JYU DISSERTATIONS 334

Katariina Valtonen

Coherency Management by Architecture?

Adapting Enterprise Architecture Framework for the Finnish Government Ecosystem

UNIVERSITY OF JYVÄSKYLÄ
FACULTY OF INFORMATION TECHNOLOGY

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In remembrance of my encouraging loving late mother Prof. E. Tellervo Valtonen who is rejoicing for me with Jesus now.

ABSTRACT

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Coherency Management by Architecture? Adapting Enterprise Architecture Framework for the Finnish Government Ecosystem
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Public sector in the West has been exposed to government reforms for a long time. On-going public reforms do not report very high success rates, e.g. concerning digitalization. *Public administration* (PA) consists of administrative units at national, regional or local levels with various cross-dependencies. *Government coherency* refers here to a logical, orderly and consistent relation of the parts of the government to the whole. According to Zachman it is impossible to change a complex entity without descriptions of the current state to create different views of the entirety - to facilitate this, enterprise architecture has been approached. *Enterprise architecture* (EA) has been used to describe and design the business operations, information systems, data structures, and technology platforms of the enterprises. The knowledge on EA best practices is scattered and evolving, though. Since in PA differs from private businesses, e.g., by the mission and business logic, there is a need to study the adaptation and application of the EA in PA. In the study, we explored how the *EA framework* (EAF) should be adapted in the government ecosystem for coherency management.

The study consists of two consecutive case studies in Finland, a national EA method development project and EA development in Kouvola City. In the first, the adaption model of the Finnish national EA framework was constructed. The model was evaluated in the second case study, where it was applied and developed by abductive logic of reasoning. We propose that EAF should be further developed conceptually and practically in order to present the current state EA information and descriptions in the frames of the prevailing management structures beyond other categorizations of the EA framework. In this way, EAF of the current state information would serve as *data model of the current state management structures in the government ecosystem*, and allow analyses of EA contents in relation to many more aspects than currently. To realize the practical benefits this should be instantiated as a common real-time EA information system. This might require a common contextual ontology in PA as the basis for the analyses of the as-is government ecosystem. The study follows abductive logic of reasoning and presents the ‘next best explanation' based on the available data, and therefore the results require further studies.

Keywords: government ecosystem, coherency management, organization design, e-government, enterprise architecture framework, method engineering

TIIVISTELMÄ (ABSTRACT IN FINNISH)

Valtonen, Meri Katariina
Koherenssi hallintaan arkkitehtuurilla? Sovittamassa kokonaisarkkitehtuuri-viitekehystä Suomen julkishallintoekosysteemiin
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Länsimaiden julkishallintoa on pitkään uudistettu ja tehostettu rakenteellisin muutoksin. Uudistuksista ei ole paljolti raportoitu onnistumisia, esim. palvelujen sähköistämisestä. Julkishallinto koostuu hallintoyksiköistä kansallisella, alueellisella ja paikallisella tasolla, jotka ovat erilaisissa riippuvuussuhteissa toisiinsa. Julkishallinnon koherenssi (engl. *coherency*) tarkoittaa tässä sen osien järjestäytynyttä ja loogista suhdetta toisiinsa kokonaisuutena. Zachmanin mukaan monimutkaista kokonaisuutta on vaikea muuttaa, ellei sen osista ja näiden suhteista ole kuvauksia, joiden kautta voidaan tarkastella eri näkymiä kokonaisuudesta. Tutkimuksessa tähän on sovellettu kokonaisarkkitehtuuria. *Kokonaisarkkitehtuuria (KA)* käytetään yrityksen osien ja näiden suhteiden kuvaamiseen ja suunnitteluun. Kokonaisarkkitehtuurista tuotettu tietämys ei kuitenkaan ole yhtenäistä eikä se välttämättä sovellu sellaisenaan julkishallintoon, jonka missio ja ansaintalogiikka ovat erilaiset kuin yksityissektorilla. Tutkimme tässä, miten KA-viitekehys olisi sovitettava julkishallinnossa laajemmin koherenssin hallintaa varten.

Tutkimus muodostuu kahdesta peräkkäisestä tapaustutkimuksesta Suomessa, 1. kansallinen KA-menetelmän kehittämishanke ja 2. Kouvola-konsernin KA-kehittäminen. Ensimmäisessä luotiin esitys Suomen julkishallinnon KA-viitekehyksen sovittamismallista, jota arvioitiin Kouvolan kaupungin toimintasuunnittelututkimuksessa, jossa mallia sovellettiin ja iteroitiin abduktiivisen päättelyketjun mukaan. KA-viitekehystä tulisi tutkimuksen nojalla kehittää käsitteellisesti ja käytännöllisesti siten, että nykytilaa koskevat KA-tieto ja -kuvaukset jäsennetään myös hallintoa kulloinkin ohjaavien rakenteiden mukaan perinteisten KA-ulottuvuuksien lisäksi. Tällöin KA-viitekehys nykytilatiedolle voi olla reaaliaikaisesti päivittyvä tietomalli ekosysteemistä joka voi palvella julkishallinto-ekosysteemin nykytila-analyysejä aiempaa laajemmin. Käytännön hyötyjen realisoimiseksi tämä vaatisi yhteistä tietojärjestelmää ja mahdollista tekoälyä tämän tueksi, mikä edelleen voi edellyttää yhteistä kontekstuaalista ontologiaa hallintoekosysteemin mallintamiseksi. Abduktiivisen päättelyn luonteen mukaan emme esitä tässä lopullisia totuuksia. Tulokset ovat edellyttävät jatkotutkimusta laajemmissa ja erilaisissa aineistoissa.

Asiasanat: hallintoekosysteemi, koherenssin hallinta, organisaatiosuunnittelu, sähköinen hallinto, kokonaisarkkitehtuuriviitekehys, menetelmäkehitys

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As time went by, in the reflection and learning phase of the study, Prof. Mikko Siponen became a new principal supervisor, providing scientific freedom for thinking as well as academic level guidelines to the formalizing work. Dr. Ville Seppänen – co-worker and co-author from the earlier research project, had pursued academic career and progressed in EA research field. When considering the implications, Ville and his research team entered in facilitating some beneficial synergies. I was then also lucky to include him in the supervisor team, which had already been changing over time.

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First and foremost, the thesis was written for the glory of my God, Jesus the Messiah and for the edification of His Kingdom. Thank you to the living God the Father of Jesus Christ and mine! All the innovations and inspiration in this book comes ultimately from Him by His Amazing Spirit. Soli Deo Gloria.

Jyväskylä 25.11.2020
Katariina Valtonen

FIGURES

TABLES

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CONTENTS

1 INTRODUCTION

The thesis has been a journey seeking how to adapt enterprise architecture (EA) methodologies in public administration (PA). EA is suggested as a method for managing the complexity of public sector coherency. The emerging findings are presented as nine scientific articles written over the course of the research period (Articles I–IX). The journey is briefly outlined in the following.

1.1 Motivations of the study

PA in Europe experienced consecutive reforms for a long time. In the 1980s, market-type mechanisms and business management logics were introduced in PA. The aim was efficiency and accountability in response to perceived bureaucratic structures and monetary deficiencies. The reform was entitled the *New Public Management* (NPM). (Hammerschmid, Van de Walle, Andrews, & Bezes, 2016) In its quest for innovation, the reform was directed to the implementation of e-government, e.g. in Estonia (Savi & Randma-Liiv, 2016). NPM was to reorganise and streamline public administrations (Cordella, 2007; Lapsley, 2009). The means were derived from the management practices of the private sector, e.g. risk management, wider utilisation of the information systems (ISs), management by agreement, privatisation of the production functions, resource savings, visible and active top management, performance monitoring, and standardisation (Lapsley, 2009; orig., Hood, 1991; and 1995). According to the critical analysis by Lapsley (2009), the reform has greatly increased the use of consultants and the number of failed IS projects, amongst other things.

Lately, newer reforms have been spoken of as the post-NPM era, where NPM instruments are used to enhance responsiveness to citizens and to respond to demands for legality and impartiality. Governance and network-style approaches are used to fight against the fragmentation of the public sector and to bring back central political control (Hammerschmid et al., 2016).

In Finland, there have been significant reforms on administrative structures and steering systems in the public sector since the 1990s, both in state administration and in municipal government (Virtanen, 2016). For example, these have consisted of attempts to reorganise the social and health services provision and provincial administration (Government of Finland, 2016) and to refine the municipal and municipal service provision structures (Ministry of Internal Affairs, 2007).

Given the importance of PA in the lives of citizens, there should be systematic tools for designing, executing, documenting and evaluating public administration reforms. Public sector reforms emerge very differently in each nation, and there is currently not enough systematic research on how the reforms have been executed and what the outcomes have been (Hammerschmid et al., 2016). In fact, governments themselves do not systematically evaluate their reform programmes. Moreover, academia lacks a comprehensive narrative of the reforms (Hammerschmid et al., 2016). In the study, EA is examined as a tool for managing change and complexity in the public sector (cf. Doucet, Gøtze, Saha, & Bernard, 2008; Op't Land, Proper, Waage, Cloo, & Steghuis, 2009; Saha, 2009a).

1.2 Theoretical background

Enterprise architecture (EA) has been used in the public sector for a long time (e.g. DoDAF, 2010; Whitehouse, 2013). According to Stelzer (2009), *enterprise architecture*

> 'is the fundamental organization of an enterprise embodied in its components, their relationships to each other, and to the environment, and the principles guiding its design and evolution' (Stelzer, 2009, p. 12).

The EA concept is sometimes confusingly attached to two meanings, first to the enterprise's inherent design, and second to the explicated representations of the inherent design (Stelzer, 2009). We use the concept EA for the inherent design of an enterprise or business ecosystem. The explicated representations of the EA are denoted as *EA descriptions*, or *EA information*, typically appearing in the form of diagrams, drawings, tables, lists and matrices (Perks & Beveridge, 2007). The documented representations of the enterprise components, their structures, properties and relations often contain structural data beyond visualisations, such as the attributes of the elements in the process diagram (OMG, 2011).

EA methodologies have evolved by purpose and scope over time. EA has been suggested for a wide variety of purposes. It has been traditionally used as a holistic tool to describe, analyse and design business operations, information systems, data structures and technology platforms in many organisations, often by utilising standards such as those of The Open Group (2011). The business-IT alignment can be conceived as the established purpose of the development of the EA and its methodologies, e.g. in (Ahlemann, Stettiner, Messerschmidt, & Legner, 2012). Thereafter, the purpose and scope of the EA methodologies have widened, e.g. for agility, assurance and wider alignment of the organisation (Doucet et al., 2008), for environmental aspects in enterprise re-innovation (Graves, 2008), for physical domains in the manufacturing process (Aldea, Iacob, Wombacher, Hiralal, & Franck, 2018) and for business ecosystems' shared EA design (Drews & Schirmer, 2014). As for the evolution of EA's purpose and scope, some categorisations have been proposed by (Ahlemann et al., 2012; Doucet, Gøtze, Saha, & Bernard, 2009b; Lapalme, James, 2012).

EA method engineering is the object of this study, especially the situational adaptation of the EA framework. The EA method typically consists of a framework, a modelling process, techniques, models and roles (Leist & Zellner, 2006). The EA framework presents the EA descriptions for the adopting enterprise in order to inform the EA design and analyses. EA frameworks of the various EA methodologies vary in nature, scope and purpose, seemingly along with the evolution of the EA purpose and scope. However, a solid consistent theory about enterprise architecture is missing (Bernard, 2012; Kotusev, Singh, & Storey, 2015; Kotusev, 2017; Lapalme, James et al., 2016; Simon, Fischbach, & Schoder, 2013). In other words, there is no unanimous perception of the purpose, scope or EA framework dimensions. The golden rule for the successful application of EA theory and methodologies should therefore be determined. This study does not answer the question of how public reforms should be executed to achieve more efficiency and lower costs, but it does focus on the phenomenon of the adaption of the EA framework in the use of public ecosystem coherency management.

