

ENTERPRISE ARCHITECTURE AND THE INTEGRATION OF SERVICE-ORIENTED ARCHITECTURE

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Abstract

In recent years, enterprise architecture (EA) has captured growing attention as a means to systematically consolidate and interrelate diverse business and IT artefacts in order to provide holistic decision support. The recent popularity of a service-orientation has added “service” and related constructs as a new element that requires consideration within EA. Since the emergence of the Service-Oriented Architecture (SOA), many attempts have been made to incorporate SOA artefacts in existing EA frameworks. Yet, the approaches taken to achieve this goal differ substantially for the most commonly used EA frameworks to date. SOA in the context of EA is one of the future research challenges. Several authors argue that further research is needed in order to understand how SOA impacts prior EA frameworks. This study explores SOA integration within EA, identifies SOA integration approaches within EA and identifies factors that impact SOA integration within EA.

Keywords: Enterprise Architecture, Service-Oriented Architecture, Service-Orientation, Integration.

1 INTRODUCTION

Modern enterprises face the increasing frequency of change in the current competitive environment, leading to the growing internal complexity of the socio-technical system “enterprise”. A commonly accepted and promising practice to deal with such complexity and to improve business/IT alignment is Enterprise Architecture (EA). EA considers a holistic view incorporating all aspects of an enterprise, such as business, application, information, data and infrastructure aspects (Buckl et al. 2010). EA is model-based architectural descriptions of the enterprise, its systems and environment. Its models improve the understanding of an enterprise’s business and information system’s landscape and support decision making (Franke et al. 2009). Thus, EA has become an important means to obtain, conceptualize, store and maintain knowledge about the enterprise, its structure and behaviour. EA describes and models the enterprise components and shows how they are organised, associated and function as a whole (Seppänen 2008). It is used to provide an inclusive descriptive overview of the organisation and to govern and direct IT and business (Ekstedt et al. 2004; Foorthuis et al. 2009).

The Service-Oriented Architecture (SOA) is an emerging architectural style. It considers each business or system a service provider offers one or more service. These services capture and encapsulate a valuable capability and abstract the details of their functionality through well-defined interfaces that facilitate the exchange of structured messages (Luthria and Rabhi 2009). SOA provides an entirely new way for enterprise engineering that covers both the organisational and technical aspects of an enterprise. This concept comprehensively involves a high level understanding of business capabilities as services (e.g. payment, fraud detection) through to the technical implementation of encapsulated software capabilities in terms of Web Services. Therefore, its principles can be used in conceptual modelling of EA. Service-orientation descriptions can be employed for semantic integration of both the dynamic and static aspects of EA frameworks (Gustas 2007). Further, services are increasingly considered as one of the enterprise’s essential assets which need to be considered and integrated in the EA (Correia and Silva 2007; Khoshnevis et al. 2009).

There is a need for SOA to be considered and integrated in an Enterprise Architecture (Khoshnevis et al. 2009). Recent surveys have shown the importance of SOA integration in EA (Infosys 2009; Varnus and Panaich 2009) and some studies integrated SOA in EA (Assmann and Engels 2008; Braun and Winter 2007; Lankhorst 2004). There is a noticeable difference in these integration approaches. Therefore, this study will be conducted to explore SOA/EA integration, to identify the different SOA/EA integration approaches and their specific characteristics and to identify factors that impact SOA integration into EA.

While the first section has provided a brief introduction, the rest of the report is organised as follows. The next section presents the research questions, followed by a literature review for this study. Next, the research model is discussed, after which the research design is introduced. The last section presents the current stage of the research and plans for completion.

2 RESEARCH QUESTIONS

Research questions can be considered as the axis around which the whole research efforts revolves (Leedy and Ormrod 2001). Leedy and Ormrod (2001) suggested breaking the research questions down into controllable sub-questions to provide directions for the research endeavour. Emory and Cooper (1991) recommended a similar approach which comprises four distinct top-down levels. The highest level in the hierarchy is referred to as the ‘managerial perspective’, which is the driving question of the study. Therefore, the managerial research question driving this study is formulated as follows:

- What impacts SOA integration in Enterprise Architecture?

