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A hybrid method for evaluating enterprise architecture implementation

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ABSTRACT

Enterprise Architecture (EA) implementation evaluation provides a set of methods and practices for evaluating the EA implementation artefacts within an EA implementation project. There are insufficient practices in existing EA evaluation models in terms of considering all EA functions and processes, using structured methods in developing EA implementation, employing matured practices, and using appropriate metrics to achieve proper evaluation. The aim of this research is to develop a hybrid evaluation method that supports achieving the objectives of EA implementation. To attain this aim, the first step is to identify EA implementation evaluation practices. To this end, a Systematic Literature Review (SLR) was conducted. Second, the proposed hybrid method was developed based on the foundation and information extracted from the SLR, semi-structured interviews with EA practitioners, program theory evaluation and Information Systems (ISs) evaluation. Finally, the proposed method was validated by means of a case study and expert reviews. This research provides a suitable foundation for researchers who wish to extend and continue this research topic with further analysis and exploration, and for practitioners who would like to employ an effective and lightweight evaluation method for EA projects.

1. Introduction

Enterprise Architecture (EA) provides a comprehensive strategy and environment for aligning enterprise business with IT (Schmidt et al., 2014; Sobczak, 2013a). To provide an appropriate environment for the alignment of business with IT, EA describes the current architecture (As-Is), elaborates the desired architecture (To-Be), and represents the migration plan for transiting from the current to the desired architecture of an enterprise (Niemi & Pekkola, 2013; Plataniotis, de Kinderen, & Proper, 2013). Four architectural levels—business, data, application, and infrastructure—need to be described in these three aforementioned EA project stages (Bernard, 2012; Giachetti, 2012; Zandi & Tavana, 2012).

EA implementation requires two main components: an EA Framework (EAF) and an EA Implementation Methodology (EAIM) (Iacob & Meertens, 2014; Rouhani, Mahrin, Nikpay, & Rouhani, 2014). EA employs EAF as the structure for modeling the various enterprise aspects and EAIM is the methodology for implementing EA in an enterprise (Iacob & Meertens, 2014; Rouhani et al., 2014; Simon, Fischbach, & Schoder, 2014). The outputs of EAF are EA artefacts, such as diagrams, models, documents, and graphs, and EAIM is an attempt to implement the EA artefacts within an enterprise (Holm & Buschle, 2014; Lankhorst, 2013 Lankhorst, 2013). Effective EA implementation provides a stable and flexible environment for an enterprise (Aier, 2014; Van der Raadt & Bonnet, 2010).

EA implementation is not the final step of an EA project; an enterprise needs to also ensure that lessons learned during EA implementation are not forgotten. Enterprises can effectively design and execute future EA projects when benefitting from lessons learned through experience with previous projects (Malta & Sousa, 2012; Rouhani et al., 2014). This is when the Post-Implementation Review (PIR) process is helpful (Robert Winter Kai Fischbach, 2013 Schmidt & Buxmann, 2010). The purpose of the PIR is to evaluate how successfully the project objectives have been met and how effective the project EA practices were in keeping the project on track (Cameron & McMillan, 2013; Löhe & Legner, 2013). Upon complete EA implementation, PIR is aimed at identifying lessons learned that can help with EA component operation and maintenance, ISs integration and overall practice improvement in the enterprise (Ojo, Janowski, & Estevez, 2012; Prat, Comyn-Wattiau, & Akoka, 2014; Zare & Ravasan, 2014). Periodically

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throughout the EA component lifecycle, managers review the value of providing ongoing funding for the operation and maintenance of a certain EA component. In this way, the entire business, technology and integration environment is evaluated for continuing value (Prat et al., 2014; Osterlind, Johnson, Lagerstrom, & Valja, 2013).

EA evaluation (EAV) is defined as the process of determining the merit, worth, and value of EA artefacts (Osterlind et al., 2013; Plessius, Slot, & Pruijt, 2012). An evaluation discipline in EA is necessary because enterprises as well as EA practitioners in general require systematic, unbiased means of assessing whether their products, practices, methods, and EA artefacts have met their goals (Karimi, Sharafi, & Dehkordi, 2016; Osterlind et al., 2013; Pruijt, Slot, Plessius, & Brinkkemper, 2016). Evaluation leads to generating information that assists with making judgments and decisions on a program, service, policy or ISs integration, and then guiding decision makers to take practical actions (Andersen & Carugati, 2014; Baliyan & Kumar, 2014; Osterlind et al., 2013; Venable, Pries-Heje, & Baskerville, 2012).

EAV enables enterprises to make strategy-driven decisions based on a holistic view of predetermined EA goals. It also promotes the ability to change management, reuse ISs and avoid duplicative expenses, and accomplish project risk management (Plataniotis et al., 2013a; Plataniotis & De Kinderen, 2015).

EAV entails methods and techniques that generate information relating to an enterprise's EA vision and its ISs integration results, such as efficiency, effectiveness, maturity, quality of results, and functionality to support planning, improving, organizing, and managing EA activities during implementation (Giachetti, 2012; Löhe & Legner, 2013; Pruijt et al., 2016).

1.1. Motivation for this research

Existing EAV models have some deficiencies and inadequacies. These problems contribute to the lack of support for evaluating all EA artefacts after EA implementation in an enterprise.

Most existing EAV methods consist of maturity models, finance and cost methods (Lakhrouit & Baina, 2013; Ojo et al., 2012; Sobczak, 2013b; Wissotzki & Koc, 2013) that primarily address the EA and development process but do not evaluate architectural decisions and solutions concerning the organization's goal achievement (Meyer, Helfert, & O'Brien, 2011; Van der Raadt & Bonnet, 2010). Since there are no models for evaluating all EA artefacts, we can only analyze techniques in the areas of business processes, data modeling, software architecture evaluation, and benchmark testing (Aier, 2014; Cameron & McMillan, 2013; Lakhrouit & Baina, 2013; Zandi & Tavana, 2012). Several studies have been conducted by both researchers and practitioners on evaluating EA implementation, but not many cover all aspects of EA implementation (Lakhrouit & Baina, 2013; Osterlind et al., 2013; Wissotzki & Koc, 2013). An appropriate evaluation requires a comprehensive evaluation, which should address all aspects of EA. Besides, most existing models are intended to measure the cost and benefits of ICT investment (Iacob & Meertens, 2014; Lakhrouit & Baina, 2013; Sobczak, 2013b). These measures are always a relevant basis for managerial decision making (Galliers, Dorothy, & Leidner, 2016; Plataniotis, de Kinderen, & Proper, 2013).