1.3 Research goal and questions

The research goal was to find principles of the EA framework adaption for public sector coherency management. An animating moment during the prolonged explorations of the thesis was the encounter with the concept of coherency management (CM), as it was introduced by (Doucet et al., 2008; Doucet, Gøtze, Saha, & Bernard, 2009a). By *organizational coherency*, they refer to 'the logical, orderly and consistent relation of the parts to the whole' as the ultimate purpose of EA (Doucet et al 2009a, p. 29). In addition, they suggest that EA be used for more than one purpose, whether in the private or public sector. This would yield new capabilities for abstracting, analysing, designing and re-engineering complex enterprises (Doucet et al., 2008). The main body of the thesis focuses on the adaption mechanisms of the national EA framework within the nation, seeking to answer the main research problem:

RQ: How do we adapt the enterprise architecture framework for public administration as a set of organisations, i.e., as a government ecosystem, for coherency management? (cf. Articles IV-VII)

Prior to this, research questions in the preliminary exploratory part of the study concerned EA method engineering contingencies and requirements:

RQ1: What kind of contingencies does PA set for EA method engineering? (cf. Article II)

RQ2: What kind of requirements does PA set for EA method? (cf. Articles I and III)

In the reflection and learning phase of the study, we asked what implications the suggested results in Article VII should cause for the entirety of a national public sector:

RQ3: What should the results in Article VII imply for the national administration? (cf. Articles VIII– IX)

1.4 Research approach and strategy

Constructive methodologies (Hevner, March, Park, & Ram, 2004; Sein, Henfridsson, Purao, Rossi, & Lindgren, 2011) and abductive logics of reasoning (Levin-Rozalis, 2009) comprise the research strategy of this study, in exploring and iteratively explaining how to adapt the government EA framework in the public sector in order to make the EA concept beneficial to general management in CM and undergoing change. EA as a social construct is a moving goal; as such, it is the principal rationale for choosing the abductive logic of reasoning as the research paradigm. The philosophical stance of the study is constructivism, where reality is built and reiteratively adapted by negotiations amongst subjects (Dietz, 2006, p. 8).

For constructivists, knowledge is co-created in the research process (Lähdesmäki, Hurme, Koskimaa, Mikkola, & Himberg, 2010). The body of knowledge consists of design principles. Design principles clarify how to design and implement an innovation, e.g. an information system, organisational structure and process or the organisational fit of an EA framework as in this study. The question 'how' is typical. This approach is widely used in IS research. The acceptability of the design principle requires confirmation based on the research rigour, e.g. proven reliability and validity (Gregor, Hart, & Martin, 2007; Gregor & Jones, 2007; Järvinen, 2004).

The thesis is comprised of research Articles I–IX from two consecutive EA case studies in Finnish PA (Fig. 1). The first case study was the national EA method engineering project, with the state administration as the unit of analysis, resulting in four articles (Article I: Hirvonen, Pulkkinen, & Valtonen, 2007; Article II: Leppänen, Valtonen, & Pulkkinen, 2007; Article III: Valtonen & Leppänen, 2008; Article IV: Valtonen, Seppänen, & Leppänen, 2009). The latter case study took place in the Kouvola City Corporation with the local administration as the unit of analysis, resulting in three articles (Article V: Valtonen, Korhonen, Rekonen, & Leppänen, 2010; Article VI: Valtonen, Mäntynen, Leppänen, & Pulkkinen, 2011). The two consecutive case studies divide the thesis into exploratory and abductive parts. The red colour in Fig. 1 denotes the exploratory part, and the green, the abductive part. The exploratory part ends with initial suggestions of the EA framework adaption in Article IV. The latter abductive part involves the deployment of the initial explanation in situ in a municipal organisation, in Articles V–VI. The latter use case is considered as the wider set of data for testing and reiterating the initial hypotheses as suggested in the abductive evaluation (Levin-Rozalis, 2009), where iterative research cycles are executed to refine the explanations. Articles I–VII did not use the concept of public ecosystem in their text, but in the implications articles, we use the term public ecosystem or government ecosystem for the set of public organisations (Article VIII: Valtonen, Nurmi, & Seppänen, 2018; Article IX: Nurmi, Seppänen, & Valtonen, 2019).

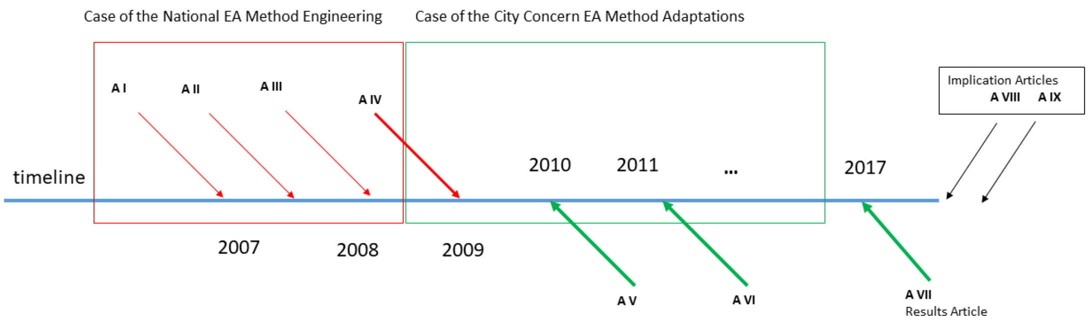

FIGURE 1 The thesis's articles in the consecutive case studies' timeline.

Both state and local administration as two archetypes are composed, in essence, of a set of organisations at different hierarchical levels in administration. Beyond the central administration, both consist of sectoral agencies and localised offices that form a mutually interdependent entirety by the common financial statement. In the municipality, however, the organisational actors are situated geographically in more constrained areas. The best explanation in the thesis suggests that all types of management structures of the entirety of the prevailing government should advise the implementation and maintenance of the as-is government EA descriptions (Article VII: Valtonen, 2017).

The structure of the introduction is as follows: The theoretical background is given in Chapter 2. Chapter 3 presents the research approach and methods in detail. Chapter 4 describes the case organisations and the practical work conducted in them. Chapter 5 summarises the thesis articles, and positions each article in the research process. Chapter 6 contains the implications of the findings for the theory and practice, limitations of the study and suggested further studies. Chapter 7 summarises the study and offers conclusions.

2 THEORETICAL BACKGROUND

In this chapter, the EA concept, EA framework, evolution of EA scope and purpose and the role of EA for public sector CM are presented. EA concepts have evolved during the study due to its length. In the reflection and learning phase of the study, therefore, concept analysis was conducted utilizing some Journal of Enterprise Architecture volumes. The meaning of the EA concept was compared from different articles to support the historical understanding ot the evolution.

Chapter 2 is based principally on the literature from each formalization phase of the study, i.e., from literature review for each individual articles. The theoretical foundations of the study is addressed in the original articles I-IX with more details. For each of the papers, the literature review was done for the specific paper supporting the research goal at hand. The key point has often been some pivotal and decisive article that has led to further literature research based on the article's reference list, as well as keyword searches about the presented concepts. Key word searches from literature databases were used during each formalization period, using keywords such as EA, and EA framework and many more. Since the introduction of Google Scholar, it has been extensively used for keyword searches and to download specific articles. This has been supported by the Jyväskylä university proxy policies by university authorizations.

2.1 Enterprise Architecture concept

EA is 'the fundamental organization of an enterprise embodied in its components, their relationships to each other, and to the environment, and the principles guiding its design and evolution' (Stelzer, 2009, p. 12). The EA concept may refer to the enterprise's inherent design or to the explicated representations of the inherent design, either in the current or future stages (Stelzer, 2009). The EA concept is used here for the inner structures, i.e. the inherent design of an organisation, a set of organisations or a business ecosystem.

Any conscious change of a complex entity requires descriptive representations of its components and their dependencies as a starting point (Zachman, J., 2009). The descriptive representations are denoted as EA descriptions or EA information. *EA descriptions* give impressions of some models or diagrams, while *EA information* consists of textual or numerical data. EA descriptions manifest as pictures, diagrams, matrices, lists etc. (Perks & Beveridge, 2007). They describe the realised current state, 'as-is', or the 'to-be' target states of the organisational contents (Schekkerman, 2004). EA descriptions make the components of an organisation and their relationships transparent:

> 'Enterprise architectures provide people at all organisational levels with an explicit, common, and meaningful structural frame of reference that allows an understanding of the enterprise' (Strano & Rehmani, 2005, p. 8; orig. GAO, 2003).

The understanding of the organisation for people 'at all levels' is conveyed through EA descriptions and information. This might be one way of fulfilling the promises involved in EA. For instance, (Op't Land et al., 2009) claim that EA provides value to the governance of complex organisations in global challenges.

In the era of digitalisation, the inner structures and division of tasks affect the functionality and effectiveness of the administration and service provision as well as the physical location of the functions. With the inner structures, we refer to administration's strategies, organisation structures (typically described as organigrams), administrative and provision processes, personnel roles and workflows, information flows and data structures, metadata and information structures and technologies, inter alia. These structures are dependent on each other in various ways. By describing the inner structures and their dependencies in an accessible manner, the entirety of the functions becomes enlightened, and supposedly transparent and manageable as an entirety. Typical management questions to be resolved via EA descriptions are whether the business processes cover the customer requests adequately or which business processes are supported by which business applications (Buckl, S., Ernst, Lankes, & Matthes, 2008).

EA descriptions are instantiations of *EA models*, the latter as types of EA descriptions. The EA model defines the concepts, elements, structures and notations in each EA description type. Each EA model is preferably based on a commonly agreed upon practice, modelling notation or standard, such as (Archimate, cf. Jonkers, Lankhorst, Quartel, Proper, & Iacob, 2011; BPMN by OMG, 2011; BSC by Kaplan & Norton, 1996; UML by OMG, 2017; Gantt-diagram by Gantt, 1919). Modelling notation typically includes predefined semantics of the representative symbols (OMG, 2014). Standardised diagrams thus become

> 'data with well-defined structures and meanings that represents the facts and concepts behind the pictures' (OMG, 2014, p. 4).

If thus constructed, the EA descriptions would form a structural data set as opposed to mere static drawings. A structural set of EA descriptions and information would allow reconstructions, various kinds of expressions and reorganisation of the content in different views (cf. Buckl, Sabine, Ernst, Lankes, Matthes, & Schweda, 2008; OMG, 2014). EA models are typically outlined in EA frameworks as instructed in respective EA methods. EA frameworks as the object of this study are discussed next. With regard to EA theory, it is often referred to as the EA framework, according to Simon et al. (2013), who found a gap between the theoretical foundations and EA practice.

2.2 EA framework

EA models are typically organised in an EA framework (e.g. Sowa & Zachman, 1992; Whitehouse, 2013). A *framework* signifies a skeletal structure, i.e. a frame containing something, also a set of frames (Dictionary.com, 2016). The framework supports the development of the architecture at hand (Bernard, 2005; IFIP-IFAC Task Force, 1999; Pulkkinen, 2006). The *EA framework* outlines EA descriptions and information of the areas considered in architectural modelling, planning and design. Categorisation of the EA contents into the EA framework frames the architecture in question. The architectural framework as a concept consists of categorisations, i.e. viewpoints, which are not fixed but bound to the stakeholders' concerns in the enterprise (ISO/IEC/IEEE 42010, 2011). The EA framework may cover parts of the organisation, or give the impression of the organisation only from a limited perspective (Graves, 2008; Lapalme, James, 2012), e.g. from the IT management perspective as in (Perks & Beveridge, 2007). For extended purposes, i.e. 'extended architecture' (Doucet et al., 2009a), it covers extended areas, e.g. business motivations with strategic goals and objectives, as in (Simon, Fischbach, & Schoder, 2014; The Open Group, 2011).

