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# Key Issues in Enterprise Architecture Adoption in the Public Sector

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**Abstract:** This paper examines the challenges of enterprise architecture (EA) adoption in public sector organisations. So far, demonstrating the benefits of EA has appeared difficult in this context, and the results in transforming public sector remain modest: Both the penetration and the maturity of EA appear rather low. In the academia, however, the adoption of EA has gained less interest than the EA development and methodologies. Hence, there is a need for research on what are the challenges of EA adoption, and how to overcome them. This paper presents the results of an expert survey on the challenges of EA adoption in the Finnish public sector. The analysis of quantitative data, supported with a qualitative data, reveals three interrelated factors: *Resistance towards EA*, *Relevant EA goals*, and the *EA practices in use*. Managing the identified key issues classified in these three broad concepts would be the prerequisite for institutionalising EA and making it a legitimate practice. The findings extend the current knowledge of the public sector EA with practicable ideas how to increase the level of penetration and maturity.

**Keywords:** enterprise architecture (EA), adoption, organisational change, resistance towards EA, relevant EA goals, EA practices in use, survey research

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## 1. Introduction

Few question the benefits, such as improved alignment, informed decision-making, and reduced costs, attributed to well-planned and methodical management of enterprise architecture (EA). However, organisations, especially in the public sector, are struggling to adopt EA and related enterprise architecture management (EAM) practices. Lack of properly managed EA leads into problems in interoperability and holistic development that are the requirements for a fluid digital transformation of governments. This study aims at uncovering the reasons for the moderate success in introducing EA to public organisations, and suggest improvements in the EA adoption stage.

EA can be used as a business management tool, that supports especially communication and change management within and between the organisational entities. EA identifies the main components of the organisation, including its information systems, and the ways in which these components act as a whole to achieve defined business objectives (Kaisler, Armour and Valivullah, 2005). However, the consensus regarding the key constituents and practices of EA is lacking (e.g., Schön herr, 2009; Zink, 2009; Lemmetti and Pekkola, 2012; Lucke et al., 2012, Rahimi, Götze and Møller, 2017) and, therefore, each organisation adopting EA can be advised to define the purpose and scope for the work based on their individual needs. The definition of EA in any particular instance emerges from the purpose and scope (Hope, 2015). Thus, the first step in building a relevant EA program is to understand and embrace the most appropriate implementation approach for the organisation (Bui, 2015). For example, Hjort-Madsen and Pries-Heje (2009) identified two types of EA programs in the public sector. One type is a stable element of information technology architecture, and the other is a fashion-driven business architecture element. Even if used in parallel, these types of EA differ substantially in focus, approach, and produced artefacts. For these reasons, in this paper we avoid committing to a single definition of EA, but examine the adoption of EA as a practice, rooted in current theory.

In the public sector, EA programs often set goals to increase the quality of public services, to improve the cost-efficiency, and to reduce the number of overlapping systems and processes (Christiansen and Götze, 2007; Saha 2009). Recently, EA has gained significance in managing the digital transformation (e.g., Aier and Schelp 2010; Schmidt et al., 2015; Zimmermann et al., 2015). However, demonstrating the benefits of EA is difficult (Morganwalp and Sage, 2004; Niemi and Pekkola, 2016), because many of the expected benefits are indirect and intangible (Niemi, 2006). EAM is a challenging task (Kaisler, Armour and Valivullah, 2005; Zink, 2009; Lucke et al., 2012; Hauder et al., 2013) and pessimistic opinions about the researchers' ability to overcome the challenges have been presented recently (Kaisler and Armour, 2017).

Many government organisations have performed poorly in their EA efforts and EA programs have failed to meet the expectations (Saha 2009; Foorthuis et al., 2015; Hope, Chew and Sharma, 2017). Currently, the research on EA success factors is mostly conducted as literature reviews (Jusuf and Kurnia, 2017) and the public sector EA adoption has gained less interest in empirical research than EA development (Dang and Pekkola, 2017). This motivates our empirical research on the adoption stage of EA. The research question is:

*What are the key challenges and issues in EA adoption in the public sector?*

To answer this question, we first search the EA literature for the reported challenges and critical issues. We turn them into a survey questionnaire, targeting EA experts in the Finnish public sector. Since the adoption of EA requires an organisational change, the survey is structured according to a generic pattern of supported organisational change, derived from good practices for organisational change management. Our study aims at revealing what are the specifics in the EA adoption case, and the reasons behind the moderate success in public administration. The study indicates the existence of three factors, namely *resistance towards EA*, *relevant EA goals*, and *EA practices in use*. The detailed results reveal the key issues in adopting EA in the public sector.

The remainder of the paper is organised as follows. First, we present the background literature and a generic structure for EA adoption process. Then, we describe the research method, present the results of data analysis and construct the key issues of EA adoption. Finally, we discuss our findings, consider their implications, and make suggestions for future research.

## 2. Background

### 2.1 Enterprise architecture in the public sector

Dang and Pekkola (2017) provide a systematic literature review on EA in public sector that we found to give a very good coverage for this area. What is significant for EA, public administration generally is a collection of heterogeneous organisations with different business processes and information systems. Consequently, public sector EA has a wide variety of stakeholders, domains and organisations, resulting in considerable complexity. This is a key difference compared to the private sector, where EA is often used within a single organisation. (Janssen, Flak and Sæbø, 2013). The focus of EA in the public sector varies from the whole-of-government to specific domain architectures, such as e-healthcare (Kaushik and Raman, 2015), online public service provision (Tambouris et al., 2014), federated identity management (Baldoni, 2012) and bureaus (Gregor et al., 2007). Whole-of-government approach has been of interest in the developed countries, such as Canada, Denmark, Japan, Netherlands, New Zealand and Norway (Christiansen and Gøtze, 2007; Janssen and Hjort-Madsen, 2007; Aagesen et al., 2011), and more recently also in developing countries (Dang and Pekkola, 2017), for instance, in Namibia (Shaanika and Iyamu, 2014) and Vietnam (Dang and Pekkola, 2016). On the other hand, some countries with high level of local autonomy, such as Sweden (Janssen, 2012), have deemed EA unsuitable for the whole-of-government.

Policymakers initiate public sector EA programs to enhance interoperability, productivity and the standard of service systems (Hjort-Madsen, 2006; Janssen et al., 2012; Janssen et al., 2013; Hiekkanen et al., 2013; Lemmetti and Pekkola, 2014). Participation in the programs is usually voluntary, although the United States and Finland have mandated the use of EA by legislation. In Finland, the government EA was introduced in 2006. The Finnish Act on Information Management Governance in Public Administration was passed in 2011, making the use of EA mandatory, for example, in central government offices, courts of law, and local government agencies conducting tasks assigned to them by law. Similarly, in the United States, EA is controlled at the federal government level through legal regulation (for example, the Clinger-Cohen Act of 1996). The legislation and encouragement by the National Association of State Chief Information Officers have lead the U.S. state governments to invest in EA adoption. 24 out of the 50 U.S. state governments have implemented EA (Bui, Markus and Newell, 2015), however, with challenges encountered in adoption (Saha, 2009). Currently, Finland shows similar adoption rates at the level of state government, but lower in municipalities and local government organisations.