The second level represents the general purpose of the study. At this level, research questions are derived from the managerial question in order to address the research problem. In this study, two core aspects are to be investigated at this level:

- What are the distinct types of how SOA and EA are integrated?
- What factors influence the type of integration of SOA and EA?

3 LITERATURE REVIEW

This research addresses the development of EA in light of changing concepts and approaches in the business and IT domains. In particular, it brings together two broad areas of study: Enterprise Architecture (EA) and Service Oriented Architecture (SOA). In this report, SOA integration into EA means the representation of SOA artefacts in the EA, or the transition to Service-Oriented Enterprise Architecture (SOEA). Since EA is considered an approach to assist an organisation in moving from the current (as-is) state to the target (to-be) state (Brooks 2009), SOEA is the target architecture for the organisation that adopts SOA. Thus, enterprises should design the target architecture (SOEA) to reflect all the required changes in the current architecture to successfully adopt SOA. Perko (2008) argued that in order to implement an architecture based on SOA and to take advantages of the new capabilities that SOA offers, a disciplined approach with supporting methods and tools is required. EA is such an approach which describes the baseline and target architectures and assists in developing a roadmap for SOA adoption. Paras et al. (2007) asserted that SOA is part of EA and it can be the main driver for an EA restart. Grigoriu (2007) contended that SOA and EA are about the architecture of the enterprise. SOA requires an intensive enterprise re-engineering effort which has significant consequences on the different EA layers such as the process, applications and infrastructure. He argued that SOA implementation does not achieve its objectives outside the context of EA development, because SOA relies on EA “as-is” models and artefacts. EA is needed to plan the journey to move from an “as-is” to a “to-be” service-oriented situation before the implementation or adoption of SOA. In fact, Grigoriu (2007) used the term Service-Oriented Enterprise Architecture (SOEA) to describe an enterprise architecture implemented with an SOA flavour. SOEA transforms the enterprise and therefore must have the top management support to be successful. Once SOEA is implemented as a blueprint of a service-oriented enterprise, it becomes a great competitive asset enabling modularity at the business services level, reusability and agility.

Recent surveys have shown the importance of SOA integration in EA (Infosys 2009; Varnus and Panaich 2009) and in the literature, some studies have considered the issue of SOA and EA integration (Aier and Gleichauf 2009; Assmann and Engels 2008; Braun and Winter 2007; Correia and Silva 2007; Lankhorst 2004; Noran and Bernus 2009; Sanders et al. 2008; Steen et al. 2005; The Open Group 2009). In addition, some EA frameworks have supported service orientation and integrated SOA artefacts, e.g., TOGAF and DoDAF. However, there is no consensus on what SOA artefacts should be included and where they are positioned on the different levels (viewpoints) of EA. A key challenge arising from the different approaches of integrating SOA into EA frameworks is to completely and correctly address SOA’s related stakeholder concerns. Due to the differences of the integration approaches in terms of SOA artefacts and positions in EA (viewpoints), an enterprise seeking to adopt SOA and document current and future SOA artefacts in EA will most likely run into difficulties in identifying and classifying the relevant and complete set of SOA artefacts for different stakeholders.

Given that different integration approaches have been identified in the literature, no studies have been conducted, to the best of the writers’ knowledge, to address what impact SOA integration in EA. Therefore, this study is designed, as the first of its kind, to address this gap in addition to exploring the SOA and EA integration practices to identify the integration approaches, similar to what Parr and Shanks (2000) developed in regards to the ERP’s different implementations approaches.

4 RESEARCH MODEL

Due to the originality of this study, there is no exact single theory to guide the research process. Thus, it will follow a theory building approach. In order to build the research model, a thorough literature review was conducted to understand and identify the major factors that might cause the different approaches of SOA and EA integration. However, a limited number of studies were found that have discussed SOA integration within EA similar to what Viering et al. (2009) described in their thorough literature review of SOA studies. They found that most publications do not relate SOA to EA conceptualizations. Nonetheless, four potential factors have been identified: SOA understanding, SOA benefits, EA maturity and SOA scope that might have an influence on SOA integration within EA (see Figure 1).

