A critical realist perspective of enterprise architecture evolution: Conditioning and outcomes

A CRITICAL REALIST PERSPECTIVE OF ENTERPRISE ARCHITECTURE EVOLUTION: CONDITIONING AND OUTCOMES

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ABSTRACT

This paper investigates how Enterprise Architecture (EA) evolves due to emerging trends. It specifically explores how EA integrates the Service-oriented Architecture (SOA). Archer's Morphogenetic theory is used as an analytical approach to distinguish the architectural conditions under which SOA is introduced, to study the relationships between these conditions and SOA introduction, and to reflect on EA evolution (elaborations) that then take place. The paper focuses on reasons for why EA evolution could take place, or not and what architectural changes could happen due to SOA integration. The research builds on sound theoretical foundations to discuss EA evolution in a field that often lacks a solid theoretical groundwork. Specifically, it proposes that critical realism, using the morphogenetic theory, can provide a useful theoretical foundation to study enterprise architecture (EA) evolution. The initial results of a literature review (a-priori model) were extended using explorative interviews. The findings of this study are threefold. First, there are five different levels of EA-SOA integration outcomes. Second, a mature EA, flexible and well-defined EA framework and comprehensive objectives of EA improve the integration outcomes. Third, the analytical separation using Archer's theory is helpful in order to understand how these different integration outcomes are generated.

Keywords: Enterprise Architecture, EA, Service-oriented Architecture, SOA, critical realism and morphogenetic theory.

INTRODUCTION

A widely adopted approach providing the required conceptual understanding of an enterprise as well as the way IS facilitates its business processes, is Enterprise Architecture (EA). EA is "a complete expression of the enterprise; a master plan which 'acts as a collaboration force' between aspects of business planning such as goals, visions, strategies and governance principles; aspects of business operations such as business terms, organisation structures, processes and data; aspects of automation such as information systems and databases; and the enabling technological infrastructure of the business such as computers, operating systems and networks" (Schekkerman 2005, p. 18). As a discipline, EA faces the challenge of responding to the emerging capabilities of both business and IT domains and integrating them within its frameworks in order to enable true representations of existing organisational elements and their relationships. EA needs to evolve on both representational and architectural descriptions levels. Architectural descriptions are the vehicle for building architectural representations (Martin et al. 2009). The representational level entails keeping EA models up-to-date with instances changes such as changes to business processes or applications data (Martin et al. 2009; Shah et al. 2011). The architectural descriptions level includes managing the concepts or properties of a system, their relationships and the principles of the system design and evolution (Martin et al. 2009).

EA needs to evolve and accommodate emerging trends (Jung 2009; McKendrick 2010; Postina et al. 2010; Sampaio 2010; Sousa et al. 2009) in order to accurately develop models capable of representing those emerging trends, concepts and relationships. Yet, EA's literature lacks empirical studies that investigate EA evolution due to emerging trends. Further, EA evolution management is still a challenge (Buckl et al. 2009). In a recent Forrester Research survey, current business and IT trends such as pervasive business intelligence, Service-Orientated Architecture (SOA) and cloud are considered challenges for EA over the next three years (McKendrick 2010). This study focuses on EA architectural descriptions evolution, through the focus on one specific new development with substantial impact on EA, namely the emergence of SOA (Martin et al. 2009; Sousa et al. 2009).

The Open Group (2010) defines SOA as "an architectural style that supports service orientation, and service orientation is a way of thinking in terms of services and service-based development and the outcomes of services". While many studies have argued for SOA integration within EA (Khoshnevis et al. 2009; Postina et al. 2010), there is a lack of empirical studies that address SOA and EA integration (Kistasamy et al. 2012; Viering et al. 2009). So far, there has been a lack of consensus on the form of such integration and its outcomes. The integration of elements and viewpoints of SOA has been approached differently and inconsistently (Postina et al. 2010). A literature survey of current approaches of SOA integration within EA was conducted and a survey of the ways the five most popular EA frameworks accommodate SOA was performed. These studies also have revealed significant variations in terms of how SOA is integrated within EA (Alwadain et al. 2011; Alwadain et al. 2013a).

