7 Overall Validation

The main questions for evaluating the proposed METHOD is breakdown into the following questions based on the concepts and features of usability.

- Question 1: Does the proposed method's components provide appropriate capabilities for EA evaluation?

- Question 2: Does the proposed method's practices provide appropriate environment for EA evaluation?

If these two questions are answered in the affirmative, then we have also provided evidence that the method developed in this thesis is an effective method (J. W. Creswell, 2013; Venkatesh et al., 2013). In order to answer the above questions, the results of two conducted cases, cross case studies, and expert reviews are considered. Figure 6.13 shows the processes of evaluation.

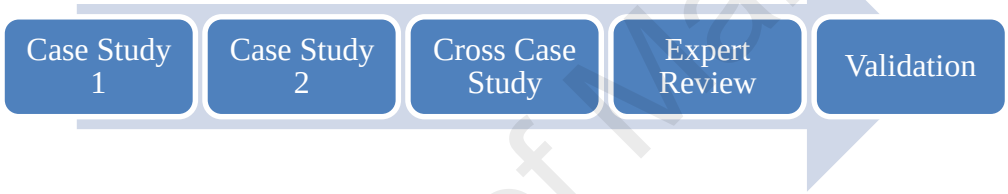

Figure 6.13: Processes of Evaluation

With respect to the first question, the results of open question analysis from Case 1 and Case 2 indicated that the proposed method contains effective components in terms of practices, methods, and deliverables. These components lead to define the project objectives by appropriate information based on business and IT requirement and support the EA implementation in order to achieve the defined objectives. Besides, in terms of completeness, it is possible to evaluate EA by means of the proposed method's practices.

The results of closed questions from Case 1 and Case 2 indicated that respondents agree that the proposed method contains the appropriate practices and metrics for evaluating the effectiveness and functionality and this means that the proposed method support evaluation of post-implemented EA in terms of its practices and metrics.

From experts' point of views, the proposed method shows the capabilities for evaluating the post-implemented EA. Easy to learn and implement, enabling enterprise's business and IT requirement, providing the step by step plan for EA evaluation and supporting governance, using appropriate practices, defining the EA outputs properly, using adequate foundation for making effective evaluation are some of its capabilities that mentioned by experts.

With respect to the second question, the analysis of interviews and closed questions from Case1 and Case 2 show that the proposed method provide appropriate environment in terms of alignment and integration. Besides, the proposed method support the future changes by providing dynamic environment for enterprise. Finally, the proposed method supports adaption plan, which uses for adjusting and readiness of enterprise for developed EA artefacts.

From experts' point of views, the proposed method provide appropriate environment for EA evaluation. Iterative phases for eliminating the mismatch of outputs, maintenance of EA project by governing, adaptability plan for increasing the acceptance rate of EA implementation by enterprise, appropriate repository for keep the updated EA artefacts, and effective transition plan for implementing the EA are some items that mentioned by expert regarding dynamic environment.

Together, Case 1, Case 2, cross case, and expert reviews provide solid evidence that the two questions can be answered in the affirmative. Therefore, we can conclude that the proposed EA evaluation method is usable and applicable.

6.8 Design Science Research validation

As mentioned in Chapter 3, design science is inherently a problem solving process (S. Gregor & A. R. Hevner, 2013; Peffers, Rothenberger, Tuunanen, & Vaezi, 2012).We evaluated the design of the proposed method against the seven guidelines formulated by Henver and Chatterjee (2010) in order to have better understanding regarding the effective design-science of this thesis. Table 6.20 summarizes the results of this evaluation.