There is a dearth of models to enable EAV effectiveness by considering the entire EA (Aier, 2014; Chun, 2012; Schmidt & Buxmann, 2010; Van der Raadt & Bonnet, 2010). Moreover, there seems to be no coherent view on EA implementation evaluation (Osterlind et al., 2013; Karimi et al., 2014; Andersen, 2015; Niu, Da Xu, & Bi, 2013). EAV models typically concentrate on EA results and there are insufficient models for the overall EA, and in most cases they do not contain all EA function elements (Aier & Schelp, 2010; Simon, Fischbach, & Schoder, 2013; Van der Raadt & Bonnet, 2010).

It is complex to achieve a comprehensive model for EA evaluation in terms of practices, methods, and processes (Niemi & Pekkola, 2013; Schmidt & Buxmann, 2010; Zandi & Tavana, 2012). Existing EAV models contain insufficient practices in terms of addressing entire EA functions and processes, using structured methods of developing EA implementation, multiple perspective consideration of EA implementation, employing matured practices and using appropriate metrics for proper evaluation. Consequently, enterprises cannot obtain the desired value by implementing EA artefacts; they cannot recognize modified, changed, or re-designed EA artefacts for further development and to improve the quality of future ISs integration. Moreover, enterprises cannot adapt to future changes due to insufficient support from IT (including IS integration, system architecture and system analysis).

There is a deficiency of structured methods for EAV. Investigations of existing evaluation models for EA implementation reveal that they are mostly inconsistent and disunited (Aier & Schelp, 2010; Armour & Kaisler, 2001; Van der Raadt & Bonnet, 2010). Besides, some existing evaluation models are obtained by means of multiple practical EA implementation projects and there is no appropriate theoretical and scientific foundation behind them (Lange & Mendling, 2011; Ojo et al., 2012; Sobczak, 2013a; Song & Song, 2010).

As a result, the aim of this research is to develop a hybrid evaluation method for EA implementation in order to cover all aspects of EA. The main focus of the reviewed studies lies in certain types of quality factors, alignment, metrics, and understanding of EAV. Although several problems have been identified in preliminary studies, covering all aspects of EA, using structured methods, and considering the technology layer and alignment are significant matters that should be taken into account by the evaluation model. EAV strongly depends on conceptual models as input and a basis for analysis and discussion, because they support sharing and communicating architectural knowledge among different stakeholders from various domains. Furthermore, more quantitative techniques like simulation and measurement can be applied but they require more detailed architectural descriptions.

1.2. Study goals and contributions

In this article, a hybrid method is proposed to assist with evaluating EA implemented in an enterprise. This research underwent three phases accordingly: preparation, development, and evaluation. The first phase provides the foundation and requirements of the hybrid method through a Systematic Literature Review (SLR) and interviews with EA practitioners on the required practices and factors that affect EA implementation evaluation. The second phase focuses on developing a hybrid method for evaluating EA implementation. The proposed hybrid method is developed based on the foundation and information from SLR, practitioners' points of view, IS evaluation theory and the program theory (Brousselle & Champagne, 2011; Rey, 2012). In the last phase, the proposed method is validated using a case study and expert reviews. The evaluation results are achieved by analyzing the data collected from the defined case study protocol, which contains the results of two case studies conducted, cross-case analysis, and expert reviews.

Each of the aforementioned steps provides vast information in the area of EA implementation evaluation. The first step identifies and describes the evaluation practices and factors that can assist researchers and practitioners in future research or that can be applied in EA projects. The second step describes a hybrid method for evaluating EA implementation to assess the achievement of intended EA goals and functionality, which is an appropriate method for evaluating EA projects. Finally, the third step illustrates the application of the proposed hybrid method.

The target audience for this research is twofold. First, we aim at researchers who wish to extend the evaluation of EA implementation and continue this research topic with further analysis and exploration. Second, we aim at practitioners who would like to employ a hybrid evaluation method in EA projects.

1.3. Structure of the paper

The remainder of this paper is divided into the following parts: related works are described in Section 2; the research methodology is presented in Section 3; the proposed hybrid method, its application and a discussion are given in Sections 4, 5, and 6, respectively; and the conclusions from this study are expressed in Section 7.

2. Related work

2.1. Evaluation of enterprise architecture implementation

Foundational papers in ISs design-science literature stress the importance of evaluation. The evaluation criteria were derived from the hierarchy of IS evaluation by (Chen, Osman, & Peng, 2012; Schmidt et al., 2014), SLR results and interviews with EA experts. Moreover, we adopted a systematic method to select effectiveness and functionality.

Evaluation research 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 projects and planned interventions." Both quantitative and qualitative methods, and even a mixed-method, can be adopted in evaluation research (Abdulrazak & Malik, 2012; Plataniotis et al., 2013a).

The purpose of evaluation research is not to explore new knowledge like other forms of research, but the aim is rather to use current knowledge to assess and study the effects, effectiveness and outcomes of some innovation, intervention, policy, practice or service and then to inform decision makers as a guide to practical actions (IGI Global, 2012; Plataniotis et al., 2013a; Zare & Ravasan, 2014).