In order to understand the integration of SOA within EA outcomes and improve the integration, the use of a critical realist (CR) theory, namely Archer Morphogenetic theory (1995), is proposed. It is applied to understand the EA evolution process by clarifying the role of pre-existing EA, SOA introduction and their relevant generative mechanisms on SOA integration within EA. We argue that by taking a critical realism stance using Archer Morphogenetic theory (1995), we are able to investigate the issue in a much deeper way leading to richer insights into the integration of SOA within EA. The rationale of a critical realist study is to explicate a given set of outcomes by uncovering the hypothesised existence of mechanisms that, once activated, could have generated these outcomes (Wynn et al. 2012). We argue that EA evolution could be improved by using Archer's concept of analytical dualism where structure (EA) and action (SOA introduction) are analytically held apart in order to appropriately study their interaction and understand their outcomes. We acknowledge the power and the relevance of all the analytical phases of Archer's model, but we will leave the architectural interaction (SOA introduction) phase out of discussion due to space limitation.

Summarising, this paper will address the following research questions: (1) How does EA evolve, in particular in relation to the introduction of SOA? (2) What are the possible different outcomes of SOA integration within EA? and (3) Can critical realism, in particular Archer's Morphogenetic theory, provide a theoretical foundation for EA evolution? The remainder of this paper is organised as follows. The next section presents the research methodology. Then, the theoretical foundations and the a-priori model are introduced. Subsequently, the revised research model and the findings are reported. Finally, the summarised findings, limitations and an outlook are presented.

RESEARCH METHODOLOGY

The study started with a literature review. Relevant empirical and analytical studies have been identified on SOA integration within EA. They have been identified through IEEEXplore, SpringerLink, ScienceDirect, EBSCO Host, Business Source Elite and AIS Electronic Library. A combination of "service-orientation", "SOA", "service oriented architecture", "EA" and "enterprise architecture" was used as keywords when searching for articles. The literature review findings were used to develop the a-priori research model based on Archer's theory (Alwadain et al. 2013b). To further enrich our understanding and refine the a-priori model, explorative interviews were conducted. From a critical realist perspective, Sayer (1992, p. 179) states that "qualitative analysis of objects is required to disclose mechanisms". Semi-structured interviews were conducted with twenty enterprise architects and EA consultants who were involved with SOA projects. The selection was based on their involvement with SOA integration within EA projects to find information-rich participants, and the snowball sampling technique, where interviewing one person leads to another (Patton 2001), was used to select further participants. Candidates from private sector, public sector and consultancy groups were approached. Twenty interviews with twenty-two persons involved in initiatives that included both EA and SOA were conducted between June 2010 and July 2011, see Table 1. We interviewed thirteen enterprise architects and nine EA consultants. Most of the participants have a long experience with EA (more than 3 years) and between 5 to 20 years of various business/IT jobs. Interviews (I-5) and (I-6) were done separately with two participants of the same originations. In each interview session of (I-4) and (I-11) two participants were interviewed at the same time. Each interview lasted between 45 minutes and one hour. An interview protocol was developed prior to the commencement to guide the interview sessions. Most of the participants reported that they use TOGAF. This is consistent with other findings that TOGAF is the most widely used EA approach (Infosys 2009).