To begin with, it appears that SOA understanding is one of the factors that might influence SOA integration in EA (Becker et al. 2009; Beimborn et al. 2008; Blinco et al. 2009; Erl 2005; Luthria and Rabhi 2009; Ren and Lyytinen 2008; Viering et al. 2009). Viering et al. (2009) discovered that there are different perspectives on SOA: a pure IT perspective or an architectural style perspective which uses services as key artefacts. However, they found that even when viewing SOA as an architectural style, there are diverse opinions in terms of SOA design principles and characteristics. In addition, Blinco et al. (2009) argued that SOA is viewed from different perspectives, that of a business owner, architect or developer. Hirschheim et al. (2010) found the organisation's view of SOA is a critical issue for the maturity of SOA, which they classified into five maturity stages. Further, (Becker et al. 2009) commented in their study that SOA comprehension, a clear and common understanding of SOA, is a big challenge for SOA adopters to achieve SOA benefits. Further, Lee et al. (2010) identified the critical success factors in SOA implementation, one of which is to deepen the enterprise-wide perception of SOA by achieving a shared understanding of enterprise-wide SOA including management and IT, and encouraging the view of SOA as a business paradigm, not a technology.

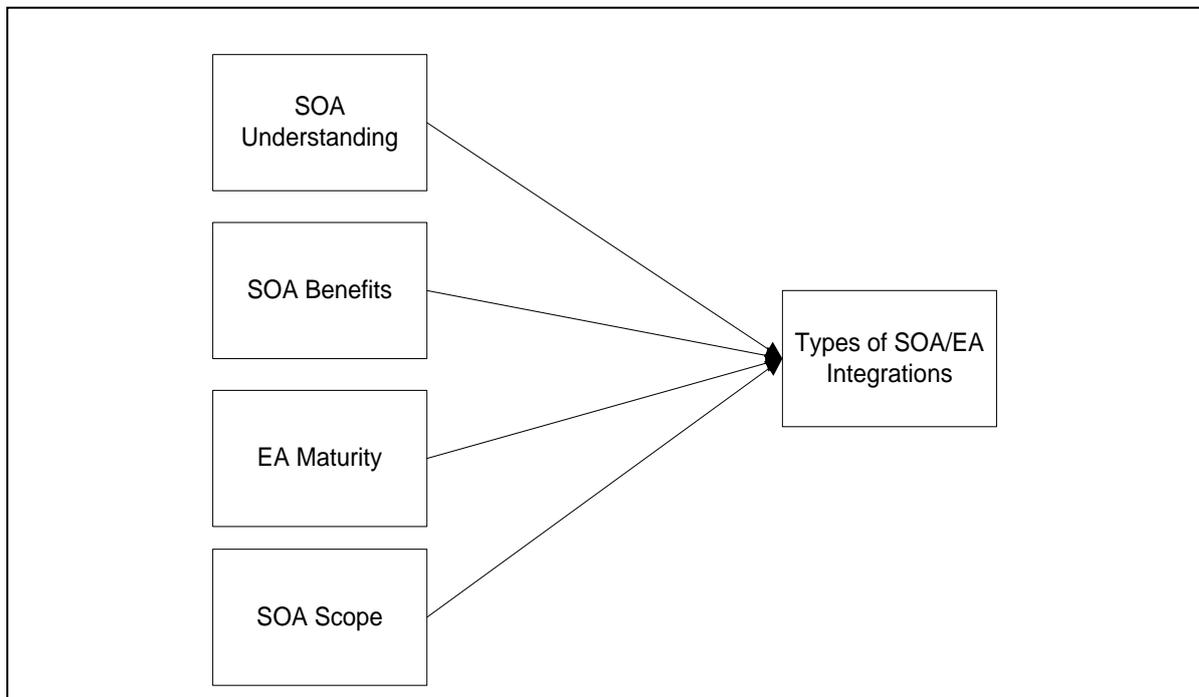


Figure 1. Research Model

SOA benefits are another potential factor influencing SOA integration in EA (Becker et al. 2009; Luthria and Rabhi 2009; Mueller et al. 2007; Viering et al. 2009; Yoon and Carter 2007). Perko (2008) claimed that SOA offers different types of benefits based on how it is perceived by enterprises. Viering et al. (2009) noted that SOA offers different benefits on three levels: technical, economic and strategic values. In addition, (Becker et al. 2009) classified SOA benefits into IT, process, and strategy benefits, while Yoon and Carter (2007) classified SOA's benefits into two groups: business and IT benefits. In their SOA adoption study, Luthria and Rabhi (2009) reported that SOA is adopted by enterprises based on certain perceived values. Lee et al. (2010) found that a clear setting of SOA goals based on business values is a critical success factor for SOA. Further, Antikainen and Pekkola (2009) informed that business driven SOA projects have achieved better benefits than IT-driven SOA projects. (Hirschheim et al. 2010) identified five stages of SOA benefits among other criteria for measuring SOA maturity in organisations.