Evaluation in relation to EA has grown into a significant topic for enterprises that need to coordinate large portfolios of projects and the adoption of IT and business processes over time. Evaluating the 'fitness' of individual IT projects that collectively constitute and support the entire EA is becoming a key strategic challenge and competency. Research shows that IS evaluation in practice is to a large extend done unsystematically (Aier, 2014; Giachetti, 2012; Niemi & Pekkola, 2013), which has similarly been suggested in relation to EAV. In terms of IS research, evaluation is particularly important. In light of the allocation of large investments and high failure rates of IS implementation, evaluation is a substantial function that directly affects IS success. Particularly, evaluation is very useful in predicting and assessing potential costs, benefits and risks associated with the development, implementation and use of IS, as well as assisting decision makers with taking proper action to mitigate the identified risks (Chun, 2012; Niu et al., 2013; Plataniotis et al., 2013b; Razavi, Aliee, & Badie, 2011; Zandi & Tavana, 2012).

2.2. Enterprise architecture evaluation process

The evaluation process is meant to identify and control the critical areas of EA project implementation. A set of evaluation criteria should be used to ensure that all dimensions of the EA endeavor are taken into account and assessed. The EAV process must be integrated into the business development, IS development, IS procurement and IT processes (Chen et al., 2012; Lange, Mendling, & Recker, 2015; Lakhrouit & Baina, 2013). The evaluation result is fundamental for each person involved in the implementation project, hence evaluation results are considered in the decision-making phase (IGI Global, 2012; Prat et al., 2014).

The outcomes of an EA implementation evaluation project determine the success of ISs implementation, ISs investment, and ISs functionality. EAV should not work only as a justification mechanism but as a tool to experience learning. During ISs development, feedback from the evaluation process should lead to corrective actions if necessary (Iacob & Meertens, 2014; Rouhani, Mahrin, Nikpay, Ahmad, & Nikfard, 2015; Rouhani, Mahrin, & Nikpay, 2015; IGI Global, 2012). Evaluating the success of ISs implementation should involve at least two dimensions: process and product success (Chen et al., 2012; Dwivedi, Wade, Schneberger, Laumer, & Eckhardt, 2016; Prat et al., 2014). Evaluating the conduct of the EA development process can facilitate learning for future projects. Product success includes both ISs functionality and the realization of expected benefits from ISs investment (Chen et al., 2012; Prat et al., 2014).

2.3. Enterprise architecture evaluation models

There are a range of ISs evaluation models, each with strengths and limitations. Moreover, different stages of the ISs lifecycle are associated with different goals, changes and outcomes (IGI Global, 2012; Luisi, 2014). As a result, the aims and focus of evaluation at different stages will also vary. Faced with this diversity and complexity, practitioners and evaluators may often find it difficult to select a model. Fig. 1 illustrates the evaluation models based on various phases. This research follows a goal-based summative and criteria-based summative process to develop a hybrid method, and descriptions of these two models are given subsequently.

2.3.1. Goal- based summative evaluation

This type of evaluation is derived from a combination of goal-based and summative evaluation. The purpose of this evaluation is to assess the implemented ISs to investigate the achievement of desired business goals. Apart from evaluating the attainment of business goals and system requirements, it is also used to assess the costs and benefits of implementing ISs in order to make better decisions. The main features of this evaluation model are as follows (IGI Global, 2012):

- Financial measures: evaluations with financial measures are carried out in terms of cost-benefit assessment based on traditional capital investment measure analysis.
- Non-financial measures: ISs investment contributions can also be evaluated from non-financial perspectives. Decision makers should evidently consider non-financial costs and benefits of ISs implementation along with the rapid development of ISs. Not

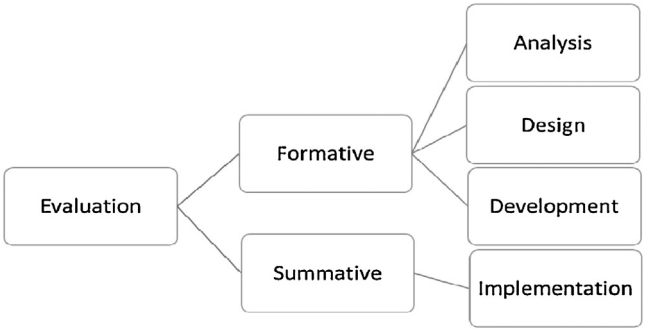

Fig. 1. Types of Evaluation Models.

only IT, but the interaction between users and ISs should also be considered in evaluation.
- Tangible measures: tangible performance measures are usually from the operational or tactical levels of ISs.
- Intangible measures: when evaluating organizational ISs, intangible measures such as organizational factors of enterprises like technological factors also need to be considered.

Since this research concentrates on the IT aspect of EA implementation, we do not investigate financial measurement. As this research is intended to evaluate the PIR of EA implementation, concern is directed toward final EA implementation and investigating the achievement of predetermined goals, which is a process referred to as goal-based summative evaluation.

2.3.2. Criteria-based summative evaluation

This type of evaluation combines criteria-based principles with the summative approach. It is usually carried out after IS development completion. This evaluation is usually aimed at certification by accrediting bodies, acceptance testing and quality assurance. It is also an exercise mostly undertaken by experts, but with a much less constructive purpose than in the formative stages of IS design and development. In order to generate both comprehensive and in-depth results, a hybrid method that mixes the use of various evaluation methods is always applied by evaluators in practice (IGI Global, 2012; Kim & Lee, 2010).

Summative evaluation can be used at the end of a project in the post-implementation inspection of the overall quality, efficiency and adequacy of IS implementation (Hou and Hu, 2012; IGI Global, 2012).

The hybrid method proposed in this research highlights specific practices determined from SLR and interviews with EA experts. This method is evaluated from the usability perspective and all processes are based on predefined checklists, hence it is called criteria-based evaluation.