Interview	Job Title	Industry Sector	EA framework
I-1	Chief Enterprise Architect	Banking	Proprietary EA framework
I-2	Chief Enterprise Architect	Multi-business	Modified TOGAF
I-3	Strategic Architect	Government	ArchiMate
I-4	(a) Chief Enterprise Architect and (b) Senior Enterprise Architect	Health	Modified TOGAF
I-5	Senior Enterprise Architect	Banking	Modified TOGAF
I-6	Senior Enterprise Architect	Banking	Modified TOGAF
I-7	EA consultant	Consultancy	TOGAF
I-8	Architecture Manager	Health	DoDAF
I-9	EA Consultant	Consultancy	TOGAF
I-10	EA Consultant	Consultancy	Modified TOGAF
I-11	(a)EA Manager and (b)Architecture Manager	Education	In-house-developed EA based on TOGAF
I-12	EA Consultant	Consultancy	TOGAF, Zachman
I-13	Enterprise Architect	Government	Meta-Group methodology, now TOGAF
I-14	Architecture Manager	Banking	Built-in Framework (Partial models)
I-15	Enterprise Architect	Banking	Built-in Framework
I-16	EA Consultant	Consultancy	Gartner
I-17	EA Consultant	Consultancy	TOGAF
I-18	EA Consultant	Consultancy	Modified TOGAF
I-19	EA Consultant	Consultancy	TOGAF
I-20	EA Consultant	Consultancy	TOGAF, DoDAF

Table 1. Participants Information

Thematic analysis was conducted in this research to analyse the interview data (Fereday et al. 2006). Each interview was recorded and transcribed. After reading each interview and getting familiar with its content, it is imported to qualitative analysis tool NVivo v9 for analysis. A predefined codebook derived from the a-priori research model was used as a starting point for coding and was updated during the coding process. Both deductive and inductive coding techniques (Fereday et al. 2006) were used. At the completion of the interviews analysis, more than 70 codes were in the codebook including the ones derived from the a-priori research model. Then, newly identified codes were grouped and organised into possible themes (either generative mechanisms or outcomes). It was an iterative process back and forth in order to come to meaningful themes that describe the grouped codes.

THE A-PRIORI MODEL DEVELOPMENT

The findings of the literature review in regard to SOA integration within EA outcomes and the possible generative mechanisms are redescribed using Archer's morphogenetic theory to explain EA evolution. The result of this activity is the development of the a-priori model of this study, which is briefly described below using Archer's (1995) analytical lens.

Archer (1995) proposed a morphogenetic theory for studying change. Interaction between structure and agency is complex to properly investigate in social situations and thus an "analytical" dualism whereby structure and agency are analytically separated is proposed in order to appropriately study their interaction (Archer 1995). Structure is defined as the "set of internally related objects or practices" (Sayer 1992, p. 92) that comprise the real entities we seek to examine in a particular contextual situation (Wynn et al. 2012). Archer (1995) states structures have properties (causal powers/generative mechanisms) which enable them to influence the world around them. The morphogenetic cycle has three analytical phases: structural conditioning, social interaction and structural elaboration. First, structural conditioning represents the existing structural properties prior to the intervention. They are consequences of past actions (Archer 1995). Second, social interaction is the second analytical level. During social interaction, agents engage with the pre-existing structures (Archer 1995). At this level, actions are enabled or constrained by the pre-existing structures. Finally, the third analytical level is the structural elaboration (either reproduction or transformation) of existing structures. Archer's theory as presented earlier was adopted for three reasons. It provides an analytical approach that (1) distinguishes EA and SOA interaction into three phases and (2) facilitates the retroduction from the outcomes (phase three) to the causes (phase one and two). (3) SOA introduction also has different properties (dependent on related generative mechanisms such as different perception, different scopes and different perceived benefits) which need to be understood to comprehend the outcomes. Therefore, it was deployed as a means to better understand how the interaction between existing architectural settings and an SOA introduction can lead to different integration outcomes. It serves as an analytical tool to represent conditions, actions and outcomes during EA evolution. Such analysis is helpful when introducing SOA by considering the pre-existing conditions and SOA aspects in order to better integrate SOA within EA.

The structural conditioning at T1 is called "architectural conditioning" to reflect the scope of this study comprising EA and its subsequent changes as a result of SOA introduction. The social interaction is called "architectural interaction (SOA introduction)". SOA activities that are performed over the time period T2 to T3 are greatly influenced by both the pre-existing architectural conditions and SOA related generative mechanisms. Then, "architectural elaboration" at T4 is the result of the interplay between pre-existing architectural conditions and SOA introduction. We argue that SOA is introduced in different architectural conditions in different contexts. SOA introduction itself has multiple generative mechanisms such as different perspectives of SOA, scopes and perceived benefits which diversify SOA implementation in different contexts. When SOA is introduced, the interplay between theses architectural conditions and SOA introduction leads to the different evolution outcomes. The a-priori model is described using Archer's (1995) morphogenetic analytical phases.