EA programs face challenges difficult to overcome, as related to the integration and interoperability within and between public agencies (Hjort-Madsen and Burkard 2006) since government structures often impede EA programs (Hjort-Madsen and Gotze 2004; Bui and Levy 2017). EA adoption cannot transform the government by itself; a transformation will happen only if institutional forces promote it (Hjort-Madsen and Pries-Heje,

2009). Overall, it seems that both the penetration and the maturity of EA remain low, even among organisations that have taken EA into use.

## **2.2 Enterprise architecture adoption**

Hjort-Madsen (2006) describes EA adoption in government as “emergent, evolving, embedded, fragmented and provisional social production that is shaped as much by cultural and structural forces in the organisational context in which they are implemented as rational technical and economic ones.” Introducing EA can be characterised as a process during which these practices are first initiated, then deployed, with the goal to institutionalise them in an organisation. To have EA as part of the organisational routines, EA management is needed. EAM is a management approach that helps organisations to plan, develop, and control their EA. EAM provides a holistic understanding of the EA (Rahimi, Gøtze and Møller, 2017). EAM influences the decision making at the level of IT/IS planning and design, and is intertwined with the strategy process of the organisation, with EA becoming a tool in strategy deployment. The practices typically include the deployment of an EA method and a governance model, as well as at least the introduction of the processes and structures for EA planning, design, and development. As an adoption of a novel set of methods, an organisational change process is required, with alterations in the current *modus operandi*.

Regarding EA development models, besides the Architecture Development Method (ADM) included in the evolving standard, TOGAF (current version 9.1), there have been also research accounts on generic EA development process models (e.g., Pulkkinen, 2006; Aier and Gleichauf, 2010). These models implicitly assume that an adoption phase has been completed, and the EA development is an established practice, supported by an executive mandate. However, our focus lies on the adoption phase, initiating the EA management process in an organisation.

The EA adoption will require changes in current operating models, regarding IT/IS planning and implementation, project and program management, and IT management. It also should change the business management practices. Implementing any novel practice, or a change in existing practices, follows a pattern of organisational change process (e.g., Kolb and Frohman, 1970; Keen, 1981; Slevin and Pinto, 1987; Kotter, 1995; Schein, 1996; see also Figure 1). A variety of explaining models exist emphasizing different viewpoints and variation in granularity. More recent literature has taken distance from these basic models, seeing them as too monolithic or too much top-down, or managerial (e.g. Smets, Morris and Greenwood, 2012). However, if a public organisation implements a regulatory change which often comes with a set time for adoption, a managed and holistic change is needed.

We compared the characteristics of the models of managed organisational change. Consequently, we chose the process of planned change (Kolb and Frohman, 1970) as a base for our study due to the following reasons. First, it incorporates the customary activities to organisational development and change management yet presents these at the level of granularity feasible for an EA adoption initiative in a public organisation setting. This allows us to explore the issues stage by stage in fine detail. Second, the model includes feedback loops to capture the iterative nature of the adoption process. Third, the context of the model and its typical use cases pay attention to the relationship between a client organisation and external consultants facilitating the organisational change. This suits our purposes, as the EA adoption projects in public organisations are commonly supported by the EA consultants. Further, we acknowledge that the different models only bring different aspects of the organisational change to the fore, and they are not as such competing or contradicting. We take all of them (Figure 1) to support the presented ideas.

The Kolb and Frohman (1970) process model, has seven stages, which may occur sequentially, or some of them simultaneously. Two feedback loops emphasize the need for continuing renegotiation or refinement during the process, and the use of evaluations of previous actions to modify the activities (Kolb and Frohman, 1970). In the case of adopting a new policy, or methodology, this reflects the needed learning in the adopting organisation. Hirvonen and Pulkkinen (2005) have been examining the client and consultant roles in EA projects, reflected on the organisational change frame. According to them, the main lesson to learn are the responsibilities of the client organisation itself for a successful change effort at its different stages.