2.4. Effectiveness of enterprise architecture implementation

The effectiveness of EA is highly uncertain and little research evidence establishes this. This criterion should help enterprises asses their integration environment and intended goals. Effectiveness is determined by the degree to which EA implementation outputs can help the enterprise attain its intended goals (Aier, 2014; Bradley, Pratt, Byrd, Outlay, & Wynn Jr, 2012; Van der Raadt and Bonnet, 2010; Weiss, Aier, & Winter, 2013). If the intended goals of the enterprise regarding EA coincide with the individual goals of stakeholders, then EA effectiveness is determined (Morganwalp & Sage, 2004; Van der Raadt & Bonnet, 2010). Moreover, the EA function of effectiveness is the degree to which organizational objectives are attained through the EA function outputs (Ojo et al., 2012; Rouhani et al., 2015a). Effectiveness may be objectively measured using organizational performance data related to the implementation of EA decision making (Lange & Mendling, 2011; Wan, Luo, & Carlsson, 2013).

2.5. Functionality of enterprise architecture implementation

From the functional perspective, EA describes how different components of an enterprise, such as organizational units, business processes, people, and ISs are interrelated and work as a whole towards the organizational goals (Aier, 2013; Tamm & Seddon, 2011).

When the former method is followed, EA deals with business architecture artefacts, such as business services and processes to allow the development of IT solutions that are better aligned with those functional components.

The necessity to evaluate the functionality performances of ISs has emerged from the importance of IT in effectiveness and efficiency of work processes in an enterprise and the rapid growth of demands in terms of resource performances in ISs. Evaluating IS functionality means evaluating performance of hardware, software, computer networks, data, practices and EA artefacts. The main purpose of functionality performance evaluation is to upgrade and especially improve the quality of maintenance (Koziolek, 2010; Närman, Buschle, & Ekstedt, 2013). IS functionality evaluation represents the procedure of assessing how successfully EA has achieved its objectives. The process of evaluation includes synthesizing and determining gathered individual scores with the purpose of forming a common opinion about the functionality of evaluated artefacts. In the process of expressing a general opinion, EA experts usually rely on their individual assessment abilities (Lange et al., 2015; Simon et al., 2014).

2.6. EA implementation evaluation practices

We conducted an SLR on EA implementation evaluation in order to identify the practices of evaluation models based on Kitcheham's (2007) instructions (Kitchenham, 2007; Kitchenham et al., 2009). We also carried out interviews with EA practitioners so as to understand practical points of view on evaluation practices. Table 1

Table 1
Description of identified practices.

Practice	Description
Business strategy	Is employed to assess the enterprise's business plans by considering the business environment and competitiveness
Alignment	Is employed to ensure the required IT requirement is used in accordance with the business strategy and supports management in developing and deploying EA
Architectural Method	Is employed to check the selection of an EA implementation method
Risk Management	Is employed to improve planning processes by enabling the key focus to remain on core business and IT to ensure continuity of service delivery; improve efficiency and general performance for desirable outcomes; and 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 integrates 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 supports EA development and deployment
Architectural Design	Is employed to define sets of technical requirements into an acceptable 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 provides input for EA decision-making and to conform to EA products

provides a description of identified practices from the SLR and interviews conducted, Fig. 2 shows procedure of finding SLR paper, in addition Table 2 illustrates number of selected studies per study type.

Table 2
Number of selected studies per study type.

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

3. Research methodology

This research underwent three phases: preparation, development, and evaluation. The first phase provides the foundation and requirements of the hybrid method by means of SLR and interviews with EA practitioners regarding the required practices and factors affecting EA implementation evaluation.

The second phase focuses on developing a hybrid method for evaluating EA implementation. The proposed method is developed based on the foundation and information of SLR and practitioners' points of view and adopts the program theory, information system evaluation theory and design science research (Brousselle & Champagne, 2011; Rey, 2012). In last phase, the proposed method is validated using case studies and expert reviews. The validation results are achieved by analyzing the collected data based on the defined case study protocol that contains the results of the two conducted case studies, cross-case analysis, and expert reviews.

To make this research appropriate and effective, the design science research approach was adopted based on Hevner et al.'s (Von Alan, March, Park, & Ram, 2004) guidelines. Design science research has previously been used within the field of EA and EA evaluation (Plessius et al., 2012; Pruijt, Slot, & Plessius, 2012a).

Besides, the System Usability Scale (SUS) model described in (Bangor, Kortum, & Miller, 2008; Brooke, 2013) is used in this work as a tool for evaluating the usability of the proposed method with the conducted case studies.

4. Proposed hybrid method

The fundamental process of the proposed hybrid method is a combination of the IS evaluation theory (Dwivedi et al., 2016) and design science in the IS theory (Von Alan et al., 2004). This research is intended to deliver practices as a basic component of evaluation with the method applied conforming to Henver and et al.'s guidelines (Von Alan et al., 2004; Hevner & Chatterjee 2010). As we are dealing with a new method of EA evaluation with the intent to cover the unaddressed problems of the effectiveness and functionality of EA evaluation, this may be considered a case of design science research.

The concepts and specifications of the proposed hybrid method are defined as follows:

- "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.
- "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."
- The "functionality" of enterprise architecture explains how all information technology elements in an enterprise – systems, processes, and people – work together as a whole.
- "Effectiveness" is defined as the degree to which the objectives (i.e. the purpose of organizational performance improvement) set by organizations with EA are being attained.
- A "hybrid method" is used to generate both comprehensive and in-depth results. Such method combines effectiveness and functionality and is thus always applied by evaluators.

Fig. 3 illustrates the proposed hybrid method model. This method is intended to evaluate objectives and products of EA implementation. By doing this, an enterprise will be able to understand the achievement of the defined EA objectives and EA implementation products. In order to generate comprehensive and in-depth results, evaluators always apply a hybrid method that mixes two criteria in practice. The method contains three main components: input, process, and output.