Phase one of the morphogenetic cycle is "architectural conditioning". It represents the conditions in which the agents find themselves (Archer 1995). The architectural conditioning could be IT artefacts or design specifications. If the object of analysis, for instance, were an implementation, the structure would be a business process or processes that would be changed as a result of the implementation (Cuellar 2010). In this study, architectural conditioning is represented through EA settings and EA maturity prior to SOA introduction. EA is the main structure that is investigated with respect to its evolution due to SOA introduction. In Archer's terms, EA is a structure that has been shaped by previous morphogenetic cycles and SOA introduction results in its architectural elaboration. EA has a generative mechanism, namely its maturity which has an influence on the world around it. Organisations need mature EA in order to successfully implement SOA and realise expected SOA benefits (Perko 2008). The availability of detailed business architecture models during SOA implementation and architects' skills affect SOA implementation (Kokko et al. 2009). Several EA maturity models have been proposed. They were studied and compared; for limitation of space, however, they are not discussed in this paper. This study adapted the NASCIO Enterprise Architecture Maturity Model (NASCIO 2003). It is considered a good example of EA maturity models by the Open Group and could be used to assess government and private EA maturity (The Open Group 2009). It

also conforms to the well-known maturity model SEI SMM (NASCIO 2003) and is widely used (Gosselt 2012).

The second analytical level is the social interaction between T2 and T3, in this study "architectural interaction (SOA introduction)", which means SOA implementation related activities. In Archer (1995) terms during social interaction, actors engage with the pre-existing architectural conditions. SOA introduction triggers generative mechanisms that impact SOA introduction and interact with other generative mechanisms in a given context to generate the observed outcomes. Bygstad et al. (2011) note that it is often a group of objects that trigger a mechanism and generate an outcome that is dependent on the objects, but not reducible to them. The interaction of agents and technology may activate a group of mechanisms pertinent for the IS discipline. Triggering the mechanism and the result it might produce is not predetermined, but will depend on other active mechanisms and the context (architectural conditioning mechanisms). Nevertheless, it tends to result in certain outcomes (Bygstad et al. 2011). We have identified some generative mechanisms relevant to SOA introduction from the literature and they are 'view of SOA', 'perceived SOA benefits' and 'SOA scope'. Agents introduce SOA entertaining a certain perspective of service-orientation, anticipating certain benefits and determining a certain scope. However, as said earlier, this phase is crucial to the explanation of the different integration outcomes but the details of this phase are excluded due to space limitations.

The third analytical level is the architectural elaboration T4 (reproduction or transformation). The interaction between pre-existing architectural settings and SOA introduction explains the architectural elaboration (integration outcomes) at T4. It results in either architectural transformation or reproduction of EA that existed prior to SOA introduction. The literature findings suggest that there are different architectural transformation outcomes of the interaction between pre-existing EA and SOA introduction. Due to the fact that EA frameworks use different architectural layers, this study aimed at finding common layers of EA to use them to structure the findings. This study adopted the widely used layers of EA; business, information systems (information, applications) and technology (Joachim et al. 2011). EA could be transformed or reproduced on all or some of the three architectural layers. The literature review findings of SOA integration within EA were covered in Alwadain et al. (2013b). This study hypothesises that EA is transformed or reproduced due to SOA integration on three architectural levels: business architecture, IS architecture and technical architecture. The outcomes of the integration could be transformation or production of EA on one or many of the three architectural levels. The first form of architectural transformation is service-orientation of business architecture. It means that SOA and its relevant elements such as business services, service channels, SOA vision, drivers, services SLAs and QoS are integrated within business architecture models. It often builds on lower architectures service-orientations (e.g., IS and infrastructure architectures are integrated with SOA or going to be integrated). Several studies have been identified which have integrated SOA within EA on this level (e.g. see Correia et al. 2007; Khoshnevis et al. 2009). The second noticed level of integration is SOA integration and relevant SOA elements such as IS services, service descriptions and SLAs. For example, SOA is adopted to reduce the complexity of its distributed application landscape. Enterprise services were integrated within the integration architecture while basic services (software components) are integrated within the software architecture (Schelp et al. 2009). Other examples are presented in Jung (2009) and Kistasamy et al. (2010). The third aspect of architectural elaboration is SOA and its related elements such as technical services, services monitoring, services security, ESB, XML standards and web services integration with the technology architecture. For example, the NSW Departments of Lands adopted a service-oriented architecture approach to transform its technical architecture using SOA. It started when an ESB was first introduced in 2005. Second, a logistics operator in Finland adopted SOA during 2005. It was an IT driven project using a technical bottom-up approach and SOA was almost reduced to the use of web services. Later, it was expanded into multiple projects to integrate the legacy system landscape employing SOA technology to mainly expose legacy system services via an integration platform (Kokko et al. 2009).