When an organisation is beginning EA development, it usually deploys a particular EA framework, either an existing or a customised one (Armour, Kaisler, & Liu, 1999). The method engineering field has shown that no method is suitable as such, and that it requires adaption to situational needs (Brinkkemper, Lyytinen, & Welke, 1996). *Method adaption* means the customisation of a method for a certain use, such as for a business domain, an organisation or a project (Leppänen, 2005). However, which EA method is to be selected for customisation is not always straightforward (Hirvonen et al., 2007). Leading EA frameworks are different in their approach (e.g. Bernus, Nemes, & Schmidt, 2012; Graves, 2008; Ross, Weill, & Robertson, 2006). In their case study, Ahleman et al. (2012) found that some organisations had adapted and used a known framework, such as (Zachman, John, 1997) or Togaf (The Open Group, 2011), whereas others had developed 'their own framework' from the properties of many frameworks. In public administrations, all of these approaches seem to be used (Christiansen & Gotze, 2006). However, a framework is not necessary; indeed, Ahleman et al. (2012) explicate in their study some enterprises where EA was adopted without a framework.

The latest standard on the architecture descriptions of systems and software engineering (ISO/IEC/IEEE 42010, 2011) has formalised the architecture framework as a concept within the ontology of the standard, as suggested in (Emery & Hilliard, 2009), and (Emery & Hilliard, 2008). This general ontology does not bind the framework viewpoints to any specific concern, which also encourages the adoption of situational method engineering in the adoption of the EA framework dimensions.

EA framework is the structure that expresses the scope and interrelations of the architecture at hand (Bernard, 2005). The scope seems to be dependent on the EA purpose (cf. Lapalme, James, 2012). The scope may evolve and expand as the EA maturity of the deploying organisation grows (Graves, 2008). The survey of architecture frameworks by (ISO/IEC/IEEE 42010, 2011) lists 78 frameworks with their name, purpose, cope, description and further references. This list effectively illustrates the variety of the architecture frameworks in scope and purpose. Assuming that no EA framework is fit to adopt as such in a complex public organisation, the research concerns how to adapt the EA framework in the public sector to make the EA concept beneficial to the general management in conditions of change and complexity.

There are no generally accepted theory, recommendations or standard of the EA framework; even though various instantiations and generalized models are suggested in numerous EA works of governmental institutions, standards bodies, academia and practitioners (Simon et al., 2013). Bernard (2005) argues for more research on the applicability and efficiency of EA frameworks. In other words, there is no unanimous perception of the EA purpose, scope or framework dimensions. This may be due to the EA concept having evolved over time. The theory may be, so to speak, running after the practice.

2.3 Evolution of the EA scope and purpose

The *purpose of EA* has evolved over time. EA was described as an advanced method for information systems engineering in the 1980s, an enhanced information systems planning and management tool by 2000, and a future tool for strategic business management by 2020 (Ahlemann et al., 2012). EA has been claimed to be the issue of the 21st century (Zachman, John, 1997) and a tool for answering business questions as the only abstract representation of the entire enterprise (Mayo & Tiemann, 2005). EA's purpose has evolved from business-IT alignment to enterprise CM, and further for adaptive co-evolution with the organisation's environment (Lapalme, James, 2012). The standard on the architecture descriptions of the software-intensive systems (IEEE-1471, 2000) was updated for systems and software engineering in general (ISO/IEC/IEEE 42010, 2011). The update extends the validity of the standard to the EA and seems to imply that architecture is a more generalised construct of any system.

The *EA scope* can be understood as the coverage of the EA descriptions of the deploying organisation or set of organisations, e.g. whether the strategies and organisational goals are described amongst EA descriptions. EA scope seems dependent on the EA purpose (Lapalme, James, 2012) and, further, can be seen reflected in EA framework instantiations. The dependencies of the scope and purpose are illustrated in Table 1, adapted from (Lapalme, James, 2012 pp. 38) with inspirations from (Doucet et al., 2009b; Drews & Schirmer, 2014). The estimated benefits and user groups are added by the author in the third and fourth columns.

The EA usage may further scale beyond a single organisation to inter-organisational cases and enterprise ecosystems (Drews & Schirmer, 2014). EA usage is specially seen as being purposed for a set of organisations in public administration in (Saha, 2009a). All of the use cases in Table 1 could at least logically be applicable in a singular organisation, amongst several partners with an inter-organisational process (IOP), in a business ecosystem or in a set of organisations, as proposed by Drews and Schirmer (2014).

The scope and purpose of the EA (in Table 1) are transferred to as the scope and purpose of the EA methodologies in Appendix A.7, in Table 5. The scope and purpose of the EA supposedly directly affects the EAF scope and purpose.

TABLE 1 Dependencies of the EA scope and purpose, adapted from (Lapalme, James, 2012, p. 38), with inspiration from (Doucet et al., 2009b; Drews & Schirmer, 2014).

Scope	Purpose	Possible Benefits	Possible Users
IT management	Business – IT alignment for IT mediated business	Technical, system and process interoperability	Strategy management Business development, BPR CIO, IM
All areas of the organization as socio-technical system	Coherency of the parts of the organization, agility, assurance and resilience	Corporate level semantic and organizational interoperability, efficiency, effectiveness and manageability	Beyond the above, the GM, possibly all chief corporate officers (CxO's) and sectoral management
Whole organization plus the interacting environment and surroundings	Adaptive and learning organization, co –evolution with partners, customers or other stakeholders in the organization interface	Cross-organizational interoperability, community tools and common development grounds with customers, stakeholders, and b-to-b businesses of the organization	Beyond the above, customers, stakeholders and strategic business –to business partners

Logical *EA scalability* for any EA purpose and scope:

- single organisation
- common inter-organizational process (IOP) of an organisation and its partners in the specified IOP
- business ecosystem (e.g., a common value chain among organizations)
- set of organisations with a common goal, like a city, a state administration, or even a national public economy

2.4 EA for the public sector coherency management

In terms of the public sector EA concept, we further refer to *government enterprise architecture* (GEA) (cf. Saha, 2009a). The GEA framework is synonymously referred to here as the Government EA grid, or *GEA grid*. PA as an ecosystem might benefit from systematic ecosystem EA concepts and methodologies. Often, public sector policies aim to affect societal behaviour. The goal may be to change the citizens' behaviour, or the functionalities and structures of the society. As a methodology, the scope of the GEA framework would thus seem necessary to cover the aspects of co-evolution with customers and society. Even though the CM seems to be 'less' than co-evolution according to Table 1, the CM should provide a remarkable value for the government as the EA purpose. The usage of EA in the set of public organisations is later referred to as a *government ecosystem EA* (GEEA) whether that set of public organisations be on the local, state or national level.

By *coherency*, we refer 'to a logical, orderly, and consistent relation of parts to the whole' (Doucet et al., 2009a p. 29). *Coherency management* (CM) assures the goals of an organisation, aligns its parts (to the entirety, common goals and the other components of it) and facilitates the agility of the organisation to respond to upcoming changes (Doucet et al., 2009a). EA emerges as a promising tool to manage the change and complexity in the public sector (cf. Ahlemann et al., 2012; Doucet et al., 2009a; Op't Land et al., 2009; Saha, 2009a). This can be seen in EA work, e.g. in Holland, where the goals of the PA were aligned with regulatory and stakeholder boundary conditions via EA methodology and framework (Wagter, Proper, & Witte, 2012a; Wagter, Proper, & Witte, 2012b). Services, organisational structures, competences, systems etc. would work rationally, cost-efficiently and fluently as co-supportive and co-dependent entities. Ideally, the inner structures of the public administration as ecosystem could be aligned, common goals achieved and the entirety kept agile.

Public administration as a set of public organisations is entitled here as *government ecosystem*. To apply EA successfully to government ecosystems on any scale, EA methodologies should be enhanced by scalability, purpose and scope. The GEA method of a government ecosystem should ultimately support the government reforms. There are hints of future opportunities for this direction in the literature: EA has been seen as both an enterprise modelling tool (Poels, Gailly, Asensio, & Snoeck, 2017) and an enterprise engineering tool (Hoogervorst & Dietz, 2015). Though it is still seen and widely used in its core function for IT business alignment (Kotusev, 2017), there seems to be a challenge in upgrading the methodology from the ISs planning level to the organisational design level. The word architecture refers to the structures and design of it. However, the designing of the corporate management structures or other management structures have not been explicitly featured in the design methodology as how-knowledge, e.g. as Kotusev et al. (2015, p. 4070) put it:

> '...we did not find any approaches to EAM [EA management] describing how exactly EA can be used for design and realization of organizational structures'.

The capability for designing and realising large structural reforms seems necessary for large ecosystems such as PA. This study focuses specifically on the EA methodology, i.e. the theory of the EA framework. Kotusev (2019) criticises the current frameworks of their non-usability, and indeed, one can agree, if the framework remains mere checklists of optional descriptions. Simon et al. (2013) mention in their extensive EA literature study that there may not be a robust EA 'theory' in the form of an EA framework, despite the abundant production of these frameworks. Winter and Fisher (2006; 2007) have tentatively identified the essential layers and elements of EA in an organisation. This has not become the final explanation – but a somewhat similar thinking model has been invoked in the results of this study – that is, we outline some principles of how the EA framework should support relevant organisational layers characteristic of the public sector as ecosystem. We wish to claim some benefits of the possible practical implications of such a common government ecosystem EA thinking for CM. The EA as a research object seems to us a moving goal, which justifies the abductive approach in our study, which is considered next in Chapter 3.

2.5 In search for the GEAF fit in the complex PA ecosystem

Janssen et al. (2006) describe PA as a complex adaptive system. PA forms different levels, often considered as macro-, meso- and micro-ecosystems (Beirão, Patrício, & Fisk, 2017; Chandler & Vargo, 2011). The national public sector can be seen as a system of systems, defined by the *metasystem*, i.e. the Finnish legislation and norms, implemented as several *macro-systems,* such as the national healthcare or national educational system, where individual organisations work within co-operating amongst each other, and with other actors of the society. The smallest functional unit of the macro-system acts as the *micro-system* encountering the customer at the sharp end (Nemeth, Hollnagel, & Dekker, 2016), e.g. the smallest functional unit of the healthcare, or any learning environment which a pupil is encountering at any moment in time. The *meso-system* is the system where the different micro-systems interact and co-operate (Bronfenbrenner, 1994). In this respect, it is easy to understand that, by analogy, organisation of a national public sector comprises a hugely complicated system. From this perspective, we argue that the complex system requires news innovations. Concerning EAF adaption the ultimate purpose should be supporting the organizational coherency of the whole-of-the-national government.

3 RESEARCH APPROACH AND METHODOLOGIES

The main issue in this study concerns the form 'how to'. This is a question typical in the field of ISs. Solutions to these types of questions are often sought through constructive approaches, e.g. design research and action design research, which produce design principles for the theoretical knowledge base. This chapter presents the philosophical stance of our study with the principal methodologies (Section 3.1) and the two consecutive case studies in Finnish PA (Section 3.2) in terms of their explorative and abductive aspects. The reflection and learning part of the study is briefly described from a methodological perspective, especially concerning the data analyses (Section 3.3).

3.1 Constructivism as the philosophical stance of the study

The philosophical stance of this study is *constructivism*, where the reality

> "is built and continuously adapted through negotiating and achieving social consensus among subjects" (Dietz, 2006 pp. 8).

For constructivists, knowledge is co-created in the research process (Lähdesmäki et al., 2010). The object, phenomenon, context and unit of the analysis in the study are, in corresponding order, the EA framework, its adaption and the public ecosystem of either the state or local administration. These are social constructs themselves, as well as the knowledge about them. Constructive research is often used in IS science. This study is constructive in nature and primarily utilises *design research* (DR; Hevner et al., 2004) and *action design research* (ADR; Sein et al., 2011). The data used in the study were collected and analysed in multi-methodological ways. Qualitative methods, such as participatory observations, textual analysis, data triangulation and archival data were used. Rich secondary data was collected from both consecutive case studies in Finnish PA.