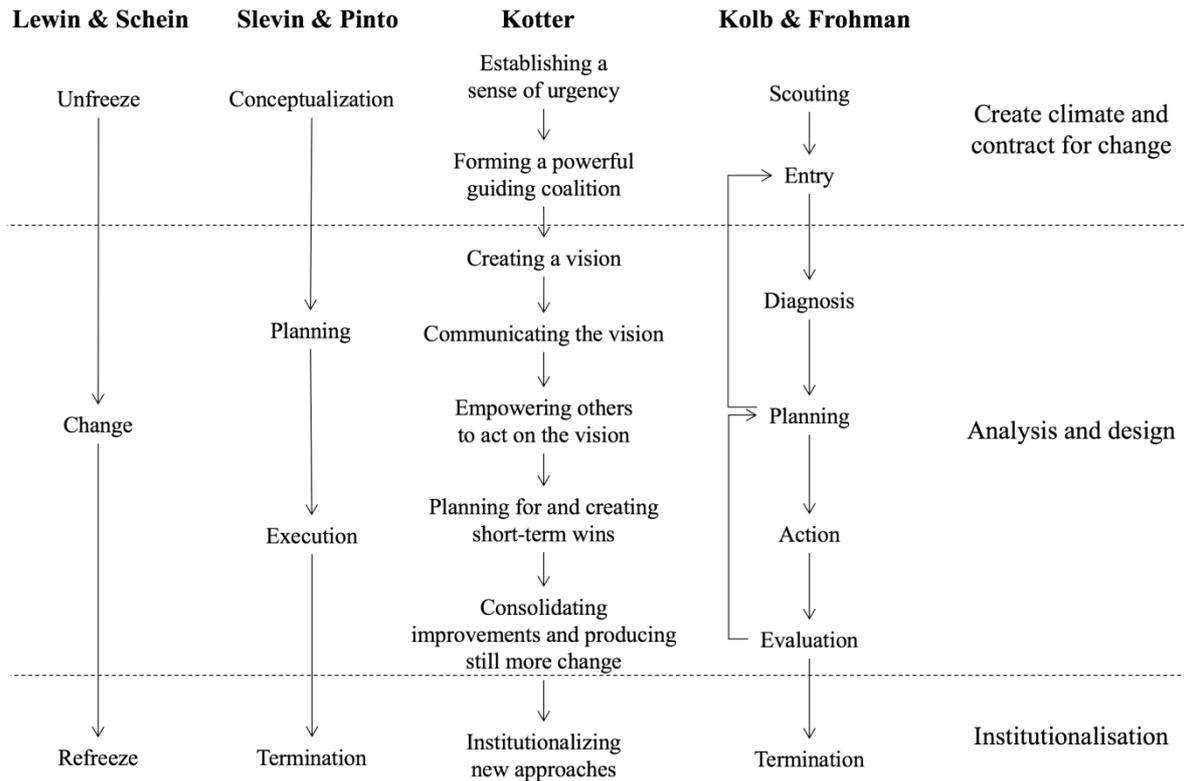


Figure 1: Change process frameworks

The *Scouting stage* precedes the launch of the adoption project. During this stage, Kolb and Frohman (1970) advise to evaluate the organisation’s resources and limitations, major subsystems (such as departments, divisions, and subsidiaries), attitudes toward change, motivation of the organisation to improve itself, and its social and cultural norms and values. In the *Entry stage*, that follows next, the key is to find an entry representative (“a project champion”), through whom the contract (i.e., how the succeeding stages of the adoption process will be implemented) can be negotiated. This stage begins with developing the initial statement of the project goals and by examining the contributions that are required from different stakeholders. The executive sponsorship for the project should be established during this stage as well. Finally, the project is positioned within the organisation, and a project team with the capabilities to perform up to the initial goals is set up.

The third stage, *Diagnosis*, focuses on refining the initial project goals. The *Planning* stage covers two parallel branches of activities. The first branch contains the tasks that contribute to planning the project implementation and operationalization. The second focuses on preparing in our case of, in introducing EA, the governance model implementation, introducing EAM to the organisation. Without EAM, EA may remain a tool only used within a single IT project. The stage ends with the creation of a formal project plan and by establishing a communication strategy that addresses all relevant stakeholders. The feedback loop from Planning to Entry emphasizes the need for continuing renegotiation in the organisation by reflecting the results of Diagnosis and Planning.

The *Action* stage can be divided into three intertwining parts: modelling the current state architecture, modelling the target state architecture, and planning the transition roadmap. The final stages are *Evaluation* and *Termination*. Evaluation involves the tasks such as evaluating the project’s results and contributions, and the overall change that has taken place. The second feedback loop, from Evaluation to Planning, enables the re-evaluation of the previous actions and, if necessary, allows to modify planning activities (Kolb and Frohman, 1970). The results of Evaluation define whether the project can move forward to Termination stage, should return to Planning stage to make a new action plan, or even reverse back to Entry stage to renegotiate the EA adoption project. It is noteworthy, that the Termination is emphasized in consultancy led projects for the practical reason that the client and the consultancy agree on the completion of the assignment and the results.

However, within the adopting organisation, the Termination stage ends the only the change process, and should flow into an organisational 'refreeze' leading to institutionalisation of the new practice.

As the adoption of EA is only the initial step in the continuous process of EAM, Termination needs to focus on confirming new behaviour patterns, transferring the responsibilities and ensuring their continuity. In contrast to a typical development project with the definitive end, an EA adoption project is only the first phase of what must transform into the continuing processes of EA planning, development, and management. These are usually undertaken as follow-up activities (Pulkkinen and Hirvonen, 2005). Therefore, during the Termination stage, it is important to ensure the continuity of the work that has been started. The institutionalisation of EAM (c.f., Hjort-Madsen, 2006; Iyamu, 2009; Weiss et al., 2013), however, is beyond the scope of this paper.

### **3. Research method and data collection**

The majority of the previous research on the problems and success factors of EA is conducted in the forms of literature review, or interpretation of qualitative data. While our research builds on these findings, we chose the quantitative approach to allow the assessment of the commonness of problems and to explore, what are the key issues. For the data analysis, we used Principal Axis Factoring accompanied with qualitative data in a triangulation setting.

To evaluate the commonness and criticality of the issues found to hamper EA adoption and use in public organisations, and to find more insights into the challenges, a survey questionnaire based on a literature review on EA-related problems was set up online. The literature was searched with Google Scholar with keywords such as "enterprise architecture" and "problem", "challenge", "issue", to find reported problems. Over 80 issues have been reported as problematic. In a critical consideration, the relevance of the issues raised, and their possible overlaps (different interpretations of the same phenomena) were evaluated. As a result, the number of different items to include into the survey questionnaire was reduced to 28. Given the space limitations, a comprehensive list of EA-related issues and the survey items are not presented here, and are provided upon request by the first author.

For each item, we asked whether the respondents had encountered similar problems, and to evaluate the criticality of each problem on a scale from 1 to 3 (*Not challenging, Fairly challenging, Highly challenging*) regarding their impact on the success of EA adoption. In addition, the respondents could leave open comments on every topic covered in the survey. This option was eagerly used, providing additional qualitative material and enhancing the reliability, as the open-ended answers were also analysed to contribute to the overall result. The structure of the survey instrument was inspired by the process of planned change (Kolb and Frohman, 1970), discussed in the previous section, and we will reflect our findings toward it in the next section.

The selection of survey respondents was based on purposeful sampling (e.g., Patton, 1990; Onwuegbuzie and Leech, 2007) in order to capture variation to represent the expertise in the Finnish public sector EA. Over half of the respondents assessed their expertise on the matter to be at the highest level (on a scale of *Weak expertise, Intermediate expertise, Good expertise*). Approximately 50% of the respondents represented central government organisations or municipalities, 25% of the respondents were actively involved in the EA development in higher education organisations that represent public sector in Finland, and another 25% came from private IT companies with experience in public sector EA consulting. 85% of the organisations represented by the respondents or their clients', in the case of consultants, had started a systematic adoption of EA, yet only 17% had completed it by the time they took the survey. The survey was created 2013, a few years after the Finnish Act on Information Management Governance in Public Administration was passed. After an analysis of the initial results in 2015 we were prepared to refine the instrument. However, no need for major revision of the topical issues was found, and we recruited more respondents to acquire sufficient data for our quantitative analysis. The survey was completed by the end of 2016 by altogether 54 respondents. By the end of the data collection period, the EA adoption rates and maturity were still low in the central government and even lower in the local government organisations. Approximately, only 20% of the local government organisations have started the EA adoption. The final sample, after removing the incomplete responses, consisted of 50 respondents.

## 4. Results

Descriptive statistics of the data show that the items related to poor understanding of the purpose and goals of EA were most commonly identified by the respondents, and were considered as the most challenging. Adoption entails both individual and organisational learning for changed behaviour. On the other hand, the respondents were quite satisfied with the EA methods they were using, as well as the benefits the EA can provide to their organisations. The least significant item in the survey addressed the inflexibility and unsuitability of the EA method, a result that could be seen somewhat surprising. Such issues were encountered by 24% of the respondents and mere 3% regarded the EA methods to pose a high challenge to successful EA adoption.