THE EXTENDED THEORETICAL (A-PRIORI) MODEL

In this section we present the refined a-priori model (Figure 1) that explains SOA integration within EA outcomes underpinned by Archer morphogenetic theory (1995). It is developed based on the literature review (a-priori model) and extended based on the interview findings. The (*) sign on some elements of the model entails that they were inductively identified from the interview findings.

The interview analysis was guided by the a-priori model. Particularly, the focus was on the architectural conditioning aspects, SOA introduction aspects and the integration outcomes. Following the analysis of the interviews, four new themes (two generative mechanisms related to the architectural conditioning phase and two integration outcomes) were identified. Other generative mechanisms related to SOA introduction emerged. However, they are not discussed in this paper due to space limitations and therefore we considered the second phase a black box as shown in Figure 1. The new emerged SOA integration within EA outcomes are "EA methods and tools" and "EA governance". It means that SOA introduction interaction with the pre-existing architectural conditioning could lead to changes in "EA methods and tools" and/or "EA governance". The interview findings are presented in the following sections and Figure 1 shows the theoretical (extended a-priori) model.

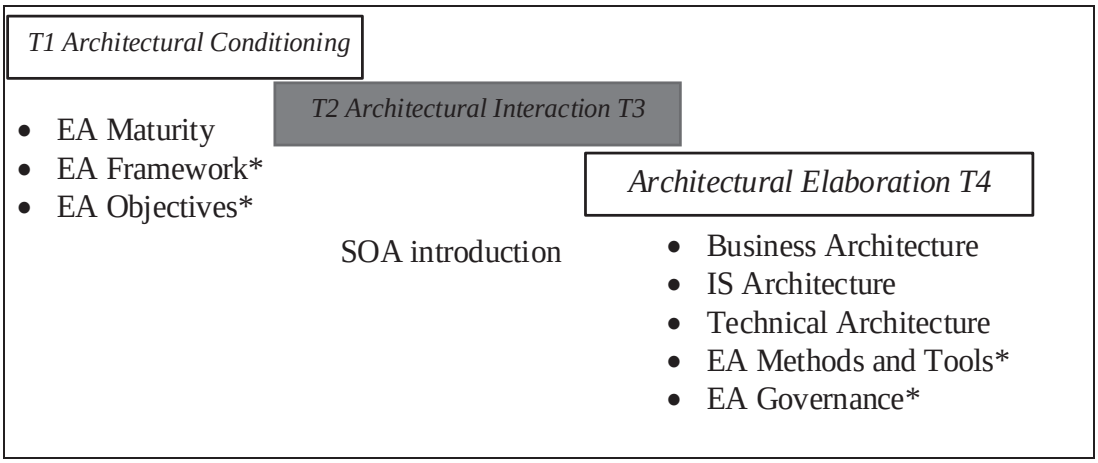

Figure 1. Enterprise Architecture Evolution (SOA integration)