Constructive methodologies (e.g. ADR and DR) provide *design principles* that describe how innovations are designed or implemented. The innovation could be in IS, organisational structure, or the situational EA framework adaption, as in this case study. The scientific acceptability of the design principle requires hypotheses about the assumed design and testing and evaluation in practice (Gregor et al., 2007; Gregor & Jones, 2007; Järvinen, 2004). DR refers to the simultaneous creation of a design artefact, both inductively and deductively, i.e. the design factors are analysed and derived, either in practical situations or examined in the literature (Hevner et al., 2004). Case studies have provided a good opportunity for this. ADR carries the research problem through an iterative development process for researchers who have an active role in designing artefacts inside an organisation (Sein et al., 2011). The ADR method combines features of traditional action research (Riel, 2016) and DR (Hevner et al., 2004). ADR is based on the marriage of action research, which insists on intervening in social practices, and DR (Sein et al., 2011). ADR is to be executed for 'building things' as a researcher in a real organisation with its stakeholders (Sein et al., 2011).

3.2 Consecutive case studies in Finnish PA

This study is comprised of two consecutive case studies in Finnish PA: the National EA Method Engineering Project (3.2.1), and the Finnish City Corporation GEA framework adaption and strategy architecture implementation. The context of the study is Finnish PA. In Finland, EA adoption was launched in 2006, and since, it has established its validated role by means of the Information Management Act 2011. The first efforts yielded the earliest version (Ministry of Finance, 2007) of the later national GEA method (FINEA, 2017), wherein the national GEA framework forms a central part. The two case studies divide the study into explorative and abductive parts:

1. *Explorative case study*: GEA method engineering project (Geamep) 2006–2007 – a development project belonging to larger National EA (NEA) project,
2. *Abductive case study*: Adaption and utilisation of the government EA framework in the City of Kouvola 2008–2014.

In the first case study, the theoretical model of the GEA framework adaption was developed. The unit of analysis was state administration (Fig. 3). The work utilised case and data triangulation from State Treasury (ST) and Road Administration (RA) state agencies as subunits. In the latter case study, the unit of analysis was the city corporation with its inherent domains and in-house enterprises, with ongoing organisational changes (Fig. 3). In the study, the EA framework adaption from the previous case study was adopted.

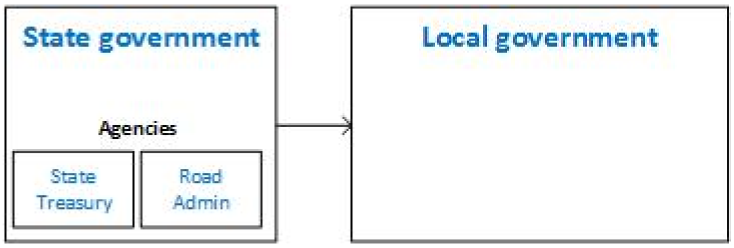

FIGURE 2 Units of analysis in the consecutive case studies.

The case study typically investigates a phenomenon (Yin, 2013). Here, the phenomenon was the adaptation of the EA framework in PA. The traditional decision between induction and deduction (Järvinen, 2004) did not seem possible, since the phenomenon was difficult to discern, and the goal seemed to move all the time during the research cycles. Thus, the abductive logic of reasoning (Levin-Rozalis, 2009) seemed justifiable.

3.2.1 Explorative studies – Case of the GEA Method Engineering Project

In the beginning of the study, 11/2006–7/2007, the researcher acted as a participant observer in the Geamep group. Participation in the wider EA adoption context included various events, e.g. review and consultation meetings for public stakeholders and meetings of the project coordination group. Primary data collection of the explorative studies took place in Geamep project meetings. The TietoEnator Corporation led the project team consisting of several government organisations. The doctoral applicant followed the project group meetings and workshops as a participant observer in 15 meetings from 24.11.2006 to 30.4.2007. The group discussions were recorded, and field notes were taken. The role of the author was to record the materials and analyse the secondary data against them, and to produce the transcripts of the workshops. To enhance the reliability of the results, the field notes and transcripts were introduced to the project team members for further comments and reassurance. See more about research method details in Articles I–IV.

The exploratory phase culminated in suggesting a theoretical adaption model for the adaption of the GEA framework in Finnish PA (Article IV). The Finnish EA method became generic in nature. In order to apply it in various sectoral domains and agencies across the PA, it was considered necessary to provide tools to identify various adaptation needs as well as to guide in situational adaptation. Based on the method engineering literature, qualitative explorations of the case and secondary data of the larger overall national EA project, as well as researcher triangulation in the research group, the guidelines and adaption model were developed in order to support the adaption and application of the Finnish EA method (Article IV). The work utilised situational method engineering knowledge, such as (Aydın, 2006; Jayaratna, 1994; Leppänen, 2005) and EA knowledge. In this phase, the design research resulted in the *EA method engineering contingency model* (EACon, Article II) and the *GEA grid adaptation model* (Geagam, Article IV).

The research methods in the explorative phase are summarised below, with relation to the results in Articles I–IV:

1. Participatory observations in the Geamep project were followed by the content analysis of the data with semi-open coding, triangulation of the secondary data and triangulation with the observations of the research group in overall national EA adoption in the wider NEA Project.
2. This resulted in requirements and recommendations on the GEA method features of the government business architecture development (BAD) in Article III, along with a description of the Geamep project and the GEA method selection criteria in Article I.
3. DR studies were then executed for two specific artefacts: The GEA grid adaption model (Geagam) was constructed in Article IV, and EA method engineering contingency model (EACon) in Article II. Beyond the context of the national EA effort, literature reviews on EA, IS development and method engineering were executed, as well as case triangulation in the research group. The research setting followed the one presented by Hevner et al (2004) and is illustrated in Article II for EACon. The same is also used in Article IV with verbal description of the research setting but without the picture. See the research design definitions in more detail in the article IV.

3.2.2 Abductive Evaluation - Case of the Finnish City Corporation

Geagam was subjected in abductive evaluation in the City of Kouvola. The author has worked in the city as a strategy designer since 1 January 2009, as a strategy manager since 1 February 2011 and, further, as a development manager since 2014. GEA grid adaption was studied in the municipal organisation from 2008 to 2014, applying the Geagam. It was adopted in September of 2008 as an initial theoretical construct in the city for the study. The case study adapted the Geagam and its inherent propositions from (Article IV) in a real-world organisation, as reported in Articles V–VII. The development served as an abductive evaluation for the Geagam model and its inherent adoption principles in the sense of (Levin-Rozalis, 2009). Abductive logic of reasoning forms a 'process of discovery', particularly effective in evaluating findings of new phenomena (Levin-Rozalis, 2009). The city provided the wider context and set of data for abductive evaluation, as insisted by (Levin-Rozalis, 2009). The case study in the City of Kouvola formed a longitudinal, multi-methodological ADR study in 2008–2015. The reflection and learning phase followed that in 2016–2017.

The research setting is presented in Fig. 3, which shows the sequential events of the case study in the timeline and the different layers of the study. The theoretical construction of the GEA grid adaption model is in the first row, the actual GEA modelling layers in the second and third rows, and the secondary organisational data are displayed in the fourth row. In the first row, the construction of the grid adaption artefact is presented over the two consecutive case studies. The city needed novel management tools in the merger. This provided the practical problem, as insisted in ADR methodology (Sein et al., 2011). The results from the state government case were deployed, i.e. the Geagam from Article IV. With the input of the chief executive officers (CxOs) in the central administration, a city-specific GEA grid adaption model (*Kouvola Geagam*) was constructed in two ADR research cycles, providing the *alpha and beta versions of Kouvola Geagam*. The versions included GEA method objectives and inherent adaption principles in Articles V–VI. In the city organisation, Kouvola Geagam was adopted as the town strategy framework by municipal executives, as well as included in the GEA governance model of the town by Chief Information Officer (CIO) and IT architects.

Based on the EA grid adaption in the Kouvola Geagam, iterative recursive development of the strategy architecture artefact was executed (Fig. 3, rows two and three). The Kouvola Geagam instructed the design and implementation of the navigation structures of a *strategy modelling repository* (row 2) and the iterative development of a *strategy database* (row three). These EA modelling artefacts evolved through iterative development cycles, which were considered recursive to the GEA grid adaption cycles. We did not consider, however, the design principles of these EA modelling artefact development except for the purposes of reflecting on the GEA grid adaption principles. The Kouvola Geagam guided practical work on strategy modelling.

The doctoral candidate designed and offered advice about the creation of navigable catalogues of strategy road maps through several organisational changes (Fig. 3, row two). In addition, she designed the supporting information system (Fig. 3., row three), which was eventually released as an open-source solution (City of Kouvola, 2014). In the municipal work, innovations in the strategy work were thus created. They were considered the primary data of the ADR study that would reflect the Geagam principles.

The secondary data concerning adoption and evaluation of the GEA artefacts are presented in Fig. 3, row four. Extensive secondary organisational data provided descriptions of the process architecture, annual development reports of the organisation in the budgeting books and annual evaluation reports including strategy architecture evaluations, inter alia. During the study, the city organisation evolved through various reforms and organisational changes, allowing cross-triangulation of the strategy architecture data with various organisational structures. This case study culminated in the reflection and learning phase of the abductive evaluation through the ADR cycles and recursive strategy architecture implementation, as described next.

BIE cycles were based on the budget years. The annual B-I-E cycle consisted of the following steps. *Building*: In each research year, either Kouvola Geagam or the recursive strategy description practices were developed, taking into account the Geagam principles. *Intervention*: When the artefacts were developed, they were immediately introduced into practice. *Evaluation*: User feedback was taken into account iteratively during the intervention, or at the latest in the next research for the artifacts of the following budget year. In addition, the strategic practices were assessed annually by the audit committee.

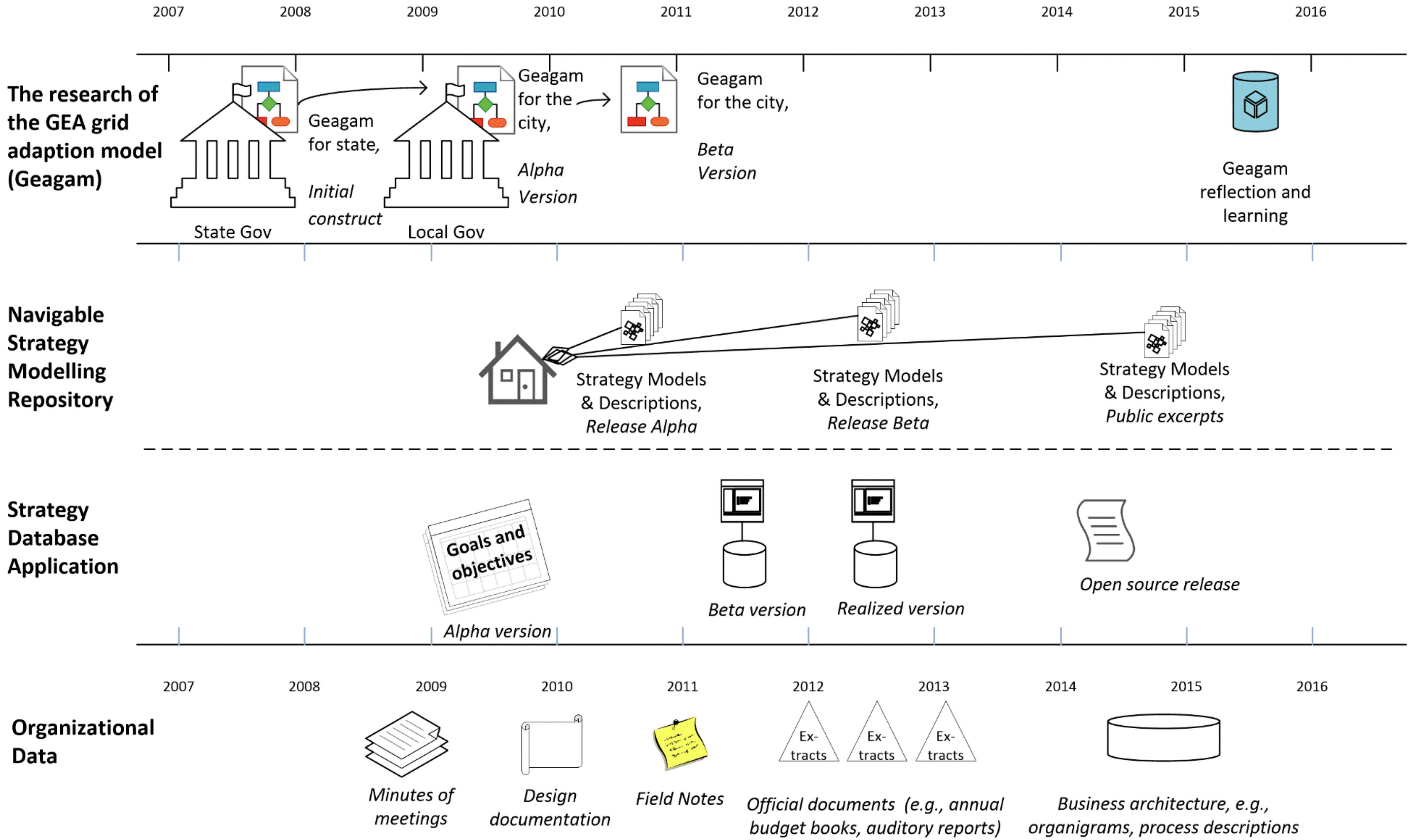

FIGURE 3 The research setting for GEA framework adaption (Article VII, p. 271).