EA maturity is also a potential factor that might influence SOA integration in EA (Brooks 2009). EA must support SOA developmental efforts through services identification, classification and management in alignment with the direction of the organisation's mission (Brooks 2009). In addition, Antikainen and Pekkola (2009) found that the use of EA helps businesspeople gain a better awareness of the organisation's architecture and of SOA. Without complete and mature EA, SOA integration in EA would be incomplete as enterprises need to have a high EA maturity in order to increase the scope and value of EA (Perko 2008).

Finally, SOA scope is a further potential factor that might influence SOA integration in EA. Campbell and Mohun (2007) presented three different approaches to SOA adoption: project, portfolio, or enterprise level (see Figure 2). Enterprises usually adopt the project approach when there is no long-term vision and the SOA benefits are mainly at the project level. In adopting the portfolio management approach, firms assess its IT portfolio projects and invest in potential projects for SOA. The objectives are to achieve benefits from SOA at the project and portfolio levels and prepare the firm for SOA's adoption at the next level, the enterprise level. The third approach at the enterprise level focuses on business processes. At this level, the firm has established long-term goals and a vision to transform the firm to a service-oriented enterprise. This approach has the potential to fully realize the maximum benefits.

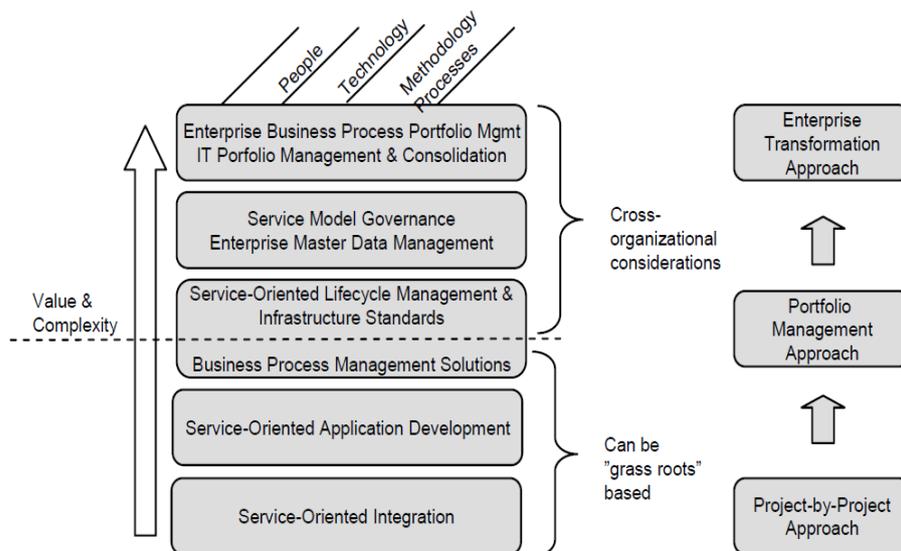


Figure 2. Value and complexity of SOA adoption (Campbell and Mohun 2007)

5 RESEARCH DESIGN

Research design can be viewed as the structure of the research. It can be understood as a blueprint displaying the arrangement for the collection, measurement and analysis of data in a manner that aims to combine research purpose and relevance (Gable 1994). The overall research approach designed and applied in this study is presented in this section. A high level research design used within this study is shown in Figure 3.