We conducted an exploratory Principal Axis Factoring to identify underlying themes in our data. To improve the factorability, two items were removed, based on the examination of Anti-image correlation matrix. The removed items also appeared to be rather insignificant issues according to the preliminary descriptive analysis. We used Varimax with Kaiser Normalization as a rotation method and suppressed the item loadings less than .5. Kaiser-Meyer-Olkin measure of sampling adequacy was .658, which indicates that the sample's factorability was mediocre. Bartlett's test of sphericity was significant ( $\chi^2(325) = 559.186, p < .001$ ). It is noteworthy that the survey was specifically targeted to experts in the public sector EA domain. Therefore, the respondents represent a reasonable sample of the total population (EA experts working within the Finnish public sector, or representing IT providers serving it). The analysis resulted in the three-factor solution that explained 44.47% of the total variance.

### 4.1 The key issues in EA adoption process

The analysis revealed an underlying three-factor solution from our data. We consider these factors to represent the key issues of an EA adoption. The factors *Resistance towards EA*, *Relevant EA goals*, and *EA practices in use* can be mapped into the stages of the process of planned change as shown below. Figure 2 also presents the Eigenvalue and explanatory power of each factor, as well as the item loadings and communalities (borderline values underlined). We follow this order in the discussion following in the next sections.

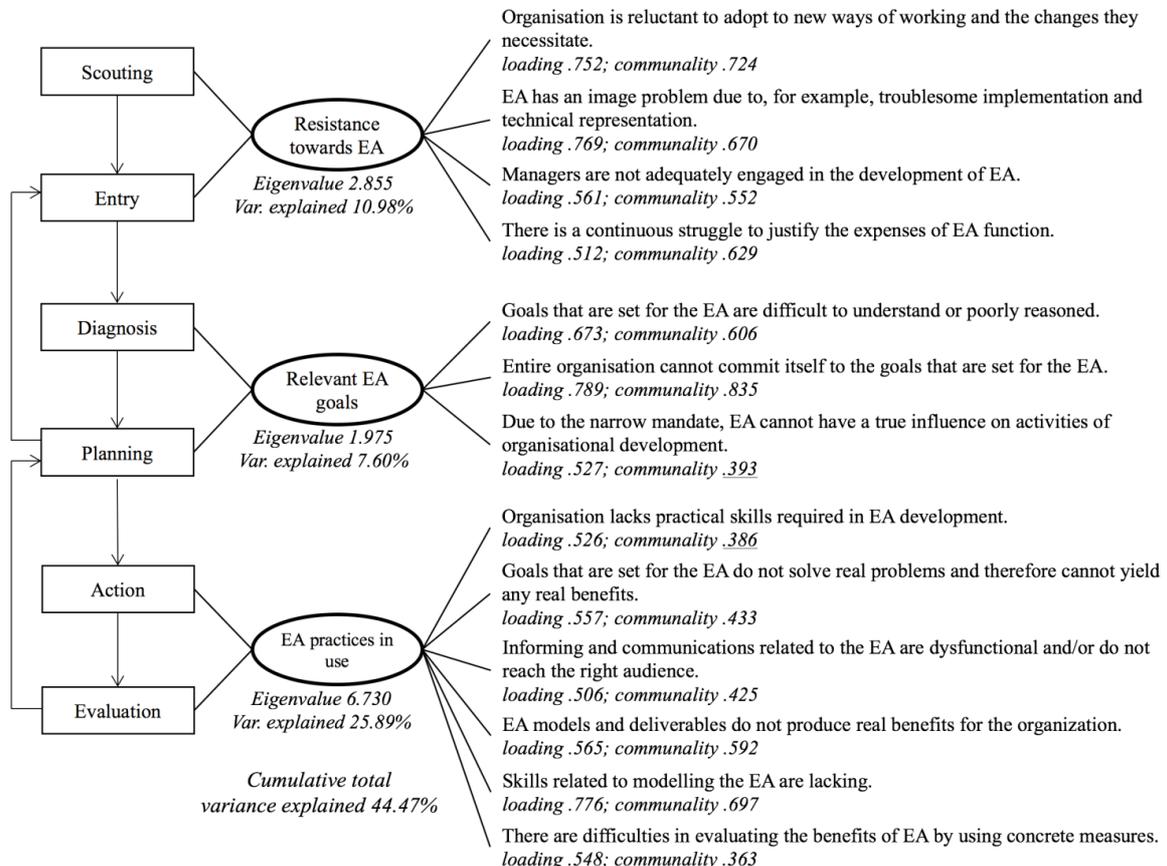


Figure 2: The three-factor solution mapped into the stages of planned change process

#### 4.1.1 *Resistance towards EA*

The first factor was loaded with four items and labelled as *Resistance towards EA*, since all the items concern the organisational change resistance, either as its cause, or an effect. In the context of this study, this factor represents specifically resistance towards the adoption of EAM as a policy in the public sector. The key issue is the organisational capability to undertake the change effort, the adoption project, which should appear in terms of the readiness and the willingness to change the status quo. This involves commitment at all levels, and the allocation of sufficient resources to implement the change.

Our respondents commented that EA appears heavily IT-oriented and therefore fails to reach all the relevant stakeholders.

“The enterprise architecting is still seen as something that only propeller heads would be interested in. The core business is not willing to participate and cannot see the benefits it could provide.”

Due to the IT-orientation, EA often suffers from a narrow mandate, which limits the viable area of its influence and impact.

“EA is considered as IT busywork and its mandate is too narrow.”

“Although our EA team consists of representatives of the entire organisation, they still see this work irrelevant and thereby are often ‘not able to participate’ the EA planning meetings.”

The lack of commitment manifests itself also in insufficient allocation of resources, which incurred several direct responses from our respondents.

“For us, it is not about the lack of EA skills, it is rather about the shortage of resources. And this is because of the management’s poor understanding about what we could achieve with EA.”

Interestingly, some respondents commented that their organisation acknowledges the need for systematic EA planning and management, yet they still fail to connect the dots.

“In our IT department, the EA work is desperately needed, and they understand it. In the business units, the EA is needed at least as much, but they haven’t realized it. Between the lines you can read their need for the holistic long-term planning, the architecture documentation, connecting the target-state with the strategy, and so on.”

#### 4.1.2 *Relevant EA Goals*

Three items loaded onto the factor labelled as *Relevant EA goals*. This is related to the EA benefits, and the factor captures that organisations are often unable to recognize beneficial use cases for the EA and problems it could help to solve. Our study, however, cannot reveal whether the root cause is the missing mandate, the inability to agree on shared strategic directions, the lack of skills needed in their operationalization, or something else. The data gives hints toward all of these directions. Kolb and Frohman (1970) call for recognizing the desired state toward which the organisation is striving and then defining the operational goals, which can be placed in the context of organisation’s total development to give a direction to a meaningful solution. Also, the goals should be set acknowledging the different subsystems of an organisation, which may have different priorities or even conflicting objectives. If the goals are poorly set, e.g., they would not lead into the desired objectives, there is a need to return to adjust them. Our respondents argued that their EA efforts, overall, are lacking clear, relevant, and measurable objectives.