3.3 Reflection and learning

The GEA grid adaption principles were crystallised in the reflection and learning phase of the study in Article VII. This phase is illustrated in Fig. 3. The database type symbol in the top row (right upper corner) indicates the final step in GEA grid adaption research. After the two case studies, reflection and learning took place in 2015–2016, and further in the summer of 2017. Thus, the 'Results Article' VII was born, comprising the concluding remarks and propositions of the study. This reflection and learning article was the most difficult part of the study. It was first submitted to Trends in EA Research Workshop (TEAR 2016), but returned with three very comprehensive and useful reviews.

During the reflection and learning phase, complementary and iterative analyses were executed concerning the Geagam and Kouvola Geagam artefacts, recursive strategy artefacts and secondary data. The candidate executed the following additive analyses (not in situ, but either at Kalibu Academy, Malawi, or at the University of Jyväskylä facilities):

- *Evaluation survey* for the users of the strategy maps in the repository was executed as a starting point in the spring of 2015, assessing the usefulness of the descriptions for leadership and between leadership levels.
- Triangulation of the propositions of both consequent case studies and ADR cycles was done by performing a *textual cross-analysis of the propositions in Articles IV–VI*. In the text analysis the crucial task was pulling out the implicit design principles from the descriptions of Geagam (Article IV) and Kouvola Geagam artefacts alpha (Article V) and beta (Article VI).
- *Reverse engineering of the strategy architecture database* implied the generalization of the results. Conceptual reverse modelling of the implemented strategy architecture database instantiation was not mere reverse engineering, but was executed with retrospection and reduction that further supported the suggested generalization of the results.
- The chronological *strategy architecture repositories were cross-analysed with structural reforms of the case organisation* over the research years.

In the reflection and learning phase of the study, the unit of analysis was considered from a broader perspective as the whole of the Finnish PA. However, the reflection and learning data were confined to creation and chronologically maintaining strategy architecture instantiations for each moment of time. The results and implications were thus confined to the as-is architecture of a whole-of-government.

The results of Article VII caused a positive mental chaos concerning the implications of the results. There were so many possible implications that two more articles were written concerning some implications, which were presented in Articles VIII and IX. These articles were facilitated with author and data triangulation with two other researchers involved in the Finnish EA adoption research. The main research approach by the doctoral candidate in her contribution was DR for constructing a few requirements and design principles of the current state GEEA as a theoretical IS solution. The Articles VIII- IX present some practical implications of the suggested dissertation results, utilising design research as well as case, researcher and data triangulation.

4 CONTEXT OF THE STUDY

The study connects to Finnish public sector GEA adoption. In Finland, the state and local administration coexist (Population Register Centre, 2017). The *state administration* comprises 12 ministries that steer their branches with the help of around fifty specialised central agencies. In addition, the state services localise in ca. 200 regional and local agencies and offices. *Local administration* consists of independent municipalities (ca. 300) who organise their services in various forms, also via joint organisations. Municipalities are self-governing entities by the Finnish constitution with the right to tax the residents. The municipal services are further dispersed locally due to vast Finnish forest areas and the low density of the population. State and local administrations develop public services together. Similar organisational trends are seen in both, e.g. corporatisations of profitable services provision units. Finnish PA is described more in the following, especially focusing on the two case organisations of the dissertation.

4.1 Finland is not an exception concerning PA challenges

Many challenges prevail in the public sector due to long historical development and various legacies. The need for effectiveness and efficiency, the new demands of the digital era and the emerging claims for new ways of executing democracy, as well as demands for changing the bureaucratic manner of decision making to the citizen-centric manner, are mentioned (Hammerschmid et al., 2016; Saha, 2009b; Zhang, Luna-Reyes, & Mellouli, 2014). The NPM in the 1980s was devised to reorganise and streamline public administrations (Cordella, 2007; Lapsley, 2009). The means were derived from the management practices of the private sector, e.g. risk management, introduction of ISs, management by agreement, unbundling the public sector into corporatised units, resource savings, visible and active top management, performance monitoring and control, and standardisation (Lapsley, 2009).

The trends of reforms have affected Finnish PA development. Finnish national PA, as a 'whole-of-government', forms a complex ecosystem of actors. The actors themselves are organisations of high complexity with a variety of products, services, official responsibilities and complex administration structures. The political organisation comprises a parallel hierarchy with the administrative organisation both in state and local administration. Various cross-organisational forms of management are typical, such as policy programmes. According to our observations, the management structures of these organisations are not always documented in a consistent manner, yet more tacit knowledge of the working organisation remains. Reorganisation of the organisational structures has become an established practice and state-of the-art in the reforms. The trends to centralise and decentralise an organisation are simultaneous and alternating. NPM-related reforms have taken place since 1987. Gradual outsourcing of prominent businesses is practised in both state and local administration. Mergers have been encouraged by the state administration, especially in the municipal sector. Municipalities have conglomerated in many ways, e.g. via forms of collaborative networks, joint ownerships and strict mergers. A conglomerate type of management is typical of public sector organisations, and it creates a complex system with various corporate governance functions, deep administrative hierarchies and multiple types of actors, such as sectoral domains, in-house enterprises, subsidiaries etc. (Article VII)

In the thesis, the GEA methodology is investigated as a tool for government reforms and digitalisation goals in two consequent case organisations: 1. National EA project (NEA Project) in Finland in 2006–2007, and 2. Local government (City Corporation of Kouvola) in 2008–2015. The sub-project of the first, the Government EA Method Engineering Project (Geamep) and the local government of Kouvola city are briefly discussed below as case organisations.

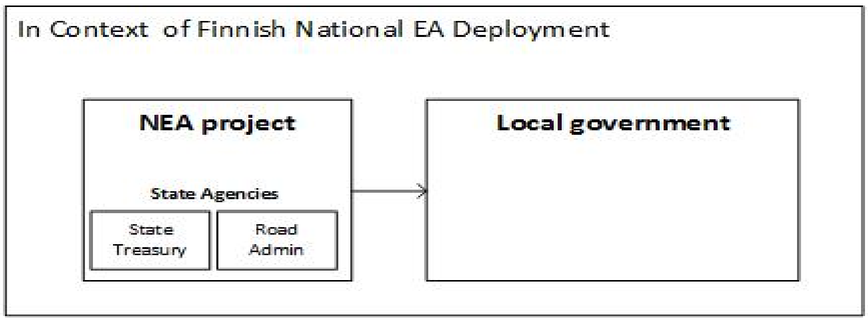

FIGURE 4 Case organisations in the study of GEA framework adaption in Finnish PA.

4.2 State administration's incentive in EA adoption

Finland has acknowledged the EA concept as the generally accepted way to address the change in PA (e.g. Op't Land et al., 2009; Saha, 2009a; Zachman, J., 2009). The Ministry of Finance launched the *Interoperability Development*

Programme (IDP) in 2006 to implement the government policy decision on interoperability (Ministry of Finance, 2006). The IDP aimed at consistent, national-level EA definition, EA management, and EA development methodologies for nationally interoperable services. The programme comprised five NEA projects, one for each of the following purposes: 1. National EA governance process development, 2. NEA method engineering, 3. Current state analysis of the state administration EA, 4. National integration architecture development and 5. Analysis of the Finnish central information registers. The key goal of the IDP was the interoperability in the large sense, i.e. interoperability of the organisations, semantics, processes and ISs.

The NEA method engineering project was the case organisation in the first case study. The NEA method was later in the study used synonymously with the *GEA method* and the Government EA method. The Geamep group included representatives from different branches and agencies of the state administration, the municipality and the university, all bringing their expertise in different fields to the project. The liable consultancy was leading the project. The project tasks were (1) the selection of a suitable EA method or EA methods to start with, (2) the adaptation of the selected EA method(s) for Finnish PA, (3) the creation of a user manual for the GEA method, (4) applying the GEA method to a small-scale case and producing an exemplar of the method use and (5) planning and describing a high-level target architecture. The project group worked in 15 workshops from October 2016 to April 2017. The key phases of the EA method requirements specification process were highlighted. GEA method development inspired conversations about adoption guidelines in a large variety of different PA entities of Finnish PA. ISD method engineering was pointed out as analogies of the essentiality of the adoption (cf. Leppänen, 2005).

The doctoral candidate attended the Geamep group as a participatory observer collecting the primary data of the case study in the Geamep meetings in tape recordings and field notes. She also participated in the overall IDP events and common meetings amongst stakeholders. Secondary data of the IDP were shared in the cross-organisational group work environment. The interaction with other NEA projects was crucial to sharing the inspired views of the IDP endeavours. Co-researchers participated in other parallel NEA projects, which provided opportunities for the researcher and facilitated data triangulation.

The IDP laid foundations for public sector EA modelling in Finland. Since 2011, EA descriptions have been insisted upon by public actors, due to the Government Act on IT Management 2011 (Government of Finland, 2011). Consistent and interoperable EA descriptions were to be formulated, in order to provide the government and decision makers with an overview of the PA structures and interrelations as well as the tools for re-engineering, interoperability and digitalisation of PA. Next, the local authority in adopting EA in the second case study is considered.

4.3 Kouvola City Corporation 2009-2015

The second case organisation investigated in the thesis was the City of Kouvola. After a fruitful research period in national EA research at the University of Jyvaskylä, the doctoral candidate returned as system designer in Kouvola City in 2008. Kouvola City was in the midst of merger of six municipalities and three municipal joint organisations. The active research period in Kouvola took six years from the autumn of 2008 to January 2015. The candidate had the opportunity to observe and analyse the development of the town. During that time, the organisational structures were redesigned several times.

The tendency of the Government of Finland has long been to encourage municipalities to merge. Kouvola was amongst the first to merge with other municipalities in 2009. In the merger of six municipalities and three municipal joint service organisations, the city gained remarkably more weight in all measures: it ended up with almost 90,000 citizens in a geographical area of 3,000 km^2, with 6,500 city employees and an annual expenditure around 500 million €. The city services were wide in their variety: education from nursery to secondary school, healthcare from basic health services up to a district hospital, business support services for entrepreneurs and farmers, social and legal services of citizens, water supply and sewerage, and the planning, building and maintenance of land, city infrastructure and town buildings. This resulted in multiple organisational actors and deep hierarchies. The output resulted in a corporate management type structure with sectoral domains, central management and in-house enterprises. Central management tasks were shared with Chief executive Officers (CxOs) in corresponding functional units, e.g. Chief Human Resource Office (CHRO). The political organisation comprised the city council and the executive and boards, totalling 19 in 2009.