T1 Architectural Conditioning

The interview results showed different architectural conditions of EA (pre-existing EA). Besides the hypothesised generative mechanism (EA maturity), two other generative mechanisms emerged from the data. They are EA framework and EA objectives. The results showed that used EA frameworks vary. Some of the reported EA frameworks are based on well-known EA frameworks and others are developed in-house. It could be concluded that frameworks developed in-house could restrict the integration outcomes due to the limited external guidance compared to the well-developed EA frameworks such as TOGAF, which has incorporated SOA. It also showed that EA was implemented prior to SOA introduction and that EA framework and methodologies have gone through some cycles of changes in theses organisations prior to SOA introduction. EA is often implemented prior to SOA introduction in organisations. EA as a discipline producing related frameworks and methodologies also existed before SOA emerged. In some cases where EA and SOA could be implemented at the same time, it is still arguably valid to assume that EA as a structure (its framework, methodology) has existed before SOA. It also could be argued that even if an organisation has not implemented a formal EA, there still is an informal EA comprised of applications, business processes and infrastructure its stakeholders are familiar with. The findings also indicated that EA was adopted for various objectives

based on how it is seen. They are classified into strategic, operational, IT and governance oriented EAs. The objectives of EA are seen to influence its use and SOA integration. For example EA consultant, I-16, commented that:

"there is a widely differing opinion on what enterprise architecture is and if you start with a different definition of EA you end up with a different relation to SOA".

The interview findings also confirmed the relevance of EA maturity in this study as a generative mechanism. EA consultant, I-17, suggested there is a link between the architectural practice and the maturity of EA. He reported that TOGAF architecture development methodology (ADM) is used differently in alignment with the level of EA maturity. He stated:

"There's very few people who use the whole ADM but typically people will align their architecture practice at their level of maturity with the relevant aspects of the ADM".

EA consultant, I-12, reported based on many engagements with EA implementations that EA is still in its early maturity stages. He elaborated that a low level of maturity of EA impacts the involvement of EA within SOA and SOA introduction. He acknowledged that

"if you don't have a mature EA capability in organisation, SOA is very unlikely to even get a look in…..If you don't have a good EA function and have it engaged and accountable, in my opinion you cannot get SOA properly implemented", I-12.

In summary, the interview findings suggest that there are two other important generative mechanisms besides EA maturity. They are EA framework and EA objectives. The participants reported different EA frameworks e.g. in-house-developed and modified well-known frameworks. Some of these frameworks have been changed in many morphogenetic cycles to match organisational changes. EA is also adopted for various objectives and there are different opinions about EA. The findings suggested that EA objectives have influence on SOA integration with EA. The findings also supported the proposed hypothesis that EA maturity (through its multiple dimensions) contingently affects the outcomes of SOA integration within EA.

T2 Architectural Interaction (SOA Introduction) T3

The interview findings supported the proposed generative mechanisms and additional generative mechanisms were inductively identified from the interview analysis. In this study, SOA introduction is hypothesised to be influenced by related generative mechanisms that lead to different integration outcomes within EA in different contexts. Due to space limitations they are not discussed in this paper, but this phase is mentioned here to emphasise that the action (SOA introduction) has generative mechanisms that interact with the architectural conditioning mechanisms to generate the different integration outcomes.

Architectural Elaboration T4 (Reproduction or Transformation)

The interview findings confirmed the three architectural elaboration levels (integration outcomes) of the a-priori model. The integration outcomes could be explained by looking at the interaction of the previous two phases (architectural conditioning and architectural interaction). EA is transformed or reproduced due to SOA integration on the three architectural levels identified from the literature. They are business architecture, IS architecture and technical architecture. Also two other levels of architectural elaboration emerged from the interview data. They are "EA methods and tools" and "EA governance". These two aspects of EA are also found to be transformed or reproduced dependent on the interaction of architectural conditioning and architectural interaction phases in a given context. The details of SOA integration within EA outcomes on these five architectural levels are examined in the following paragraphs.