“It would be very important to have relevant goals accompanied with some kind of indicators that would help us to visualize the achieved progress to management as well as employees. This would greatly help the overall commitment to EA.”

It was noted that the objectives should be divided into manageable sizes.

“Problems can be avoided by dividing the objectives into smaller pieces that are easier to cope with. I mean sub-goals. It is also important to learn to tolerate the incompleteness.”

Furthermore, it was argued that the objectives should be tightly aligned with the existing practices of project portfolio management.

“I think that the architectural requirements must be aligned with the project management models. This would make it possible for the EA to oversee, and especially to help, the development projects so that they could understand the architecture requirements and perform accordingly.”

According to respondents, there are also problems in the strategic organisation management.

“The problem of defining the target-state is not due to difficulties of finding the relevant information. Rather, the problem is that our organisation as a whole cannot agree the direction we should be heading to.”

#### 4.1.3 EA Practices in Use

Six items loaded onto the factor we labelled as the *EA practices in use*. First, this factor characterises the lack of skills that are required in modelling and designing organisation’s architectural structures. The factor emphasizes the importance of that the enterprise architects must have not only methodological but also social skills. The practices centering around blueprints and other artefacts cannot guarantee the success, if these are not useful for the dedicated purposes: informing and negotiating on architecture solutions, evaluating them, making decisions on, and further designing and developing solutions. Continuous evaluation enables defining if there is a need to return to adjusting the action plan. The obstacles in adoption are related to both individual and organisational learning – the communication and negotiation skills mean facilitation of the learning to diffuse the information and support the reception of it.

Our respondents noted that EAM at an organisation-wide level is by no means a trivial task. The existing professional skills may not translate into the specific purposes of EAM.

“[...] it is still challenging to step outside of our own silos and to transfer these skills into the context of EA.”

The respondents were generally satisfied with the EA methods and tools they are using. However, they identified the need to improve the presentation of EA artefacts to make them usable for wider audiences.

“Methods and modelling languages are flexible enough and offer decent tools for planning and modelling. But they are not commonly readable and understandable, and therefore require vernacular translations before the full benefits can be reaped.”

Our respondents noted that the methods and tools have to conform with the domain specific requirements and the modelling must be prudent.

“Methods and tools must be adjusted to fit the need. It makes no sense to model the whole world.”

Respondents also considered the realization of benefits to be challenging.

“Making plans is quite easy but it gets difficult when you try to operationalise those plans. It requires real work and that the organisation is willing to change.”

This may be due to that the EA benefits realization is a complex phenomenon that involves several interrelated concepts, which include also the social environments. Verification and measuring of benefits was also addressed by our respondents.

“Overall, it is difficult to measure the operations development. Indicators are fabricated afterwards, and they are vague.”

Some respondents argued that the vocabulary used by the enterprise architects and EA consultants is filled with technical jargon, which causes problems in communications between the stakeholders.

“Directing the communications to different stakeholder groups is challenging. The enterprise architects should be able to speak fluently both business language and the IT jargon.”

Finally, in addition to that the EA-specific terminology and artefacts fail to communicate with the relevant stakeholder groups, the overall understanding about the purpose of EA seems to be lacking.

“General managers [...] don’t understand what the term enterprise architecture means.”

## 5 Discussion

In this study, we present results based of a survey among experts on the challenges of EA adoption in the public sector in Finland. Represented under the 54 respondents were a number of different public sector organisations, as well as IT providers working with the public sector. Based on the analysis of the survey study, aligned with the stages of the generic model of planned change in organisations, we propose three key issues in the adoption of EA in the public sector.

For the most parts, our results comply with previous studies. However, compared to studies on private companies, it appears that the resistance towards change plays a more considerable role in the public sector, characterised by inertia likely caused by issues typical of the public sector, as bureaucracy. For example, in Finland EA is mandated by law; nevertheless only in 17% of the organisations represented the adoption was completed. It is important to get the management to commit to the EA and to ensure fluent communication between the stakeholders. This is reflected in the previous research (Lucke, Krell and Lehner, 2010; Lucke et al., 2012; Jusuf and Kurnia, 2017). Janssen and Klievink (2012) also note that the starting points of a project are crucial and inability to solve the failure factors at the beginning will likely result in a failure at the end. First, their results emphasize the importance of knowing the potential issues in advance. Our study contributes to the practitioner community by identifying such issues. Second, the results of Janssen and Klievink (2012) are in accordance with the analysis we present.

If examined per item, our data indicates that the most commonly encountered and the most challenging problems appear during the early stages of an EAM adoption process. We were able to find only one study on the public sector EA that specifically suggests factors that influence the adoption phase. In their case study, Dang and Pekkola (2016) identified five major problem areas, namely responsibility and credibility, objectives, readiness and awareness, EA work and output, and stakeholders’ different views. Although they applied slightly different perspectives in the conceptualisation, our results are in line with theirs. Table 1 summarises notable observations from the previous studies in relation to the key issues constructed from our data.

**Table 1:** The key issues in relation to the previous research findings

Key issue	Observations from literature
Resistance towards EA	EA often lacks the top-level sponsorship, or the entry representative. This compromises the mandate that is necessary for the successful adoption and for the benefits realization. (Armour and Kaisler, 2001; Dreyfus, 2007; Lucke et al., 2012; Roth et al., 2013; Kaisler and Armour, 2017)
	EA’s IT-orientation causes resistance in other stakeholder groups (Isomäki and Liimatainen, 2008; Seppänen, Heikkilä and Liimatainen, 2009; Asfaw, Bada and Allario, 2009; Penttinen and Isomäki, 2010; Poutanen, 2012).
	Public organisations are often characterised by inertia in the sense that institutional structures and professionalism constrain and channel new arrangements (c.f., Scott, 2005; Isomäki and Liimatainen, 2008).
Relevant EA goals	The EAM should be driven and guided by the organisation’s strategic objectives (Dang and Pekkola, 2016; Rahimi, Gøtze and Møller, 2017).
	The failure in setting goals may lead to local optimization with global ramifications (Dreyfus, 2007).
	EA development should be organised with manageable sized objectives that enable ‘quick wins’ (c.f., Niemi, 2006; Hopkins and Jenkins, 2008).
EA practices in use	EA should be aligned with the practices of project portfolio management (Aier and Schelp, 2010).
	Specialized skills and capabilities are required to discern and manage large and complex structures (James, 2002; Strano and Rehmani, 2007; Hauder et al., 2013; Dang and Pekkola, 2016).
	Practice of EA requires a combination of both hard and soft skillsets (e.g., Strano and Rahmani, 2007; Hope, Chew and Sharma, 2017; Banaeianjahromi and Smolander, 2017).
	Stakeholder groups outside the IT domain fail to utilize EA artefacts (e.g., Lucke, Krell and Lechner, 2010).
	The majority of potential benefits of EA are either strategic, indirect or intangible, and therefore difficult to measure and even attribute as the results of EA (Niemi, 2008).
There is a lack of shared vocabulary (Lapalme, 2012) and confusion regarding the understanding of EA and its concepts (Lemmetti and Pekkola, 2012).	