Table 6.20: Summary of Applying Henver and Chatterjee Guidelines to the Proposed method (A Hevner & S Chatterjee, 2010)

Guidelines	Description
Design as an artifact	Our thesis delivered the practices of EA implementation evaluation and a method for evaluating EA implementation.
Problem relevance	The proposed method was developed in order to provide a structured and holistic evaluation method for post-implemented EA
Design evaluation	The proposed method was developed based on the identified practices by means of SLR and practitioners' points of view. The proposed method was applied to two types of cases (external validity). Construct validity was aimed for by using multiple participants when applying the model. The constructs behind the model were well-understood. Reliability was achieved by describing the process through which the proposed method's practices were developed.
Research contributions	The main contribution of this thesis is having developed an evaluation method to enhance the evaluation procedure and support all aspects of EA implementation. The provided list of evaluation practices in EA implementation is another contribution of this thesis. Besides, it is a value driven and theory based method, which has appropriate foundation for evaluating the developed EA artefacts.
Research rigor	The foundation for developing the proposed method was achieved by conducting SLR on evaluation practices and semi-structure interviews with EA practitioners. Moreover, the proposed method was evaluated using a case study and cross-case analysis. The proposed method is in line with the Enterprise Architecture Body Of Knowledge (EABOK) and design science research.
Design as a search process	The requirements for developing the proposed method are considered research steps, which were described in Section 3.5.1
Communication of research	This thesis considers both a technology-oriented audience (researchers who will extend this method and practitioners who will implement it) as well as a management-oriented audience (researchers who will study the method in context and practitioners who will decide if it should be implemented in their organization).

This thesis developed the proposed method for effective evaluation within an EA implementation in enterprise. This thesis employed the proposed method in two different EA projects. According to the results of conducted case studies, the proposed method is usable and applicable for EA implementation into selected cases. The case studies results reflect the characteristics of the proposed method in terms of effectiveness and functionality metrics and provide a transparent connection between the Case 1 and Case 2 within cross case study. The proposed method represents an effective method for making explicit the evaluation of EA within an enterprise and as such enables the effectiveness of EA. It builds the bridge between the EA practice and the area of achieving business goals.

6.9 Threats to Validity

In this thesis, validity threats were analyzed in terms of the followings items. In order to reduce bias of individual researchers, the analysis was conducted by multiple researchers.

- The general validity was checked by considering the checklist items for the design and data collection plan proposed by Host and Runeson (2009).
- Construct validity demonstrates that the correct operational measures were planned for the concepts under study. Tactics for ensuring construct validity include using multiple sources of evidence, establishing chains of evidence, and expert reviews of draft protocols and reports. Construct validity was achieved by involving participants from various backgrounds in the EA evaluation case studies.
- External validity identifies the domain to which the study findings can be generalized. Tactics include using theory for single-case studies and using

multiple-case studies to investigate outcomes in different contexts. In this research, external validity is supported by the fact that the proposed method was applied in two very different types of organizations.

- Reliability was achieved by clearly describing the process through which the proposed method's practices were developed and how the different cases were implemented for the proposed method.

6.10 Summary

This chapter represent the validation activities for the proposed method for evaluation EA implementation in enterprise. The proposed method is validated from, i) the industrial perspective through the practitioners from Enterprise Architecture (EA) industry by conducting two case studies, ii) EA expert review , iii) cross case study. The criteria of "applicability ", "usability" are defined for the validation. The results are investigated through quasi-statistical and descriptive analysis with Atlas.ti and SPSS. In this regards, the procedure of conducting case study along with the selection criteria for case are represented. The data collection plan and data analysis for case study are fully described. Finally the validation was done based on the conducted case studies results, expert review, cross case study analysis, and design science research. The following chapter will provide the overall discussion and conclusion of this research.

CHAPTER 7: DISCUSSION AND CONCLUSION

7.1 Overview

This chapter summarizes the present research work, the strategy used to achieve the research objectives, the research contributions and limitations, and future work recommendations.

7.2 Research Summary

This thesis was aimed to develop a Post-Implementation EA Evaluation Method (PEAR) in order to address issues with evaluating the EA artefacts. Existing evaluation method practices do not comprehensively support effectiveness and functionality as evaluation aspects of EA artefacts developed in EA implementation projects. As a consequence, evaluation projects may face inadequate adaptation to future changes, a lack of structured guidelines for EA artefact evaluation, and a lack of structured practices for continual improvement of EA implementation. The PEAR is based on the program theory and relevant industry practices in order to provide a structured method and support enterprise decision-makers.

The PEAR intends to address the functionality and effectiveness of developed EA artefacts for acquiring the EA objectives of an enterprise. The method encompasses 3 phases, 12 practices and 72 metrics.