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

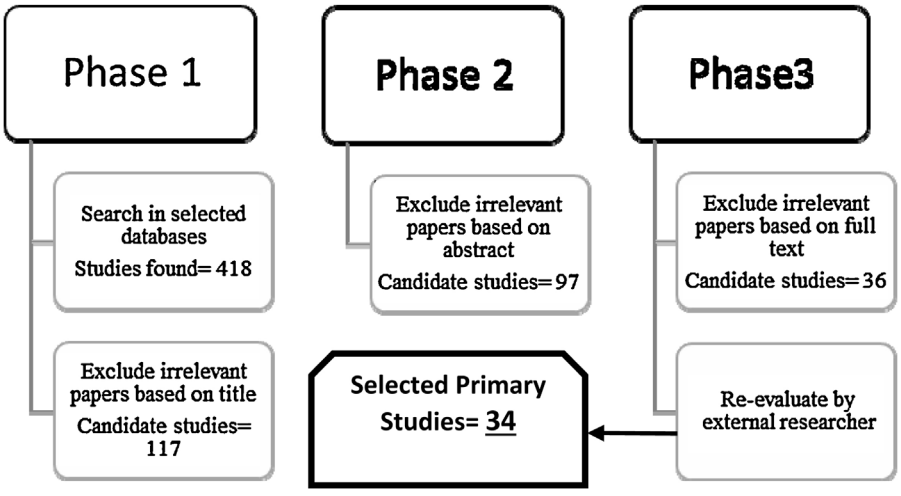

Fig. 2. Procedure of finding SLR papers.

Fig. 3. The proposed hybrid method.

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

4.1. 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; Giachetti, 2012; Iacob, Quartel, & Jonkers, 2012).
- Date Architecture captures the EA information dimension, high-level structures of business information, and at a more detailed level, the data architecture (Holm, Buschle, Lagerström, & Ekstedt, 2014; Jahani, Javadein, & Jafari, 2010; 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 (Lakhrouit & Baina, 2013; Lange & Mendling, 2011; Löhe & Legner, 2014).
- Technology Architecture covers the technologies and technological structures used to build information and communication systems in enterprises (Pruijt et al., 2012a; Quartel, Steen, & Lankhorst, 2012).

4.2. Description of components

4.2.1. Input

This section provides the specification of the input as a first component of the proposed method. The outputs of EA implementation architectural levels are considered inputs of the proposed method. The EA outputs were derived from the architecture layers comprising business, data, application and technology architecture. The input section provides appropriate categorizations for applying the evaluation practices. The evaluator consider inputs during the applying of the identified practices in Section 2.6. As a result, the evaluator answer the metrics of effectiveness and functionality based on the input reports.

Table 3 presents a categorization of EA outputs based on the Enterprise Architecture Realization Scorecard (EARS) model (Pruijt, Slot, Bos, & Brinkkemper, 2012). EARS offers an architecture development cycle that covers all lifecycle aspects required in EA evaluation.

As mentioned in Table 3, the proposed method entails five main input items, which were derived from the EA implementation outputs.

4.2.2. Process

The proposed method contains two criteria for evaluating EA implementation, namely functionality and effectiveness (Fig. 4).

Functionality and effectiveness are proposed method dimensions, whose features are applied to the evaluation practices.

4.2.2.1. Evaluation practices. This section describes the proposed method practices in detail. The following activities are done for each practice:

- Objective of the practice.
- Functionality metrics of the practice.
- Effectiveness metrics of the practice.

The proposed method employs the evaluation practices identified from the SLR and interviews with practitioners. Fig. 5 illustrates the proposed method's structure of the process component.

To better understand the proposed method practices, the practices are divided into the following groups:

- Initiation, which refers to preparing the enterprise to begin EA implementation (Šaša & Krisper, 2011; Sembiring, Nuryatno, & Gondokaryono, 2011; van Steenbergen & Brinkkemper, 2009).
- Controlling, which refers to conducting and developing the EA implementation within the enterprise (Alwadain, Korthaus, & Rosemann, 2011; Bradley et al., 2012; Stankovic, Nikolic, Djordjevic, & Cao, 2013).
- Sustainability, which refers to controlling and governing the EA implementation and taking appropriate action to cope with future changes (Bradley et al., 2012; Buckl, Schneider, & Schweda, 2013; Plataniotis et al., 2013a).

Table 3
Categories of EA outputs.

Input	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.

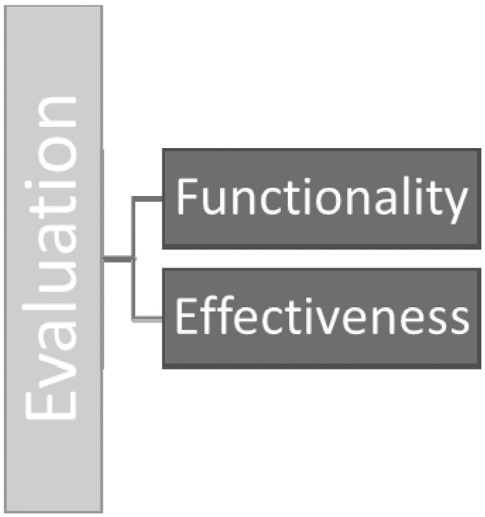

Fig. 4. Proposed Method Criteria.

4.2.2.1.1. Initiation. This section regards the evaluation practices related to the initiation of EA implementation. There are four practices, including business strategy, risk management, initiation, and EA framework. Table 4 represents the specifications of these practices.

4.2.2.1.2. Controlling. This section focuses on the evaluation practices related to EA implementation management. There are four practices, including alignment, technology function, management and stakeholder satisfaction. Table 5 represents the specifications of these practices.

4.2.2.1.3. 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 6 represents the specifications of these practices.

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

- For each input, all or some practices should be applied based on the enterprise architects ideas about implemented EA artefacts.
- For each practice, there are two sets of metrics including effectiveness and functionality.
- For each practice metric there are five criteria with weight scores.
- The enterprise architect is considered the evaluator with the proposed method due to their comprehensive view of EA implementation.
- The evaluator will score each metric based on Table 7.
- For each practice, the average of all metrics is considered the score.
- The cumulative score of each metric from all applied practices is the result of that metric, but the score of each practice will report the output component.
- According to Table 7 the maximum score for each metric is 48.
- The acceptability of each metric's score depends on the evaluator's idea and implemented EA performance; however, it is recommended in this research that an adequate score for accepting the EA implementation based on the selected criteria is between 24 and 36. In EA implementation, all EA artefacts are considered and some of them should be implemented according to the priority of the enterprise.