To summarize, our study aims at drawing a more consistent and aligned picture of the problem area than could be found in the literature on the obstacles encountered in adoption of EAM practices in public sector

organisations. Firstly, starting out with the existing body of knowledge, earlier findings were tested and mainly confirmed (see Table 1), but also extended theoretically, with the organisational change process. Prior studies largely rely on small scale or qualitative data, as case studies. Testing the findings in a quantitative study provides in our view a confirmed baseline for the whole area of research and practice. This is helpful for the future developments in both research and practitioner fields, in finding solutions for the known problems.

Secondly, in our quantitative study, we draw together the individual items to three main clusters and align them with the generic organisational change process. This gives in our view a fitting theoretical frame for a more consistent theoretical base for future research. Additionally, it is important to clarify the setting from a theoretical point of view. As one of the benefits of EA, support for organisational change does get mentions. However, to be able to support organisational change, practices related to EA must be introduced and adopted in an organisation in due course. This is a stage prone to the numerous problems as discussed in this study. It appears that EA is often perceived solely as an IT artefact and as such, it evokes similar reactions as information technology induced changes.

Further, the individual items confirmed in the survey, and their relative importance can be translated to action points in organizations, both in new adoptions and in organizations with adoption stage behind but still experiencing problems. Here, maybe the most prominent overall result is the importance of issues other than tools and techniques, but related to the footing of the necessary changes in the organizational practices. This supports the views of recent literature on EA management that stresses the involvement of the organization business management.

### **5.1 Reliability and validity**

In regard to the reliability of this study, an obvious limitation is the sample size. However, the recruited respondents were carefully chosen experts who not only show merits in practice of our research topic, but also represent a notable portion of experts in the Finnish government EA scene at the time of the data collection. In addition, the respondents came from tens of different organisations, giving the data quite diversified sources. The qualitative data we have previously collected as participant observers in EA adoption projects (Seppänen, Heikkilä and Liimatainen, 2009) also supports the identified factor solution.

The survey instrument was built on the issues that were found in the published research literature. Condensing the 80 issues mentioned to the 28 in our survey instrument, involves some subjective judgment. However, the open-ended questions gave an opportunity also to test the validity of the set of issues used in the survey. The survey instrument used a three-point scale to allow the evaluation of EA problems' criticality. While we believe that this scale was suited for the purposes of this study and did not result in significant decrement in reliability or validity (c.f., Jacoby and Matell, 1971) it may not always allow optimal differentiation between the respondents' opinions.

To evaluate the generalizability of our results, and to further broaden the understanding on the problems of EA adoption, additional research cases and data, preferably from other countries, would be needed.

### **5.2 Implications for research and practice**

The current research seldom attempts to make the distinction between public and private organizations explicit. Concentrating on the public only, we found that there are differences. Hence, further research on differences and commonalities would be an interesting research avenue. The use of EA has longer tradition and is more tightly rooted in the private sector, giving deeper insights, from which again government organisations could profit. Also, our study focused on the adoption phase, which, in our terminology, adherent to that of Goodman et al. (1979), may or may not lead to the actual institutionalisation. Therefore, follow-up studies on the success of institutionalisation, i.e., positioning EA as a practical and even social norm in the organisational development activities, that can be observed only through time (Barley and Tolberg, 1997), would be interesting. Further, the success factors, as the other side of the coin, could be reflected on the problematic issues.

Due to the continuous pressure to save on administrative costs, to improve the quality of public electronic services, and to reap the benefits of digital transformation, the EA adoption is currently on the agenda of many public organisations and more so in the future. Our results can be used to improve the preparedness to cope with problems that are likely to be encountered and the readiness for related organizational change, adopting

EA and supported by it, continue the organizational transformation in desired areas. Therefore, this study is of interest to the IT professionals and enterprise architects serving in public organisations as well as the consultants who participate in government EA projects.

## 6 Conclusions

We suggest that the three key areas, namely *Resistance towards EA*, *Relevant EA goals*, and *EA practices in use* proposed in this paper, should be in the focus in any EA adoption project. The organisation and the relevant stakeholders should establish a common understanding and will to commit themselves to the process of change that the adoption and utilisation of EA and adoption of EAM practices require, to find the agreement on the goals, and to develop a capability to implement.

We argue that the present understanding shows that there is no need to get stuck in the details, such as versioning and fine-tuning the EA methods, as these are the areas that thirty years of accumulated practical experience and research have already covered. Rather, we should focus on establishing ‘architectural thinking’ (c.f., Winter, 2016) and while the benefits of EA are unquestionable, they cannot be realised without moving from words to deeds.

As also ample methodical support exists for organizational change, the alignment of the EA adoption problems to the organizational change process supports in our view the practitioners, where seeking to avoid problems and mitigate risks in the adoption efforts. Beyond the EA practice, our study is a message to the organization management interested in the benefits from a managed EA, and leading the change efforts.