Since the beginning, the new city has been undergoing continuous change. After starting as a *purchaser-provider organisation* in 2009, this changed gradually to a *process organisation* by 2013. The purchaser-provider structure here denotes the division of the administration into two types of units. The purchaser unit, e.g. for the education services, set the targets and budgets for provider units of the education, also taking responsibility for the supervision and legal surveillance. Management levels appeared administrative due to vast service menus and geographical or governmental oversight tasks. Accordingly, the administrative levels were diminished several times. Gradual outsourcing of prominent business areas was apparent, as they were exposed to market competition. These were some drivers resulting in three major organisational changes in 2011, 2013 and 2015. The change had come to stay, since the state administration still had pressure to reorganise the public duties for better efficiency. The pressure for the change is ongoing, e.g. concerning employment in order to raise the employment rate, or to merge the social and healthcare services in larger units for better effectiveness. The evolution of organisational structures in the city corporation during the research period is described in more detail in Appendix A.1.

4.4 EA adoption and development in the City

The city needed novel management tools in the merger. EA methodology was accepted as a tool for both strategy management and information management (Section 4.4.1). Kouvola was one of the forerunners in GEA adoption amongst the Finnish municipalities. National GEA tools were adopted, and architectural descriptions were implemented. In the strategy unit, strategy architecture development continued iteratively through the ADR case study, based on Kouvola Geagam principles and guidelines (Section 4.4.2).

4.4.1 EA adoption in the city from 2008–2011

With the insight of the CxOs in financial and strategy management, a city-specific Kouvola Geagam was iteratively constructed. In the city organisation, Kouvola Geagam was accepted as the town strategy framework by municipal executives, as well as included in the GEA governance model of the town by CIO and IT architects. The GEA tools were intended to support the general management in everyday work as embedded architecture (Doucet et al., 2008) and, concurrently, the traditional foundation architecture in IT management. The parallel and iterative approach was a way to introduce the completely new subject to the leaders, in order to bring in the CM as parts, and finally to exploit the foundational, extended and embedded architectures as multiple modes of EA (Doucet et al., 2009). We have approached this goal by enhancing the foundation architecture and the embedded architecture concurrently: in general management, we proceeded with the strategy and process architecture descriptions, and in the IT team with the change management and IT alignment goal. The main descriptions adopted in the business architecture development were 1) strategy architecture, 2) service architecture and 3) process architecture blueprints. A description tool for process and strategy descriptions was introduced, notations standardised as a guidebook, and main users of the tool educated to act as in-house process consultants. Process architecture was used for different purposes, e.g. for productisation and to establish new organisational structures. (Valtonen et al., 2011)

The CIO led the IT team of four IT coordinators in Kouvola from 2009 to 2011. The team was responsible for systems specifications, coordination of the IT investments, IT architecture, interoperability, information security etc. The IT team was responsible in the foundation architecture descriptions for the alignment of government with IT and assuring IS support in change situations of the organisation, as well as supporting strategic information innovations and e-government. The IT team launched several EA initiatives in 2009 and 2010, such as 1) EA capability fostering, 2) GEA governance model development, and 3) Service oriented architecture platform development. GEA capabilities were added by educating the IT team on EA. The first version of the GEA governance model was adapted for the city in early 2010, specifically for the management of systems and technology architectures. According to the model, the IT team acts in the role of IS/T architect. The governance process yields annual IS roadmaps aligned with implementation resources and ensures coherent IS and IT architectures with locally and nationally interoperable systems. The requirements of Kouvola's technical e-government platform were specified with the GEA method and implemented with SOA principles and technologies. (Valtonen et al., 2011)

4.4.2 Recursive strategy architecture development from 2008-2014

Strategy architecture artefacts and their development in the Kouvola City Corporation provided the primary data in the reflection and learning phase of the study. The town strategy was formulated in 2010 and reformulated in 2013 as the new council was taking over. Capturing the town vision, goals and business guidelines meant various types of analyses, workshops and meetings. The study focused on the strategy implementation. The town strategy was institutionalised through strategic planning (Mintzberg, 1994), i.e. by setting up sub-strategies for specific purposes and sub-goals at hierarchical management levels. It meant instantiation and follow-up of refined goals and actions for each organisational actor and relevant management level. Strategic planning was updated annually as a part of the financial and operational planning process. This yielded annual results matrices in the budgeting book (cf. Figure 13 in Appendix A.2). The budgeting book serves as the principal guideline in any Finnish municipality for the year (Government of Finland, 2015). Town strategy was concurrently institutionalised in the four-year strategy planning roadmaps of the various organisational actors. These blueprints comprised the strategy architecture of the city.

In the beginning of 2009, there were several practical problems in strategic planning. No systematic long-term expressions of the goals beyond the budgeting year could be perceived in the budgeting book. Strategy visualisation and modelling were unknown. There was no IS support for strategic planning beyond text editing. No adequately specific solution could be found in the market either. Goal and objectives, as well as subsequent follow-up information, were given mostly individually by each actor. This yielded unstructured strategy institutionalisation and incoherent strategy implementation. Annual risks were analysed as a separate process from strategic planning, consuming the same management resources without much synergy gains (Appendix A.2).

To enhance the strategy institutionalisation, management discourse was facilitated during the research period utilising GEA practices and tools: 1) Strategy modelling notations and practices were created, implemented and maintained as a strategy model repository (Appendix A.3) and 2) Strategy information in the results matrices was designed as structural data with a browser-interfaced in-house strategy database application (Appendices A.4 & A.6). These strategy artefacts were intended for senior and sectoral management, taking into account further intentions to scale the usage to middle management and unit levels. All of the city personnel had reader access to both applications in the published information. The former yielded visualised long-term plans for four years. The latter managed the structural strategy data of the goals, objectives and measurements for each organisational actor. The development of the user interfaces was parallel in two separate IS developments, however carrying a vision of the united database of the two because of the interlinked data. By using separate development paths, the formulation and evolvement of the strategy-modelling notation was kept independent of any structural data model.

5 RESULTS

The results articles of the study are presented in three parts: the exploratory results in the NEA Project (Section 5.1), abductive results in the city corporation (Section 5.2) and reflection and learning results (Section 5.3). Finally, a summary table of the articles, their principal research phase and method and authors' contribution of the results are presented (Section 5.4). Each research article is summarised at least with short inferences on the research question, method, results and significance. The role of each article in the thesis is pointed out, and the author's contribution is explained. Each summary may include references or excerpts from the article in question.

5.1 Explorative results from NEA method engineering

The summarised articles are referred to as Article I (Hirvonen et al., 2007), Article II (Leppänen et al., 2007), Article III (Valtonen & Leppänen, 2008) and Article IV (Valtonen et al., 2009). These articles describe the case study results in the state administration.

5.1.1 Article I: Selection Criteria for Enterprise Architecture Methods

Research question

The article describes what kind of NEA method selection process and criteria were used in the Finnish NEA method engineering. This was done in the Geamep, which was a large half-year development project involving representatives of several PA organisations. EA methods were selected for further readjustments and tailoring as the Finnish NEA Method. The article presents the method selection phase of method engineering.

Results

The IS method engineering field provides a few strategies for constructing the method for specific use (Leppänen, 2005). The applied ME strategy applied in the paper was to select some of the existing methods and combine them as a new one using elements of each. Requirements specification phases and selection of the EA methodologies for adaption in Finnish PA are presented. EA methods were selected through the following steps: 1. Literature study on EA methods and methods selection criteria, 2. Method requirements questionnaire administered to various government parties, 3. Collaborative requirement analysis and prioritisation, 4. Analysis of existing frameworks and methodologies and 5. Collaborative selection of the methods to be adapted and integrated. Selection results were reviewed in a larger group of PA representatives who were nominated by the Ministry of Finance. The evaluation process followed common ISD method evaluation processes, the steps being as follows: 1. Characterise the context at hand, 2. Search for potential methods and 3. Carry out the evaluation to match the two first steps (cf. Jayaratna, 1994; Leppänen, 2005; Van Offenbeek & Koopman, 1996).

The resulting NEA method selection criteria were as follows. The method had to: 1. Extensively cover a variety of different government units, 2. Contain business, information, systems and technology architecture viewpoints, 3. Provide a place for standards in administration, 4. Support different decision-making levels, 5. Be simple and easy to understand, 6. Support communication amongst different stakeholders, 7. Include development methodology, 8. Support continuous development as well as long-term planning, 9. Support interoperability among administrations and 10. Be public, i.e., provide an open innovation.

Method

The Geamep group served as an action research workshop in the study. Liable consultancy acted as the change agent and main contributor to the interventions and NEA method artefacts. The first and second authors were the main contributors to the article. The doctoral candidate was the second co-author. She attended all AR workshops and other evaluation events as a participatory observer and carefully documented the workshops and project meetings. Beyond the project group workshops, a survey was sent to state administration organisations to collect all EA methodology requirements. The author's contribution was confined to the literature analysis of IS method engineering, comparing that knowledge to the findings in the Geamep and EA knowledge bases. The paper suggests concerning knowledge transfer from the profound ISD ME knowledge base, for further readjustment on enterprise architecture knowledge base.

Significance

Despite several reviews on EA frameworks, the scientific theories of EA method selection criteria for EA ME purposes seemed to be lacking at the time of the study. The validation of the results was rooted in the collaborative action research process amongst end users and stakeholders in PA. The study was based on a single case and serves as the start to the research topic. The further validation of generalised EA method selection criteria was beyond the scope of the thesis and would require more studies.

Relevance as part of the thesis

For the thesis, the paper provided an introductory view of the national EA work and its requirements. The resulting criteria for EA method selection hold true in all of the subsequent cases and reflections as requirements of the NEA method in the public sector in Finland. Thus, it has affected the following articles, artefacts and interventions in them.

5.1.2 Article II: Towards a Contingency Framework for Engineering an Enterprise Architecture Planning Method

Research question

In this article, we suggest what kind of contingencies can be attached to different types of EA method engineering occasions. We use design research to construct an EA contingency framework (EACon).

Results

The EACon provides a conceptual model of the EA ME context in order to support the selection, construction and customisation of the methodical artefacts for EA planning. The conceptual model (Fig. 5) presents the recognised entities and their relations in the EA ME context: an EA ME endeavour takes place in the EA ME environment with the cluster of actors, e.g. enterprises or organisations that take charge of the endeavour. The cluster engineers the EA method for a target EA context, whether it is a target domain, target organisation(s) or target EA project. The endeavour is guided by the given EA method goal, EA management, and EA principles as well as the given resources and roles. As the most essential contingency factors, we have suggested the industry sector, EA maturity of the cluster, scope of the EA method, and skills and experience of EA method engineers and users. The contingency approach is based on the idea of situational problem-solving, i.e. there is a need to select a pattern with the best fit for the situation at hand. Contingency factors act as situational differentiators to characterise the situation and match the situation with the properties of available sets of solution patterns.