The PEAR was evaluated from i) the industrial perspective using practitioners from the Enterprise Architecture (EA) industry by conducting two case studies, ii) using EA expert reviews, and iii) through a cross case study. ‘Applicability’ and ‘usability’ were the two validation criteria. To develop the PEAR, 3 research objectives were defined and fulfilled.

7.3 Responses to Research Objectives

This section describes the findings, research methodology, and deliverables of the defined research objectives. This thesis was set out to develop an evaluation method for the post-implementation of EA projects. The overall research process is divided into three main sections, including preparation, development and validation.

Objective 1 - RO1- To identify the requirements for developing the EA evaluation method

In order to achieve objective 1, this thesis defined the following questions:

RQ1-What are existing evaluation methods?

RQ2-What are the practices that recommended for EA evaluation method?

RQ3-What are the current issues of EA implementation evaluation?

To achieve the first objective, a Systematic Literature Review (SLR) was conducted (Section 4.2) as a first step. The SLR was carried out by using the guidelines given by (BA Kitchenham, 2007). To conduct the SLR, six electronic databases were targeted: i) IEEE Xplore, ii) ACM, iii) Science Direct, iv) Springer Link, v) Taylor and Francis, and vi) Google Scholar. Studies were selected by applying inclusion, exclusion and quality assessment criteria. After analyzing 418 studies, 4 categories of evaluation methods were identified (answer to RQ1). These categories of existing EA evaluation methods identified are IT management-based methods, effectiveness methods, metrics-based methods and maturity methods, as mentioned in Sections 4.3.1 and 4.5.1. Besides, practitioners' inputs on EA evaluation methods were extracted by means of interview (Section 4.6).

Existing EA evaluation methods' information in the Enterprise Architecture Body of Knowledge (EABOK) (Hagan, 2004) can be extended by providing specific information on the EA evaluation methods' structure.

After analyzing the results, 12 practices were extracted as mentioned in Sections 4.3.2 and 4.3.3 (answer to RQ2). The identified practices are Business Strategy, Alignment, Risk Management, Maintenance, Integration, Continuity, Management, Architectural Technique, Governance, Planning, Stakeholder Satisfaction, and Architectural Method. In order to include practitioners' perspectives, interviews with EA practitioners were conducted for this thesis. After omitting overlapping practices, the Architectural technique and architectural method were recommended by practitioners. The provided practices can be used to improve the effectiveness of existing EA evaluation methods or for enterprise architects to develop a customized evaluation method

14 issues with existing evaluation methods were identified (answer to RQ3). Besides, the perspectives of practitioners regarding objective 1 were achieved through interviews. After considering the SLR and interview results, the current issues with EA evaluation were obtained.

This investigation revealed the complexities of existing EA evaluation method practices, which hinder enterprise architects with EA implementation due to inappropriate foundations and structures. The results are very useful for researchers who are interested in the EA evaluation domain to obtain more solutions to existing problems.

RO2- To propose an evaluation method for post implementation EA

In order to achieve objective 2, this thesis defined the following question:

RQ4- What are the components of the evaluation method of post implementation EA?

Through SLR (Section 4.1) and by conducting interviews with EA practitioners, the 12 practices of EA evaluation were identified (Figure 4.10).

To develop an applicable and useful method, the identified practices needed to be categorized based on concept and meaning. Therefore, the identified practices were categorized into three groups including: initiation, control and sustainability. Furthermore, in order to provide an appropriate evaluation method, the required metrics for each practice had to be represented. The provided metrics cover two main aspects of evaluation, including effectiveness and functionality. These metrics support the applicability and usefulness of the proposed method. As a result, the proposed method was developed based on the results of the conducted SLR in response to objectives 1 along with interviews conducted with EA experts.

The PEAR contains three key components, which are input, process and output. It is based on a combination of the solid theory and best practices. The first component, input, includes EA deliverables. The process component takes into consideration providing functionality and effectiveness as two criteria for evaluation and uses the identified practices for evaluating the inputs by means of defined metrics. The process component contains three main stages, which are initiation, control and sustainability. For each stage, there is a separate set of practices as an evaluation structure. The output

reports the results of EA evaluation in terms of effectiveness and functionality (answer to RQ4).