## References

- Aagesen, G., van Veenstra, A.F., Janssen, M. and Krogstie, J., 2011. The Entanglement of Enterprise Architecture and IT-Governance: The Cases of Norway and the Netherlands. In *Proceedings of the 44th Hawaii International Conference on System Sciences*.
- Aier, S. and Gleichauf, B., 2010. Applying Design Research Artifacts for Building Design Research Artifacts: A Process Model for Enterprise Architecture Planning. In R. Winter, J.L. Zhao, and S. Aier (Eds.), *DESRIST 2010*, LNCS 6105, pp. 333–348.
- Aier, S. and Schelp, J., 2010. A reassessment of enterprise architecture implementation. In *Service-Oriented Computing. ICISOC/ServiceWave 2009 Workshops* (pp. 35-47). Springer Berlin/Heidelberg.
- Armour, F.J. and Kaisler, S.H., 2001. Enterprise architecture: agile transition and implementation. *IT Professional*, 3(6), pp. 30-37.
- Asfaw, T., Bada, A. and Allario, F., 2009. Enablers and Challenges in Using Enterprise Architecture to Drive Transformation: Perspectives from Private Organisations and Federal Government Agencies. *The Journal of Enterprise Architecture*, 5(3), pp. 9-17.
- Baldoni, R., 2012. Federated Identity Management systems in e-government: the case of Italy. *Electronic Government, an International Journal*, 9(1), pp. 64-84.
- Banaeianjahromi, N. and Smolander, K., 2017. Lack of Communication and Collaboration in Enterprise Architecture Development. *Information Systems Frontiers*, August 2017.
- Barley, S.R. and Tolbert, P.S., 1997. Institutionalization and structuration: Studying the links between action and institution. *Organisation studies*, 18(1), pp. 93-117.
- Bui, Q., 2015. Increasing the relevance of enterprise architecture through “Crisitunities” in US state governments. *MIS Quarterly Executive*, 14(4), pp. 169-179.
- Bui, Q.N. and Levy, M., 2017. Institutionalization of Contested Practices: A Case of Enterprise Architecture Implementation in a US State Government. In *Proceedings of the 50th Hawaii International Conference on System Sciences*.
- Bui, Q.N., Markus, M. and Newell, S., 2015. Alternative Designs in Widespread Innovation Adoption: Empirical Evidence from Enterprise Architecture Implementation in US State Governments. In *Proceedings ICIS 2015*.
- Christiansen, P. and Gøtze J., 2007. Trends in Governmental Enterprise Architecture: 9 Reviewing National EA Programs – Part 1. *Journal of Enterprise Architecture*, 3(1), pp. 9-19.
- Dang, D.D. and Pekkola, S., 2016. Institutionalising Enterprise Architecture in the Public Sector in Vietnam. In *Proceedings ECIS*.
- Dang, D.D. and Pekkola, S., 2017. Systematic Literature Review on Enterprise Architecture in the Public Sector. *Electronic Journal of E-Government*, 15(2), pp. 130.
- Dreyfus, D., 2007. Information system architecture: Toward a distributed cognition perspective. In *Proceedings ICIS 2007*, pp. 131.
- Foorthuis, R., Steenbergen, M.v., Brinkkemper, S. and Bruls, W.A.G., 2016. A theory building study of enterprise architecture practices and benefits. *Information Systems Frontiers*, 18(3), pp. 541-564.
- Goodman, P. S., Bazerman, M., and Conlon, E., 1979. Institutionalization of Planned Organisational Change (No. 1). Carnegie-Mellon University, Pittsburgh, PA. Graduate school of industrial administration.

- Gregor, S., Hart, D. and Martin, N., 2007. Enterprise architectures: enablers of business strategy and IS/IT alignment in government. *Information Technology and People*, 20(2), pp. 96-120.
- Hauder, M., Roth, S., Schulz, C. and Matthes, F., 2013. An examination of organisational factors influencing enterprise architecture management challenges. In *Proceedings of ECIS*, pp. 175.
- Hiekkanen, K., Korhonen, J.J., Collin, J., Patricio, E., Helenius, M. and Mykkänen, J., 2013. Architects' Perceptions on EA Use -An Empirical Study. In *Proceedings of the IEEE 15th Conference on Business Informatics*, pp 292-297.
- Hirvonen, A. P., and Pulkkinen, M., 2005. User participation in consulting projects: client and provider role variations. *ECIS 2005 Proceedings*, 20.
- Hjort-Madsen, K., 2006. Enterprise Architecture Implementation and Management: A Case Study on Interoperability. In *Proceedings of the 39th Hawaii International Conference on System Sciences*.
- Hjort-Madsen, K. and Burkard, J., 2006. When enterprise architecture meets government: An institutional case study analysis. *Journal of Enterprise Architecture*, 2(1), pp. 11-25.
- Hjort-Madsen, K. and Gøtze, J., 2004. Enterprise architecture in government-Towards a multi-level framework for managing IT in government. In *Proceedings 4th European Conference on e-Government*, Dublin Castle, Ireland, pp. 365.
- Hjort-Madsen, K. and Pries-Heje, J., 2009. Enterprise architecture in government: Fad or future? In *Proceedings of the 42th Annual Hawaii International Conference on System Sciences*, 2009, Waikoloa, Big Island, Hawaii.
- Hope, T., 2015. *The critical success factors of enterprise architecture*. Dissertation, University of Technology, Sydney.
- Hope, T., Chew, E. and Sharma, R., 2017. The Failure of Success Factors: Lessons from Success and Failure Cases of Enterprise Architecture Implementation. In *Proceedings of the 2017 ACM SIGMIS Conference on Computers and People Research*, pp. 21-27.
- Isomäki, H. and Liimatainen, K., 2008. Challenges of Government Enterprise Architecture Work – Stakeholders' Views. In *Series of Lecture Notes in Computer Science 5184, proceedings of the 7th international EGOV conference*, Torino, Italy, 2008. Berlin: Springer, pp. 364-374.
- Iyamu, T., 2009. The Factors Affecting Institutionalisation of Enterprise Architecture in the Organisation. In *Proceedings of the IEEE Conference on Commerce and Enterprise Computing*, pp. 221-225.
- Jacoby, J. and Matell, M. S., 1971. Three-Point Likert Scales Are Good Enough. *Journal of Marketing Research*, 8(4), pp. 495-500.
- James, G., 2002. *Architecture Maturity: Acting on the Signs*. [online] Available at: <<https://www.gartner.com/doc/365425/architecture-maturity-acting-signs>> [Accessed 5 June 2017].
- Janssen, M., 2012. Sociopolitical aspects of interoperability and enterprise architecture in e-government. *Social Science Computer Review*, 30(1) pp. 24-36.
- Janssen, M., Flak, L. S., and Sæbø, Ø., 2013. Government architecture: concepts, use and impact. In *International Conference on Electronic Government*, Berlin, Heidelberg: Springer, pp. 135-147.
- Janssen, M. and Hjort-Madsen, K., 2007. Analyzing enterprise architecture in national governments: The cases of Denmark and the Netherlands. In *Proceedings of the 40th Hawaii International Conference on System Sciences*.
- Janssen, M. and Klievink, B., 2012. Can enterprise architectures reduce failure in development projects? *Transforming Government: People, Process and Policy*, 6(1), pp.27-40.
- Jusuf, M.B. and Kurnia, S., 2017. Understanding the Benefits and Success Factors of Enterprise Architecture. In *Proceedings of the 50th Hawaii International Conference on System Sciences*.
- Kaisler, S.H. and Armour, F., 2017. 15 Years of Enterprise Architecting at HICSS: Revisiting the Critical Problems. In *Proceedings of the 50th Hawaii International Conference on System Sciences*.
- Kaisler, S.H., Armour, F. and Valivullah, M., 2005. Enterprise architecting: Critical problems. In *Proceedings of the 38th Annual Hawaii International Conference on System Sciences*.
- Kaushik, A. and Raman, A., 2015. The new data-driven enterprise architecture for e-healthcare: Lessons from the Indian public sector. *Government Information Quarterly* 32(1), pp. 63-74.
- Keen, P.G.W., 1981. Information Systems and Organisational Change. *Communications of the ACM*, 24(1) pp. 24-33.
- Kolb, D.A. and Frohman, A.L., 1970. An Organisational Development Approach to Consulting. *Sloan Management Review*, 12(1) pp. 51-65.
- Kotter, J.P., 1995. Leading Change: Why Transformation Efforts Fail. *Harvard Business Review*, March-April.
- Lapalme, J., 2012. Three Schools of Thought on Enterprise Architecture. *IT Professional*, November/December 2012.
- Larsson, H., 2011. On the Road to Interoperability: Complexities of public sector enterprise thinking. FOVU:s rapportserie, nr 2, *Örebro Licentiate Studies in Informatics*, nr 2.
- Lemmetti, J., Pekkola, S., 2012. Understanding enterprise architecture: Perceptions by the Finnish public sector. In H.J. Scholl et al. Eds. *Lecture Notes in Computer Science*, Berlin: Springer, pp. 162-173.
- Lemmetti, J. and Pekkola, S., 2014. Enterprise architecture in public ICT procurement in Finland. *Electronic Government and Electronic Participation: Joint Proceedings of Ongoing Research and Projects of IFIP WG 8*, pp. 227-236.
- Lucke, C., Bürger, M., Diefenbach, T., Freter, J. and Lechner, U., 2012. Categories of enterprise architecting issues-an empirical investigation based on expert interviews. In D.C. Mattfeld and S. Robra-Bissantz Eds. *Multikonferenz Wirtschaftsinformatik*, pp. 999-1010.
- Lucke, C., Krell, S. and Lechner, U., 2010. Critical issues in enterprise architecting—a literature review. In *AMCIS 2010 Proceedings*. 305.