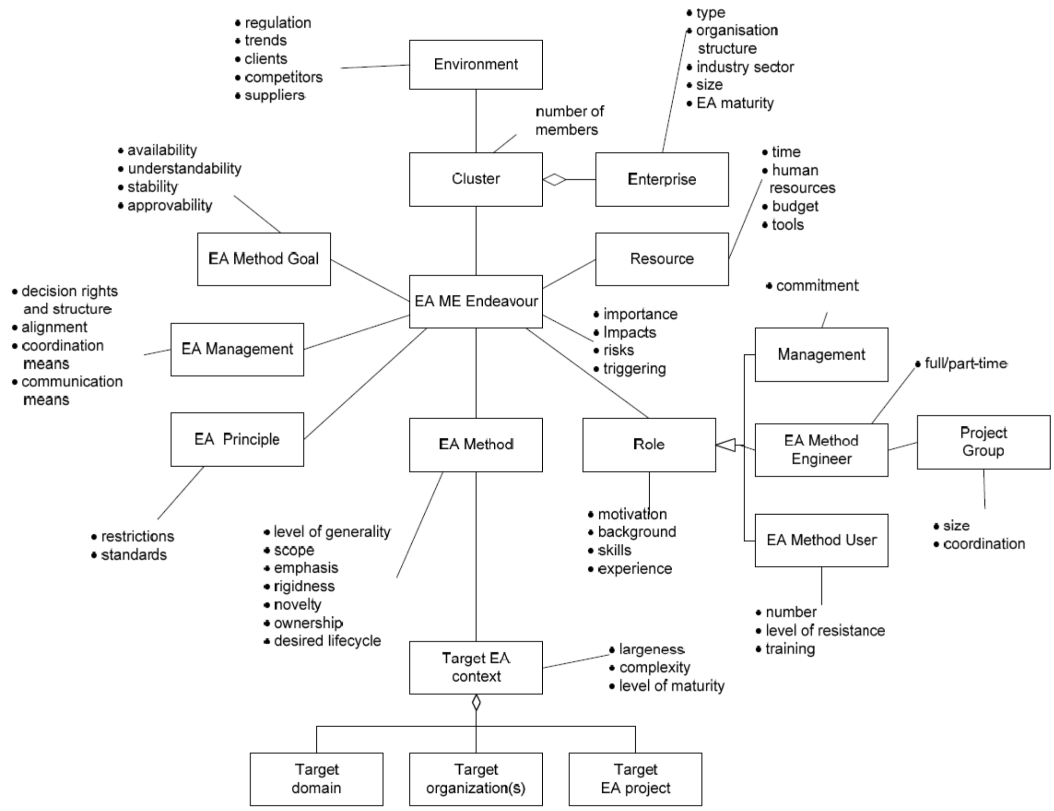

FIGURE 5 EACon framework for different EA method engineering phases (Article II, p. 440).

Method

The study is a constructive study based on design science principles (Hevner et al., 2004). Contingency factors were inductively derived from experiences in the Finnish NEA project, based on active participation in the project. On the other hand, the results were deductively drawn from existing theories. We derived contingency factors from those suggested in the ISD and method engineering literature. We utilised the literature on critical success factors of EA planning to determine which of aspects of EA planning are crucial. The author was the principal designer of the EACon model.

Significance

The contingency approach was first introduced in organisational design. In the ISD field, contingencies relate to ISD project aspects and give relevant input for decisions on development approaches, processes and end user participation. The ME field does not present contingency frameworks as such. In the EA field, the choices of EA frameworks, design artefacts and processes are crucial for the management as well (e.g. Ahlemann et al., 2012; Schekkerman, 2004). As far as we were aware of, no contingency frameworks were available at the time of the study. The study derived a preliminary set of contingencies to be applied in any NEA ME. The result was preliminary, with restrictions as given in Article II, pp. 443–444 as follows: 1. The definitions of the given contingency factors should be elaborated by literature reviews and analyses of the practice, 2. EACon should be equipped with concrete instructions to deploy it in EA ME efforts, 3. Empirical studies in different fields should be executed to validate the model and 4. The study did not cover the various characteristics of the EA method artefacts, suggesting a proper match between the environmental contingencies and the suitable method components. Instances varied from situation to situation, and recommendations of the EA methods' usability could be linked to different sets of contingencies. In further studies, guidelines that are more specific should be developed to advise the tailoring of the situational EA method. However, this type of further study was beyond the focus of the thesis.

Relevance as part of the thesis

In respect to the thesis, the paper belongs to the exploratory part of the study. The results have affected the following articles, artefacts and interventions in them. The results in Article II provided a situational understanding of the GEA grid adaption in Articles IV–VII.

5.1.3 Article III: Business Architecture Development at Public Administration – Insights from Government Enterprise Architecture Method Development Project in Finland

Research question

The study provides insights into business architecture development (BAD) in PA. The article describes what type of GEA method engineering took place in Finnish NEA adoption and gives suggestions on what kind of methodological guidelines of the BAD could enhance the GEA method.

Results

The government BAD should be better facilitated in at least three areas: by creating a shared BAD vision amongst the target state stakeholders, by enhanced customer involvement and by emphasis on better process re-engineering. The suggested improvements are referred to in the paper as: 1) shared vision facilitation, 2) customer involvement and 3) better process re-engineering.

Facilitating the creation of shared vision among stakeholders

E-government implementations may fail because of stakeholder resistance when changes are required for processes of organisational structures (e.g. Scott, Golden, & Hughes, 2004). Inspired by some suggested e-business models (Rappa, 2010; Weill & Vitale, 2001), we proposed that the use of e-government business models be added into EA development methodologies. They should facilitate establishing a shared vision amongst government and other agencies involved in a common goal. This suggestion was mainly inspired by the literature, but the requirement was also present in the data.

Better customer involvement

The data revealed the need for better customer involvement. Some improvements were apparent in the data: proactivity of the services, transparency, automation of non-value adding actions of the customer, and mapping of provider and customer processes. We suggested the following steps to meet needs determined by the observations: 1) model both views, i.e. the service provider's service life cycle process, and the customer's life-event workflow, 2) identify the possible e-services for the customer, 3) analyse the customer process to eliminate the non-value adding spots and 4) ask the customer groups what pro-active services they desire and which information they would use.

Better Process re-engineering practices

The data brought forth three main issues for PA: the need for 1) process integration amongst different governmental agencies and other service providers, 2) process standardisation to intensify IS use and 3) more pervasive management and strategy process descriptions. Some literature references were given for these to fill in the gaps with better methodological support. The main bottleneck in resolving all of these issues seemed to be the lack of vision and commitment to the methodological approach. This relates to the strategic and management levels of the involved parties.

Method

The results were determined by the following steps: 1. Analysing the recorded and transcribed Geamep group meeting and the secondary data, 2. Comparing the emerged BAD issues with EA and BA literature and 3. Evaluating the GEA method as the main output of Geamep. The author was the principal actor in the first and second steps and the co-actor in the third. The author worked as a participatory observer in thirteen Geamep group meetings, recording, transcribing and coding the data of nine of them, and in others by taking detailed field notes. Field notes and transcriptions were submitted to the Geamep group for review. As secondary data, the project documentation, such as minutes of meetings, results and intermediate results of the Geamep group, were extensively exploited during data synthesis and analysis. The primary data were subjected to in-depth textual analysis by semi-open coding to uncover the salient issues. Categorised issues were organised into main themes. BAD literature served as a frame of reference and knowledge base for the evaluation and suggested improvements.

Significance

The data reinforced the known business architecture (BA) design principles and suggestions found in the literature. There were also gaps yet to be filled in the practice, as to comparisons with the theories. The results should serve to advise PA leaders and GEA developers in particular. The need for a common vision and agreement amongst the agencies is one of the basic bottlenecks revealed in the data, beyond what was found in the literature. In addition, the lack of best practices in customer-orientated development and process re-engineering were evident in the data concerning Finnish practices that time.

Relevance as part of the thesis

For the thesis, the paper provided situational understanding of the PA characteristics which had to be taken into account in further method adaption in Articles IV–VII. The data was rich and included much more, but in the scope of the article, the business development perspective was chosen as the most relevant topic to closer investigation in the scope of the dissertation thesis.

5.1.4 Article IV: Government Enterprise Architecture grid adaptation in Finland

Research question

The study suggests what kind of the GEA grid adaption model and principles would serve in Finnish PA. State administration is used as the unit of analysis. We first describe how the Finnish National EA method was engineered by integrating components from known methods. We describe the resulting Finnish GEA method concisely, as well as its further adoption and adaptation in two government agencies, the State Treasury and Road Administration. The Geagam is constructed and presented to overcome shortcomings in further adoptions and adaptations.

Results

The main construct was the National Geagam and inherent adaption principles (Fig. 6). The adaptation principles were observed from findings and bottlenecks in Finnish political and strategic steering. The adaptation was to give support to 1) the entirety of organisational actors and public service providers in the public, private or third sectors, 2) systematic transformation towards the target state GEA, 3) EA planning at management level, 4) analysis and direction of a whole-of-an-administration and 5) the adaptation of description levels that had to reflect rational and centrally advised decomposition of the organisation into coherent architectural entities.

The model (Fig. 6) advises an administrative operator on how to instantiate a national grid in an organisation, whether a centralised solution, a virtual cluster or an agency along with its administrative hierarchy. The arrows connecting different types of GEA frameworks (a.k.a. GEA grids) denote supervision power over one another – whether by resource management, agreement or other control mechanism. The state administration grid is an example of a topmost leadership grid, serving information delivery to state administration in this national instantiation. It is supposed to yield the current as-is continuously and timely – depicting the strategic synthesis and highest abstraction of all branches, clusters and agencies under the state administration. The respective grids are denoted with different criss-crosses in Fig. 6. Architectural pictures for all organisational actors should be comparable and reveal the shared or specific needs with possible overlaps and conflicts. This is ideally supported by a centralised and navigable description tool in practice. For the top decision making, the bottom-up information is thus made available. In the state administration row, the descriptions present a top-down vision and 'the will of the government'. This enhances top management's ability to set goals and share responsibilities with different actors under them. Furthermore, the grid types suggested for centralised institutions, clusters or single actors are simpler, without the same amount of abstracted data as in the state administration EA grid.

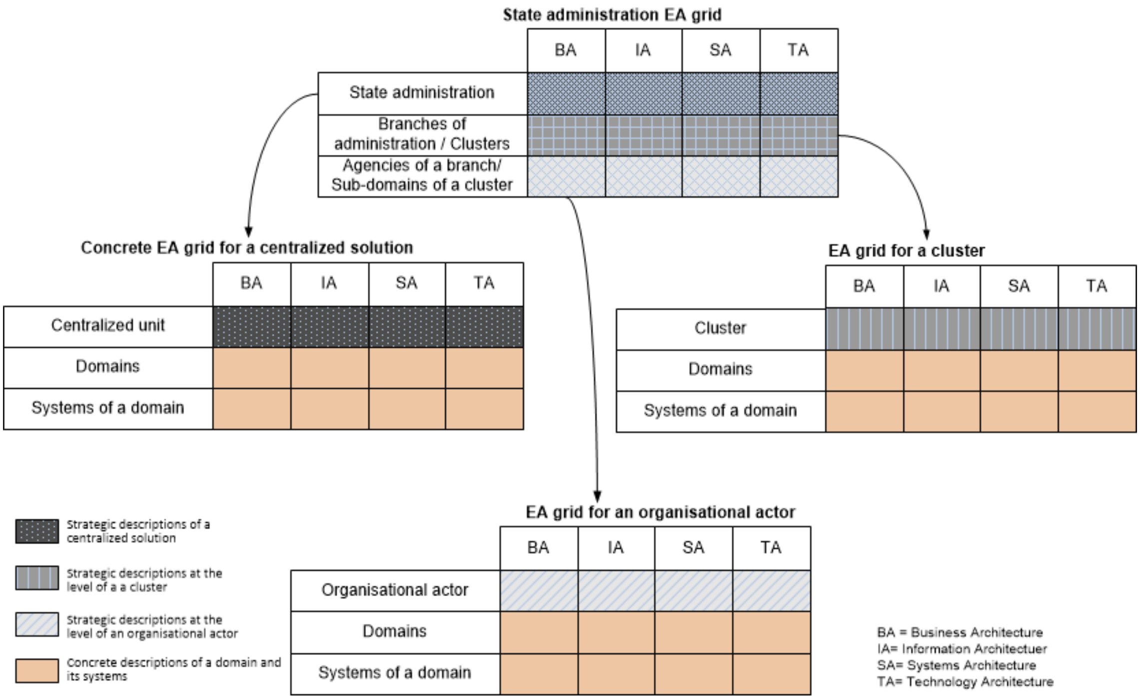

FIGURE 6 Geagam – GEA Grid Adaptation Model for Finnish PA (Article IV).