The proposed hybrid 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 hybrid 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.

4.2.3. Output

The output of the proposed hybrid method for evaluating EA implementation 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.

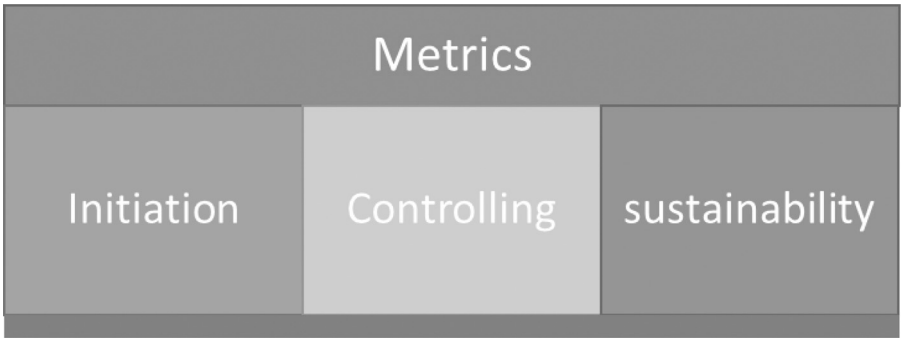

Fig. 5. Structure the process components.

Table 4
Specifications of Initiation 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 determine the risk identification
		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?
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 models 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?

Nonetheless, selecting worthy evaluators is a very important matter that needs to be considered by EA stakeholders.

Particular tool has been developed in order to support the proposed evaluation model's practices and metrics and make it easy to use. This tool considers the designed procedure for giving the scores to the functionality and effectiveness metrics and presents the output of the proposed evaluation model. Figs. 6–8 illustrate some samples screenshots of the proposed evaluation model support tool.

5. Case studies

This section describes the application of the proposed hybrid evaluation method to two selected cases.

5.1. Case study design

A case study protocol defines the detailed procedure of collecting and analyzing the raw data (Runeson & Höst, 2009). Table 8 presents the case study protocol designed for this research.

The objective of the case studies was to investigate conducting this hybrid method in real-life settings, particularly in an industrial environment. One specific focus of the research was on the usability and applicability of such evaluation, for example the benefits of project outputs for the enterprise upon applying the proposed hybrid method. Two cases were selected for the current study. Table 9 compares the selected cases on different subjects.

5.2. Case study procedure

We provided guidelines for conducting an EA implementation project based on the proposed hybrid method and submitted it to the EA managers in each case. We also held a meeting to explain the proposed hybrid method to the participants in each case, including a presentation on implementing the step-by-step hybrid method practices. We also provided the online version for further support. The project participants could also ask questions via the email address given.

All EA evaluation activities for each case defined at the beginning of the evaluation and the activities required to achieve the defined objectives based on the proposed method are described. The chief enterprise architect manages the EA evaluation and controls the EA artefact development.

Table 5
Specifications of controlling 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?
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?

We asked the chief enterprise architects to use the practices and instructions from the proposed hybrid method in their EA implementation projects. In this regard, the chief architects had 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 models.

The selected cases were a private bank and an e-health operator, which are famous in their sectors in the Middle East. The hybrid 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 project 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' performance in response to the EA objectives.
- Check the developed EA artefacts' adaptability to future changes.
- Check the developed EA artefacts' usability.

5.3. 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. Table 10 shows the user groups who participated in the selected cases' EA projects.

We used triangulation in order to increase the precision of this research (Runeson & Höst, 2009). Triangulation means taking different angles towards the studied object and thus providing a broader picture (Myers & Newman, 2007; Yin, 2013). The following triangulations were used in the current research 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 study were divided into two sections: closed questions and open questions. The closed and open questions were designed based on the SUS model. These questions cover the following points:

- A general understanding of the organizational profile, organizational structure, and the interviewees' roles in the organization.

Table 6
Specifications of sustainability 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
	Functionality metrics	Does the EA implementation provide an appropriate plan for integration?
		Can the developed EA artefacts respond to the 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?

Table 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 interviewees' understanding of EA implementation evaluation.
- The interviewees' perception of the proposed hybrid method in terms of the SUS models.
- The interviewees' general understanding of the proposed hybrid method.

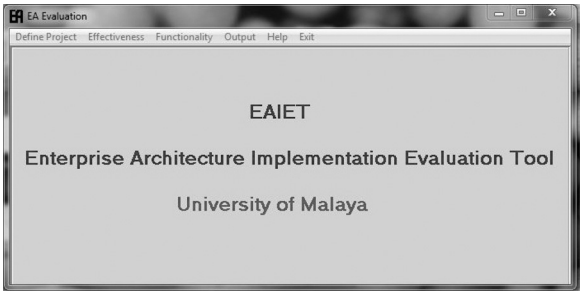

Fig. 6. First page of evaluation support tool.

5.4. Data analysis

Two types of data were collected from the selected cases, including qualitative and quantitative data. The quantitative data collected from the questionnaires were analyzed by means of statistical method by assigning a weight to each answer of the questionnaire. 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). Fig. 9 illustrates the analysis structure of the closed questions based on the SUS structure (Brooke, 2013).

Qualitative data collected by means of interviews were analyzed based on the case study protocol (Section 5.1). Fig. 10 illustrates the procedure for qualitative data analysis.