Business Architecture

The interview findings showed some examples (seven cases) of this level of transformation where the SOA is integrated with the business architecture. All the cases that have reported SOA integration with the business architecture also integrated SOA with the IS and technology architectures. For example, participant, I-2, said

"we don't differentiate between SOA architecture and EA, you know for us, SOA is very much part of the enterprise architecture... You know, until you start getting up into the information and business layers you start achieving true service orientation",I-2.

Information System Architecture

SOA integration with the IS architecture is also supported in some of the interviews (three cases). All the cases that integrated SOA within the IS architectures have integrated it with the technology architectures as well. For example, participant, I-11, stated that SOA is integrated within the IS and the technical architectures. He noted

"the applications level has service and [service] components. At the operations level or the infrastructure level we talk about security and monitoring in terms of services".

Chief enterprise architect, I-1, also stated that SOA is integrated within the integration architecture. He said

"Integration architecture is where we have these artefacts and everything you described right down to the service descriptions, the SLAs and the detail, all exist within it".

Technical Architecture

The interview data supported this level of architectural elaboration. The abovementioned cases at the service-orientation of business and IS architectures level reported that SOA is integrated within EA at this level as well. In addition, participant, I-13, described their SOA integration at this architectural level. Enterprise architect, I-13, presented that SOA implementation started using a point-to-point integration using web services and a couple of years later, an enterprise service bus was introduced. He also reported that their documentation of EA and SOA was very limited. He said

"We're not strong; we haven't been strong in publishing a huge range of artefacts…. on a five point scale we're somewhere between one, one and a half on SOA and probably enterprise architecture".

EA consultant, I-20, also described this limited integration aspect. He said

"People look at the service oriented architecture and then straight away they think of the technology adaptors, enterprise service buses and things like that and they forget about the business reason", I-20.

EA methods and tools

Some participants argued that SOA introduction requires some changes to the architectural design and development methods and processes. For example, chief enterprise architect, I-1, argued that such changes need to be considered at a very early stage of SOA adoption in order to identify and build the right services. He claimed that:

"Not laying foundations first such as changes to SDLC, governance processes…" leads to "…building the wrong services", I-1.

Chief enterprise architect, I-2, argued that upon SOA adoption, their guidelines, methods, processes that are required to implement service-oriented projects are established. EA consultant, I-7, also supported the idea of the changes of EA methodology to be able to identify services. He said

"So what we believe is that after the requirements, the business requirements, we need to have a service identification space. Which basically allows us to see what are the solutions that are needed and where can we actually get it... So we believe that there is a service identification and a service realisation phase that need to be a part of the life cycle of IT services in the future".

However, participant, I-13, argued that SOA is not a new thing that needs changes to EA development methods and processes.

This observed integration outcome in some cases is convincing when existing EA methods are integrated with project and solution portfolios. This possible integration outcome is also argued for in the literature. For example, changes to EA methodology are needed to manage the service architecture (Postina et al. 2010). To do so, EA needs to be embedded in established IT management and processes. In particular, EA practices, roles and artefacts need to be integrated within the existing IT management processes and tasks (Löhe et al. 2013). EA and projects also need to be integrated to make sure that the project team develops a solution that aligns with the target architecture. This includes the definition of the architectural components, the specification of interfaces and activities needed to implement the solution (Ahlemann et al. 2012).

EA governance

The fifth possible level of architectural elaborations (integration outcomes) is SOA governance integration with EA governance. SOA governance is an important aspect to be considered when introducing SOA. However, the participants have different perspectives on SOA governance in relation to EA governance. Some participants emphasised SOA governance is part of EA governance. For example, participant, I-12, argued that

"SOA is just an architectural pattern, EA governance is the thing that is going to make this work, so SOA is part of your overall enterprise architecture governance", I-12.

Enterprise consultant, I-18, declared that SOA is delivered as part of EA, and thus EA governance covers and influences SOA governance and practices. He said

"That [EA] governance should stem into anything that is delivered as part of the enterprise architecture which includes SOA", I-18.

However, EA consultant, I-20, argued that SOA is a large initiative and requires its own governance practices that are aligned with architectural governance practices. It is also supported by another EA consultant, I-16. He stated that there is a relationship between EA and SOA governance on high level aspects, but EA should not get involved in low technical aspects of SOA.