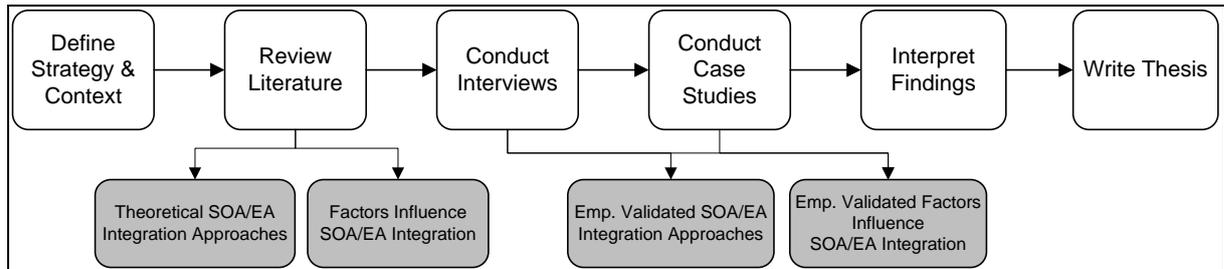


Figure 3. High level research design

This study follows an interpretive qualitative paradigm for two reasons. (1) This study attempts to understand and interpret SOA integration within EA. The integration takes place in the context of a social system, organisational structures and processes. (2) This study will be exploratory in the first phase to set the scene, explore, understand and become familiar with a relatively new phenomenon. Therefore, this study uses a combination of explorative interviews followed by in-depth multiple case studies for data collection to (i) explore and understand in-depth research problem and (ii) achieve triangulation at the data and method level, as Creswell (2003) noted that researchers may combine methods in a sequential procedure in which the investigator's intention is to expand or elaborate on the findings of one method with another method.

The first phase is the explorative interviews. Creswell (2003) suggested conducting qualitative interviews if the researcher's objective is to understand the phenomena, if little research has been done, and if the researcher does not know all the important variables to examine. The goals of conducting interviews are (1) to obtain the respondents' views and experiences in their own terms instead of collecting data that are basically a choice among pre-established choices, and (2) to give the interviewer flexibility to elaborate and follow up on unanticipated valuable information, and probe for further explanations (Kaplan and Maxwell 2005). In this study, the research questions, research context and literature review are the primary input to the interview phase. A semi-structured interview protocol was developed to guide the interview process. The protocol defines the structure of the overall interview effort and guides the researcher in collecting the data (Yin 2003). In regards to the selection of the participants, enterprise architects are deemed appropriate candidates for the interviews, because they are the main stakeholders in the integration project and they are the experts in such study. Raadt and Vliet (2009) stated that enterprise architects are experienced employees, often highly valued for their knowledge on the enterprise's structures, systems, processes and technology. The number of participants is determined based on (i) the explorative nature of this study at its first stage, and (ii) time and resources constraints. The aim of the interviews is not to generalize, but to discover and enrich the understanding of SOA and EA integration issues. Therefore, the targeted number of participants is fifteen interviews with enterprise architects who are involved in SOA integration in EA projects. The outcomes of the interviews will be used to refine the research model and identify SOA and EA integration types.

The second phase is to conduct multiple case studies. Case study is an empirical inquiry that investigates and explains a contemporary phenomenon within its natural context (Yin 2003). It utilizes qualitative analysis and is considered the most widely used qualitative method in information systems research (Benbasat et al. 1987). It is the recommended method to investigate an emerging phenomenon in which few previous studies have been conducted. Eisenhardt (1989) confirmed that the case study method is particularly suitable in new topic studies and Benbasat et al. (1987) noted that case study is appropriate for certain research problems when research and theory are in their early formative stages. The case study examines a phenomenon in its natural setting and employs multiple methods of data collection, such as interviews, documents analysis and observations to gather information from one or several entities (Benbasat et al. 1987; Yin 2003). According to Eisenhardt (1989), the case study can be employed to achieve a variety of objectives, such as describing, generating or testing a theory.