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

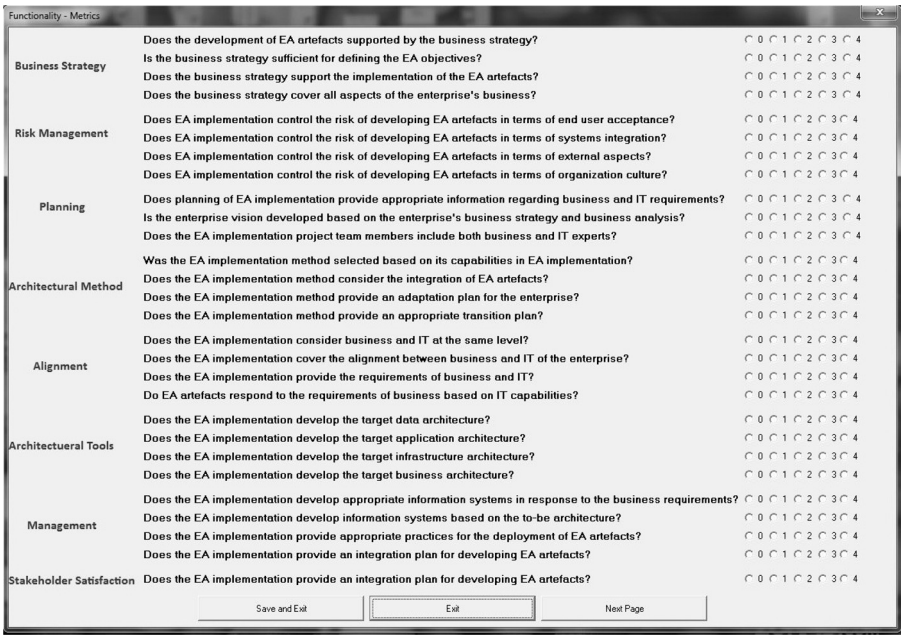

Fig. 7. Sample of metric page.

Fig. 8. Sample of report page.

developed from the proposed method features and case study protocol (Myers & 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 (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 (Creswell, 2013; Maxwell, 2012). Table 11 shows the codebook of open questions.

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 12 lists the themes identified from the open questions and Fig. 11 illustrates the structure of the themes.

5.5. 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). Fig. 12 shows a scoring sample for usability testing.

In Case 1, the participants' SUS score was 82.5. 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.

Table 8
Case study protocol.

Section	Description
Objective	To use the proposed hybrid method in an industrial environment in order to evaluate the method's usability
General Procedure	Using the proposed hybrid method in the implementation phase of the selected case
Case Selection Criteria	Familiarity with EA Having Enterprise Architects, Business Architects, IT Architects, and so on Interested to utilize EA An existing, defined EA project Investment in EA implementation Support of EA projects by top management
Research Instrument	Interview and Questionnaire
Data Collection	Semi-structured interview and closed questions were asked of enterprise architects, business architects, and system stakeholders from the selected case.
Data Analysis	Editing and quasi-statistical approaches were used for coding, and calculating the frequencies of words and phrases. A cross-case study was done to generalize the results.
Validity	Validity threats were analyzed based on checklists proposed by Runeson (2009). It would also have been possible to analyze threats according to construct validity, internal validity, external validity, and reliability.

Table 9
Comparison of the two case studies.

Criteria	Case 1	Case 2
Data Collection Period	Sept 2015–Dec 2015	Sept 2015–Dec 2015
Respondents Interviewed	Business/IT stakeholders, 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 IT department and different divisions of IT sub-domains	Using the IT, research and development department
EA understanding	Using a specific team for EA	It does not have an EA section but has expert consultants
Support from top management	CEO and CIO fully support the project	Supported directly by the CEO

Table 10
User groups.

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

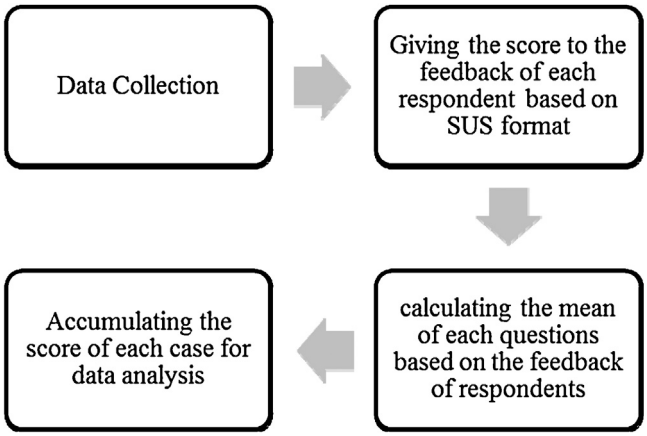

Fig. 9. Quantitative data analysis procedure based on the SUS structure.

In Case 2, the participants' SUS score was 87.5. 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.

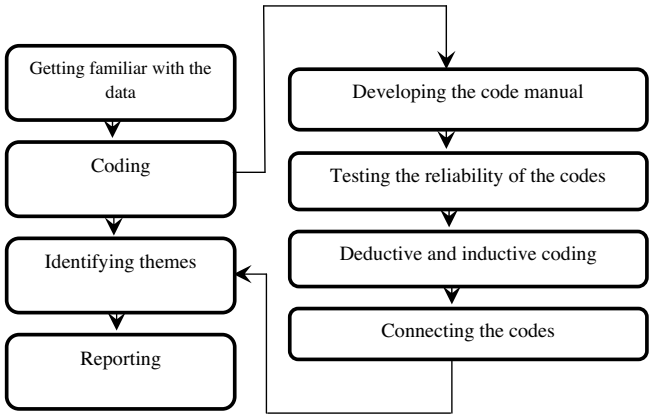

Fig. 10. Qualitative data analysis procedure.

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

Regarding qualitative data, the following sections provide a summary of the analysis based on the defined data analysis procedure (Section 5.4).

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 intendent 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 a dynamic 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.

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.

5.6. Threats to validity

In this research, validity threats were analyzed (Runeson & Höst, 2009) in terms of the followings items. In order to reduce bias

Table 11
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.

Table 12
Themes from open question analysis.

Theme Name	Description	Code
Capabilities	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

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).