This thesis extended the application of the Program theory to other IS aspects by using the relevant concepts in the proposed EA evaluation method. The proposed method contains effective practices and phases, which were extracted from EA practitioners' perspectives and the SLR report. The proposed method can also be added to EABOK (Hagan, 2004) as a usable method for supporting EA implementation evaluation. Practitioners can employ the proposed method in EA projects as a usable method to evaluate the achievement of EA objectives, govern evaluation practices, and provide appropriate capability for evaluating the developed EA artefacts in terms of effectiveness and functionality. The proposed method will enable enterprises to evaluate the implemented EA artefacts and assess their advantages.

Objective 3 -To evaluate the usability and applicability of the proposed method

In order to achieve objective 5, this thesis defined the following question:

RQ5- How to evaluate the proposed method?

RQ5 focused on validating the PEAR by means of a case study and expert review. Two case studies were conducted based on the designed case study protocol, as mentioned in Section 3.3.2.1. The data were collected from practitioners who participated in the case study by means of interviews and closed-ended questions. The procedure of data analysis was designed for both quantitative and qualitative data collection in Section 6.8. Moreover, interviews with EA experts were also used for further method evaluation.

A total of 14 participants were interviewed during the case studies. The participants were enterprise architects and business users. All interviewees work directly in EA

implementation projects. Besides, 7 experts were interviewed in order to enrich the validation processes. The consolidated results of the conducted case studies, cross case study, and expert reviews indicated that the proposed method supports the usability and applicability criteria.

The evaluation report contained an analysis of qualitative and quantitative data that were collected from Case 1 and Case 2 participants. The quantitative analysis showed that the respondents believed the PEAR is usable and applicable. The qualitative analysis indicated that the PEAR has the applicability to support the evaluation of developed EA artefacts.

7.4 Contribution and Significance of the Research

The contributions of this thesis not only provide appropriate information in the area of EA evaluation to support future researchers but also have practical applications. The contributions of this thesis are as follows:

- Crucial information is provided about evaluation practices that can extend the EABOD and can be used by practitioners to improve the effectiveness of implemented EA within an enterprise or develop a customized EA evaluation method. Besides, an appropriate direction was recommended for future research (Chapter 4).
- A lightweight post-implementation EA evaluation method is offered, which assists the evaluation of EA implementation and enables enterprises to assess developed EA artefacts and achieve EA objectives. This method is based on the program theory and evaluation theory.

- A list of critical issues with EA evaluation methods, practices and methods was given. These issues should be highlighted by researchers to develop relevant solutions with the objective to increase the effectiveness of EA implementation.
- A novel way of applying the program theory in EA evaluation was suggested in order to evaluate developed EA artefacts in post-implemented EA projects

7.5 Limitation

Despite the list of contributions, this thesis work has some limitations, including:

- According to (Barbara Kitchenham, 2004; B. A. Kitchenham & Charters, 2007)'s guidelines and procedures, the following steps cause some limitations for SLR:
    - Since the search was done particularly on online databases, there may be some related resources that were not included in this SLR. This is because of paper type, such as private technical report, and security reasons (Mahdavi-Hezavehi, Galster, & Avgeriou, 2013).
    - The data collection procedure for the conducted SLR was fulfilled in 2015. Therefore, it is possible some related publications were not included in this SLR because they were published after SLR data collection ended.
- This thesis work involved a number of questionnaire surveys mainly containing closed-ended questions. Closed-ended questions limit the innovation and thinking of respondents, which may affect the findings. This problem was tackled with open-ended questions.

7.6 Discussion

Several studies have been done on the development of EA evaluation for both practitioners and researchers. The majority of existing evaluation methods were not developed on any theoretical basis. The lack of attention to attaining an appropriate and holistic method for evaluating EA implementation leads to insufficient and inaccurate analysis of EA artefacts. Thus, an enterprise cannot achieve the intended EA project goals. An effective evaluation method should involve a comprehensive requirement analysis in terms of functionality and effectiveness.