Multiple case studies are included in this study to refine and confirm the findings from the previous phase and to study SOA integration within EA in depth, as the interviews may provide limited information. The case study method is chosen for multiple reasons. SOA and EA integration is (1) a new phenomenon and little is known about the issue, (2) it is a broad and complex issue, and (3) it cannot be studied outside the context (the organisation) in which it occurs. Further, the multiple case design strengthens the results and enables generalisations to be drawn from the gathered data. Candidate cases are organisations that have integrated SOA within their EA and have high maturity levels in terms of SOA and EA.

6 CURRENT STAGE OF THE RESEARCH

The first three phases of the research are almost finished. Defining the research scope, research strategy and research methods were done in the first phase. A thorough literature review was done in the second phase and fourteen qualitative interviews have been conducted. They are currently in the process of data analysis and interpretation. Nvivo is being used as a data management and analysis tool.

In this study, four sets of questions were used in each interview. First, background information about the interviewee and their organisation was collected. Second, questions relating to SOA initiative and implementation in the organisation were posed. The third set of questions on the EA framework, methodology and practice was discussed. The fourth set focused on SOA integration within EA and the potential factors that impact the integration.

The interviewees were identified through different sources. Enterprise architecture groups on LinkedIn, presentations by enterprise architects on the topic, and snowballing techniques (Myers and Newman 2007) were employed to identify potential candidates for the interviews. Some interviews were done face-to-face, while others were done via phone. The interviews lasted from 40 to 90 minutes. They were recorded and transcribed.

Data analysis of the interviews is still at an early stage. Interview data were imported to Nvivo software. Pattern coding is being used to group data into a smaller number of overarching themes (Miles and Huberman 1994). As a starting point for this study, a predefined set of codes were derived from the literature and from the interview protocol following the guidelines from Miles and Huberman (1994). A tree-like node structure was initially created to capture SOA initiative related information, EA framework, structure and content related information, SOA integration within the EA approach and the factors that influence the integration. They will be refined and extended during the analysis.

The next step is to finalize interviews analysis in order to refine and enrich the model and to identify SOA integration within EA approaches. On completion of this stage, multiple case studies will be conducted. The selection of relevant cases is important and will be considered in this phase. Benbasat et al. (1987) suggested that site selection should be based on organisational characteristics when

research is on organisation-level phenomena and should be on specific technologies or IS methodologies for researchers who are interested in such characteristics. In this research, appropriate cases will be chosen based on factors such as industry (public versus private), company size (small, medium, large), geographic location (Australian based or international), adoption of SOA and EA, and the integration of SOA within EA. Participants within each case site will be selected with respect to their role in the respective SOA/EA integration project. People who work in SOA and EA teams and managers are deemed appropriate candidates, because they are qualified and experienced in the issue under investigation.

7 CONCLUSION

One of the key benefits to be gained from Enterprise Architecture is the ability to support decision making in changing businesses. To be able to deliver this benefit, Enterprise Architecture frameworks themselves need to embrace change in ways that adequately consider the emerging new paradigms and requirements affecting EA, such as the paradigm of service orientation. In the literature review for this study, different attempts to extend EA frameworks in ways that accommodate SOA and services have been identified. Identified approaches point to the fact that there is a lack of consistency in where and how to position SOA and services in EA frameworks in order to meet stakeholder-related concerns. Therefore, explorative interviews were conducted and will be followed by in-depth case studies to explore and investigate the practice of SOA/EA integration in order to identify the different integration approaches. The study also aims to investigate why EA and SOA are integrated in different ways, if and how this may be related to the different understandings of SOA, different perceived benefits of SOA or other factors. It ultimately strives to derive normative guidelines from these insights that will assist organisations to adopt an integrated EA and SOA framework, a service-oriented enterprise architecture that is tailored for their specific business goals.

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