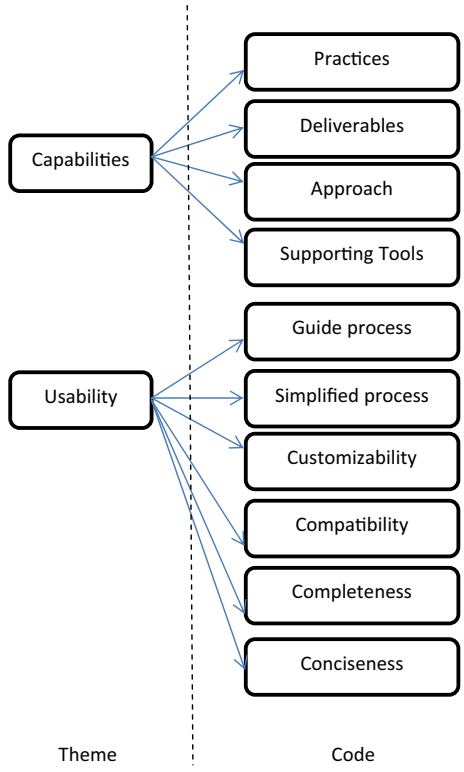

Fig. 11. Coding style of open questions.

- 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 implementation 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.

5.7. Design science research evaluation

As mentioned in Section 3, design science is inherently a problem-solving process (Gregor & Hevner, 2013; Hevner & Chatterjee, 2010; Peffers & Rothenberger, 2012). We evaluated the proposed hybrid method design against the seven guidelines formulated by Henver and Chatterjee (2010) to gain better understanding of the effective design science of this research. Table 13 summarizes the results of this evaluation.

This research presented a hybrid method for evaluating the effectiveness and functionality of EA implementation within an enterprise. The proposed method was employed in two different EA projects. According to the results of the case studies conducted, the proposed method is applicable for EA implementation evaluation in selected cases. The case study results reflect the characteristics of the proposed method in terms of a usability model and provide a transparent connection between Case 1 and Case 2 via a cross-case study. The proposed method represents an

Section II

Based on your point of view about mentioned Hybrid Method, please response level of agreement to each of the following statement of this hybrid method:

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
1	2	3	4	5

Question	User's rating	SUS score
1. I think that I would like to use this hybrid Method frequently	4	3
2. I found this Method unnecessarily complex	2	3
3. I thought this Method was easy to use	3	2
4. I think that I would need the support of a technical person to be able to use this Method	2	3
5. I found the various functions in this Method were well integrated	5	4
6. I thought there was too much inconsistency in this Method	1	4
7. I would imagine that most people would learn to use this Method very quickly	5	4
8. I found the this Method very cumbersome to use	2	3
9. I felt very confident using this Method	4	3
10. I needed to learn a lot of things before I could get going with this Method	1	4
SUS score		82.5

Fig. 12. SUS Sample.

Table 13
Summary of Henver and Chatterjee's (2010) guidelines applied to the proposed method.

Guidelines	Description
Design as an artefact	Our research delivered the practices of EA implementation evaluation and a hybrid method for evaluating EA implementation.
Problem relevance	The proposed hybrid method was developed in order to provide a structured and holistic evaluation model for EA implementation
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 research is having developed a hybrid 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 research.
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.
Communication of research	This research 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).

effective model for making explicit the evaluation of EA implementation in an enterprise and as such enables the effectiveness and functionality of EA. It fills the gap between architecture practices and achieving business goals.

6. Discussion and future work

Several studies have been done on the development of an EA evaluation for both practitioners and researchers. The majority of existing evaluation models were not developed based on a theoretical approach in terms of practices and processes. The lack of attention to attaining an appropriate and holistic method for evaluating EA implementation leads to insufficient and inaccurate analyses 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.

An EA implementation evaluation method should support the EA project lifecycle, including design, management (development), and maintenance. There is a lack of concern regarding consistency between evaluation aspects in existing evaluation models and methods. Consequently, EA evaluation should begin with using one method followed by other methods that are not interlinked. Besides, there is no specific practice for evaluating the functionality and effectiveness of existing evaluation models. A usable evaluation method should concern providing a plan for evaluating the effectiveness and functionality of implemented EA artefacts.

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 proposed method supports EA implementation functionality and effectiveness; provides practices that are easy to use and learn, consistent and with different perspectives; provides step-by-step guidelines to its structure and supports maintenance and

continual improvement; and supports all EA implementation practices. Additional features of the proposed method include:

- Completeness – the proposed method 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 – the proposed method presents the impact that concrete enterprise development generates in an enterprise, allowing choosing and selecting 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 – the proposed method coordinates the set of disciplines that exist in an enterprise in order to convey decisions in one plan with common objectives.
- Structured analysis and design method – 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. The process component practices offer such consideration for evaluating EA implementation.
- 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.
- The proposed method is flexible. It provides a set of dynamic practices that are flexible in addressing new changes based on requests for updates and changes.

6.1. Implications for future research

The findings of this study can impact related works, such as evaluation models for EA implementation. Factors like organizational culture and high management commitment can affect the success of EA implementation evaluation, especially when using the proposed method. Identifying the success factors for evaluating EA implementation, and developing appropriate management tools are examples of future research topics in line with the present research results.

6.2. Implications for practice

First of all, the findings emphasize the relevance of an effective and usable evaluation method owing to its impacts on an enterprise's performance. The consequences are twofold: evaluating EA implementation requires an effective method, which can generate additional value for enterprises. The results from this study show effective potential for use in EA implementation projects by practitioners.

7. Conclusion

This article presented a hybrid evaluation method for EA implementation within an enterprise. The EA evaluation literature investigation carried out in this study facilitated better understanding of the proposed method's concepts and problems. By exploring existing evaluation models, it was realized there is no comprehensive and structured model in terms of effectiveness and functionality. The method proposed in this study is light and holistic, which supports the functionality and effectiveness of EA implementation. It is easy to learn and use, applicable for all types of enterprise, usable for evaluating implemented EA artefacts, complete in terms of supporting all aspects of EA implementation, flexible in terms of providing a dynamic environment for EA evaluation, and a structured method developed based on theoretical approaches. The results of this research can be useful for academics and practitioners in employing EA projects and also extending research on EA implementation evaluation.

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