Monitoring and governing EA implementation is a critical part of EA implementation maintenance, and an evaluation method should provide a suitable plan to support these activities in any EA project. By doing so, the evaluation method can assist architects and stakeholders to continue improving EA implementation and increase the quality of the intended EA implementation goals.

The features of the PEAR are as follows:

- ***Easy to use***: it provides step-by-step guidelines to assist the evaluator.
- ***Comprehensiveness:*** it supports all aspects of an enterprise. The practices provided by the proposed method support the initiation, control and sustainability of EA projects.
- ***Support for decision making***: it represents the impact that concrete enterprise development generates in an enterprise, allowing the selection of one amongst other programs to improve enterprise performance. The output of the proposed method represents the practices supporting decision-making by enterprise architects and stakeholders.
- ***Multi-disciplinary coordination***: it coordinates the set of disciplines that exist in an enterprise in order to convey decisions in one plan with common objectives.

- ***Structured method***: it considers the overall enterprise and includes several views. Technological, informational, organizational and human aspects are considered along with the relationships between them and their external elements. The process component practices offer such consideration for evaluating EA implementation.
- ***Covering the gaps***: it covers the gap between EA implementation objectives and stakeholders' perspectives without leaving further gaps. This means that both stakeholders and enterprise architects' perspectives are taken into account in evaluating EA implementation.
- ***Flexible:*** the proposed method provides a set of dynamic practices that are flexible in addressing new changes based on requests for updates and changes

7.7 Future works

There are several opportunities for further work and some lines are suggested for continued work. According to the findings of this thesis, potential research for future works includes:

- Based on the conducted SLR, there are some pending issues with EA evaluation methods that need to be addressed, such as evaluating the performance and efficiency of EA implementation (Section 4.5.3).
- Employing specific tools for managing, developing and maintaining EA evaluation will contribute to better understanding of project status for stakeholders and project team members. This thesis suggests the development of such tools in future work. For instance, a management tool should be used in EA evaluation projects, whereby the current status of each EA evaluation method's practices described leads to increased understanding of the project progress for the main stakeholders. In short, developing more supporting

tools to facilitate and manage the use of EA evaluation methods will tremendously help enterprises conduct such process in a more convenient and practical way.

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LIST OF PUBLICATIONS AND PAPERS PRESENTED

The followings papers have been extracted and published in the journals and conferences based on the findings of this thesis:

Conference:

1) Fatemeh Nikpay, Rodina Binti Ahmad, Babak Darvish Rouhani. "Current Issues on Enterprise Architecture Implementation Evaluation "(2015)." World Academy of Science, Engineering and Technology International Journal of Social, Behavioral, Educational, Economic, Business and Industrial Engineering Vol:9, No:1, 2015.

Journals (ISI):

1) Fatemeh Nikpay, Rodina Ahmad, Chiam Yin Kia "A *method for evaluating enterprise architecture implementation*". "Evaluation and Program Planning , Elsevier , Volume 60, February 2017, Pages 1–16 (ISI indexed)
2) Fatemeh Nikpay, Rodina Ahmad, Babak Darvish Rouhani, Shahaboddin Shamshirband. "An Effective Enterprise Architecture Implementation Methodology " , Information Systems and e-Business Management , Springer January 2017
3) Fatemeh Nikpay, Rodina Ahmad, Babak Darvish Rouhani, Shahaboddin Shamshirband (2016). "A Systematic Review on Post-Implementation Evaluation Models of Enterprise Architecture Artefacts." Information Systems Frontiers December 2016. (ISI Indexed) Impact Factor: 1.450

4) Babak Darvish Rouhani, Mohd Naz'ri Mahrin, Fatemeh Nikpay, Rodina Binti Ahmad, Pourya Nikfard "*A systematic literature review on Enterprise Architecture Implementation Methodologies"*. "Information and Software Technology" – Elsevier- Volume 62, Pages 1-20

5) Fatemeh Nikpay, Rodina Ahmad ," critical success factor model for enterprise architecture implementation" , Malaysian Journal of Computer Science (ISI Indexed)- Accepted