"Enterprise architecture has set certain boundaries within those boundaries you can solve things in many different ways.…And especially when it gets to the lower layers of the SOA where you implement the technical services, the low level services I don't think EA should necessarily have much to say about that", I-16.

This level of integration, whether to integrate or not, is even discussed in recent literature. Some argue for the integration of the existing governance mechanisms with SOA governance while others argue for a stand-alone governance body for SOA (Joachim et al. 2013). This could even be used as an argument for the value of this study model, once completed and tested, to be able to explain why SOA governance is or is not integrated within EA governance using the hypothesised existence of many generative mechanisms at the first two phases of the model that interact to produce the observed integration outcome.

CONCLUSION AND OUTLOOK

As a result of the dynamic environment, the increasing pace of change and technological innovation, organisations are faced with huge challenges not only of assessing how their businesses could be affected but also how the emerging trends impact their EAs. EAs need to co-evolve with organisations in response to new technical and business paradigms. One of the more significant developments in recent years is the emergence of SOA. Several studies have attempted to provide approaches for how to integrate SOA within EA. Yet, there are different outcomes, different emphases and different representations of SOA elements. Moreover, there is a lack of empirical studies that examine EA evolution due to emergent trends. Thus, this paper aimed at better understanding the EA evolution through SOA by taking a closer look at both literature and practice based on a solid theoretical underpinning for understanding change. It employed Archer's morphogenetic theory to understand the process of EA evolution when SOA is introduced. It built the foundations for subsequent empirical phases to further understand and explain EA evolution. Through the understanding of EA evolution, the viability of improvements arises. Such analysis is helpful to identify whether the architectural settings are needed to be enhanced prior to the dedication to SOA introduction.

The paper derives its significance and relevance from interrelating important contemporary phenomena based on a theoretical foundation. It uses a sound theoretical underpinning to enrich the understanding of the EA evolution process and outcomes. Archer's morphogenetic theory is employed as an analytical framework to exemplify the interaction between pre-existing architectural settings, the actions taken to introduce SOA and the elaborations occurring as a result of that interaction. The main findings of this study are threefold. First, in Archer's terms, architectural conditions at T1, before an SOA introduction, are the results of previous actions. These architectural conditions have an influence through their generative mechanisms (EA maturity, EA framework and EA objectives) on the action of agents (SOA introduction). The maturity of EA, its framework and objectives either enable or restrict the action of SOA introduction between T2 and T3. We hypothesise that the likelihood of comprehensive architectural transformation (integration of SOA within EA's five architectural levels), contingent upon the introduction of SOA interaction, increases when (i) the architectural conditions are mature, (ii) the adopted framework is capable of handling SOA, is comprehensive and well-defined, and (iii) EA has comprehensive strategic, operational, IT and governance objectives. Second, the interaction between the architectural settings (T1) and SOA introduction (T2-T3) results in the different architectural elaboration (T4) - either transformation or reproduction. The existing architectural settings could be transformed or reproduced on one or many of the five architectural outcomes. They are business architecture, IS architecture and technology architecture, EA methods and tools and EA governance. Third, Archer theory is adopted and its analytical separation was used in order to understand how these different integration outcomes are generated. It is a powerful theory that offered a way of analysing EA evolution due to SOA introduction in three analytical phases to explain the integration outcomes.

A limitation of the paper is the lack of overarching evidence that link the evolution process building blocks because it is out of scope of this paper. The discussion of the second phase (the architectural interaction) was removed due to space limitations. The preliminary findings presented above need to be examined in different contexts to further explore the model and its explanatory power. Multiple longitudinal case studies are appropriate to examine the architectural settings before SOA introduction, the way SOA is introduced through the examination of its related generative mechanisms and their integration outcomes. Further, the proposed model could be reused to examine EA evolution as a result of other emerging trends. This could be easily conducted by replacing the inner phase (the architectural interaction) with an emerging trend of interest such as cloud computing or enterprise mobility.

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