- Morganwalp, J.M. and Sage, A.P., 2004. Enterprise architecture measures of effectiveness. *International Journal of Technology, Policy and Management*, 4(1), pp. 81-94.
- Niemi, E.I., 2006. Enterprise architecture benefits: Perceptions from literature and practice. In *Proceedings of the 7th IBIMA Conference Internet & Information Systems in the Digital Age*, Brescia, Italy, 2006.
- Niemi, E.I. and Pekkola, S., 2016. Enterprise architecture benefit realization: Review of the models and a case study of a public organisation. *SIGMIS Database*, 47(3), pp. 55–80.
- Onwuegbuzie, A. J. and Leech, N. L., 2007. A call for qualitative power analyses. *Quality and Quantity*, 41(1), pp. 105–121.
- Patton, M.Q., 1990. *Qualitative evaluation and research methods*. SAGE Publications, inc.
- Penttinen, K. and Isomäki, H., 2010. Stakeholders' Views on Government Enterprise Architecture: Strategic Goals and New Public Services. In Normann Andersen, K., Francesconi, E., Grönlund, Å. and van Engers, T., Eds., *Electronic Government and the Information Systems Perspective*, Proceedings of the EGOVIS2010 Conference.
- Poutanen, J., 2012. The Social Dimension of Enterprise Architecture in Government. *Journal of Enterprise Architecture*, 8(2), pp. 19-29.
- Pulkkinen, M., 2006. Systemic management of architectural decisions in enterprise architecture planning. four dimensions and three abstraction levels. In *Proceedings of the 39th Annual Hawaii International Conference on System Sciences*.
- Rahimi, F., Gøtze, J. and Møller, C., 2017. Enterprise architecture management: Toward a taxonomy of applications. *Communications of the Association for Information Systems*, 40(1) pp. 120-166.
- Roth, S., Hauder, M., Farwick, M., Breu, R. and Matthes, F., 2013. Enterprise Architecture Documentation: Current Practices and Future Directions. *Wirtschaftsinformatik*, pp. 58.
- Saha, P. (Ed.), 2009. *Advances in government enterprise architecture*. IGI Global.
- Schein, E.H., 1996. Kurt Lewin's change theory in the field and in the classroom: Notes toward a model of managed learning. *Systems Practice*, 9(1), pp. 27-47.
- Schmidt, R., Möhring, M., Härting, R.C., Reichstein, C., Zimmermann, A. and Luceri, S., 2015. Benefits of enterprise architecture management—insights from European experts. In *IFIP Working Conference on The Practice of Enterprise Modeling*, Cham: Springer, pp. 223-236.
- Schönherr, M., 2009. Towards a common terminology in the discipline of enterprise architecture. In G. Feuerlicht and W. Lamersdorf, eds. *Service-Oriented Computing – IC3OC 2008 Workshops*, Lecture Notes in Computer Science, Berlin, Heidelberg: Springer-Verlag, 5472/2009.
- Scott, W.R., 2005. Institutional theory. In *Encyclopedia of Social Theory*, Thousand Oaks, CA: Sage, pp. 408-414.
- Seppänen, V., Heikkilä, J. and Liimatainen, K., 2009. Key Issues in EA-implementation: Case study of two Finnish government agencies. In *Proceedings of the 11th IEEE Conference on Commerce and Enterprise Computing*.
- Shaanika, I. and Iyamu, T., 2014. Developing Enterprise Architecture Skills: A Developing Country Perspective. In *IFIP Conference on Information Technology in Educational Management*, Springer, Berlin, Heidelberg, pp. 52-61.
- Slevin, D.P. and Pinto, J.K., 1987. Balancing Strategy and Tactics in Project Implementation. *Sloan Management Review*, Fall 1987, pp. 33-44.
- Smets, M., Morris, T. I. M., and Greenwood, R., 2012. From practice to field: A multilevel model of practice-driven institutional change. *Academy of Management Journal*, 55(4), pp. 877-904.
- Strano, C. and Rehmani, Q., 2007. The role of the enterprise architect. *Information Systems and e-business Management*, 5(4), pp. 379.
- Tambouris, E., Kaliva, E., Liaros, M. and Tarabanis, K., 2014. A reference requirements set for public service provision enterprise architectures. *Software & Systems Modeling*, 13(3), pp. 991-1013.
- Weiss, S., Aier, S. and Winter, R., 2013. Institutionalization and the effectiveness of enterprise architecture management. In *Proceedings 34th International Conference on Information Systems, Association for Information Systems*, Milan, Italy, 2013.
- Winter, R., 2016. Establishing 'Architectural Thinking' in Organisations. In *IFIP Working Conference on The Practice of Enterprise Modeling, PoEM 2016: The Practice of Enterprise Modeling*, Part of the Lecture Notes in Business Information Processing book series (LNBIP, volume 267).
- Zimmermann, A., Schmidt, R., Jugel, D. and Möhring, M., 2015. Adaptive enterprise architecture for digital transformation. In *European Conference on Service-Oriented and Cloud Computing*, Springer International Publishing, pp. 308-319.
- Zink, G., 2009. How to restart an enterprise architecture program after initial failure. *Journal of Enterprise Architecture*, 5(2), pp. 31-41.