Method

Geagam is a design research artefact that was built based on the NEA project and EA literature. The practical data were collected from the Geamep and GEA method pilot adaptations in two state central agencies. The study was a constructive case study following design science principles. The construct was built on general principles of method engineering, taking into account the experiences from two GEA method adaptations in Finnish PA. The author acted as the principal designer in the Geagam construction. The second author observed the pilot adaptations of the GEA method in RA and ST. Both authors attended several IDP events. The documents for the IDP were also available during the study. The work was reviewed by the steering group of the research project. The model was also validated in stakeholder reviews.

Significance

Geagam exemplifies adaptation of a layered EA grid in a hierarchical set of organisations. One purpose of the adaption is to enhance the development of inter-organisational services in this set. The inherent ideas in the Geagam can be applied with other layered EA grids. For example, when a certain ministry of the government is adopting the GEA grid, it should position itself regarding two perspectives. On one hand, it should function below the state administration, ready to share the EA information and descriptions with state administration in an interoperable manner across interoperable framework adaptions. On the other hand, it should implement more EA grids for the agencies and actors under the supervision of the ministry. The ministry should demand all EA descriptions from the organisations under its supervision to share their descriptions with a common tool or to otherwise publish them. Geagam presents, if not yet a 'partial theory' or 'incomplete theory' (Gregor & Hevner, 2013), at least a novel, 'surprising empirical generalisation in the form of a new design artefact' (Gregor & Hevner, 2013). To the best of our knowledge, adaptation models for the national public sector have not been widely published. Therefore, we proposed an exploratory GEA grid adaption model *Geagam*.

Relevance as part of the thesis

For the thesis, the proposed artefact (Fig. 6) with its underlying adaption principles formulated the *initial explanation* that was submitted for abductive evaluation in the following case study with a 'wider set of data' (Levin-Rozalis, 2009) in thesis Articles V–VII.

5.2 Abductive evaluation results from city corporation

In this section, we describe the GEA grid adaption in the local government. The articles concern emerging Geagam principles that reflect the structures of the city. The reports describe the Geagam adoption in a real organisational setting. The artefacts represent the snapshots of the two ADR Build-Intervene and Evaluate cycles (BIE-cycles). The evaluation took place along with the organisational development, implementation and adoption. The references to the thesis articles are marked as (Article V: Valtonen et al., 2010) and (Article VI: Valtonen et al., 2011).

5.2.1 Article V: Enterprise Architecture as a Tool in Change and Coherency Management – a Case Study of a Local Government

Research question

The study reports how the national GEA method was adopted in real administration by exploiting the Geagam described in Article IV. The Geagam was applied in the City of Kouvola. The adaption is described and analysed with local government as the unit of analysis.

Results

The City of Kouvola board accepted Geagam adoption for strategic planning in 2009. One of the main reiterations of Geagam was to enlarge the EA viewpoints with strategy viewpoints. Figure 7 points out the resulting grid types, new EA viewpoints and their contents, as well as the description levels in the new city organisation. The grids were specified first for the central management as strategic grid, and for the purchaser and provider organisations as operational grids. An operational grid was also suggested for any centralised service provider. The description levels reflect the hierarchical decision and management levels of the new city as a provider-purchaser organisation. The arrows denote the steering function of the central administration in respect to other parts. The first research cycle, as presented in Article V, provided the city-specific adaption model of the national GEA grid as the *Kouvola Geagam*. We populated the grid with the EA descriptions that were already made and those that had newly been introduced in the city. The enthusiasm was immense at these times, and many initiatives and development projects were ongoing with various actors. The suggestions of the GEA contents for each row, with exemplary GEA descriptions, are denoted with background notations and numbers as explicated in the legend text (Fig. 7).

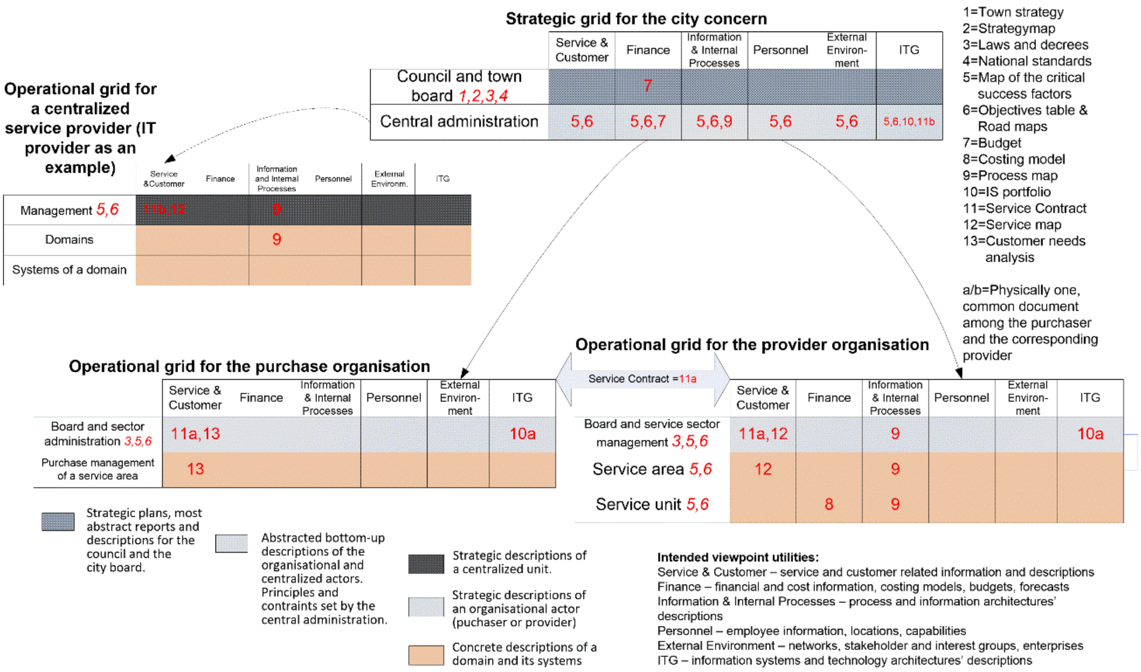

FIGURE 7 *Kouvola Geagam alpha-version*, see legends in the figure (Article V)

The strategic grid for the city (Fig. 7) is intended to serve the highest management level. Functional managers (CxOs) collect information about the purchasers, providers and centralised service providers, which altogether yields the global picture of the city architecture. The 'big picture' is to be provided in the uppermost row and is supposed to support communication with the city board and council. Thus, the descriptions at this level are to be presented in a conceptual and abstract manner in order to support observations on essential shortcomings and consequences of the decisions at hand. The grid also works as a top-down management tool. The decisions of the city council are ideally implemented in target state descriptions as the basis for development of the involved organisational actors. *Operational grids* have a narrower view in the data. They guide the strategic planning and management of each organisational actor, whether providers, purchasers or other service providers.

Method

The study comprises a constructive case study in situ following action research principles. Thus, the article reports the research method as being action research. However, as Kouvola Geagam provided the development artefact as required in design research, the method in Article V is post-interpreted as a cycle in ADR research. In the original paper presenting the ADR method (Sein et al., 2011), the authors themselves illustrated the ADR research method by reinterpreting an earlier study as ADR research. As the ADR method specifies, practical and research work were intertwined from the recognition of the problem to the building, intervening and evaluation phases (*BIE-cycles*) of the study (Sein et al., 2011). The doctoral candidate acted as both researcher and practitioner. This meant thinking processes on two levels, both on the instantiation and the theorizing levels. This insisted reflecting on the requirements of the context, the background knowledge of the EA and ISP literature and the development artefacts from time to time.

The articles report a part of the first ADR cycle from the recognition of the problem to building and intervention. In autumn of 2008, the new merger of the cities urged new solutions, and the Geagam adaptation process began. From September 2008 until June 2009, the GEA grid with relevant EA viewpoints and architectural levels adapted and adopted. The adaption workshops of the BIE-cycle comprised eight workshops starting in the autumn of 2008. After building the Kouvola Geagam, in January and February 2009, the grid was evaluated and reiterated with practitioners. For this purpose, focus group interviews were held for each functional or sectoral management team. Discussions were carefully documented.

Intervention and adoption with practitioners started intensely in the spring of 2009. In the implementation, strategy architecture descriptions were developed in accordance with the Kouvola Geagam. In later years, strategy architecture development successfully continued as iterative and recursive development cycles in relation to the Kouvola Geagam artefact development. The interactive implementation continued through 2009, starting with a kick-off for sectoral and functional management teams in March. Monthly meetings of functional management teams followed, where the strategy modelling started. Modelling produced Balanced Score Card (BSC) related matrix tables and strategy road maps for the next four years. These were essentially ready by the end of the year. In addition, field notes were collected of the informal functional and sectoral team discussions during the implementation. At the end of the year, the management teams answered a survey, evaluating their strategy descriptions and qualitative feedback on strategy modelling practices.

The city audition process took a stance on post-design strategy implementation and methodology after every financial account was given. The evaluation practices were included in the second BIE-cycle of the Kouvola Geagam itself. The first three authors worked in the Financial and Strategy Management (FSM) unit of the new city, the candidate as strategy designer, taking the role of the researcher and main designer of the Kouvola Geagam. She acted as the principal designer of the research artefact and research setting while the co-authors contributed to the development in the practitioner role.

Significance

The report provides a rich practical case study description, which is authentic and original. Strategy architecture development followed the research artefact development, providing 'embedded architecture' as everyday government practice (Doucet et al. 2009). Strategy architecture development was part of the doctoral candidate's employee role. The study sheds light on an organisation's structural transformations, which were followed by strategy architecture in a merger. Not many generalisations in the theory could be made on the basis of this report, however.

Relevance as part of the thesis

For the thesis, the article presents the 'next best explanation' (Levin-Rozalis, 2009) of the national EA grid adaption in an administrative ecosystem with local government as the unit of analysis. The city corporation as the local administration provided a wider set of data which is required for the abductive logic of reasoning (Levin-Rozalis, 2009).

5.2.2 Article VI: Enterprise Architecture Descriptions for Enhancing Local Government Transformation and Coherency Management - Case study

Research question

In this article, we report what needs of various GEA descriptions in the city were perceived, as well as their categorisation in the GEA grid. The Kouvola Geagam is reconfigured, unfolding and eliciting the business architecture viewpoint, and populating the grid with GEA descriptions for coherency management and interoperability. The work is a continuation of Article V as the second BIE-cycle of the Kouvola Geagam. The work was intended 1) to provide a common frame of reference for thinking, 2) to show the necessity of blueprinting in all management areas of a big municipality, 3) to facilitate IT architects' work and 4) to offer support for all functional leaders.

Results

The Kouvola Geagam beta version is presented in Fig. 8. The grid types have not been changed; there is a strategic grid type for City Concern and Council, an operational grid type for a provider, and another for a purchaser. The description levels are in accord with prevailing decision making levels of the organisation. The reconfigured and elicited EA viewpoints are presented in Table 2 and are differentiated as six specific viewpoints. *Operational environment* refers to documents of the external world related to the administration, such as laws, decrees, standards, external organisational actors or stakeholders, reference strategies and architectures. Strategy road maps pertain to all management levels of the organisation. These are designed to lead to business requirements and architectural principles. In the *Service & Customer viewpoint*, the purchaser-provider organisation is reflected in a variety of the BA descriptions for each. Customer needs analyses provide tools for the purchaser in planning procurements. The purchaser is responsible for arranging and funding the services. The goal is to depict the operational model concerning providers, customer groups and services and their timely delivery. The service provider is keenly interested in the business provision model and services mapping to the production process. Client segmentation and structure, the process map and process descriptions should be prerequisites for both purchaser and provider as well as the service map and catalogue. However, they may interpret these mutual descriptions from different perspectives.

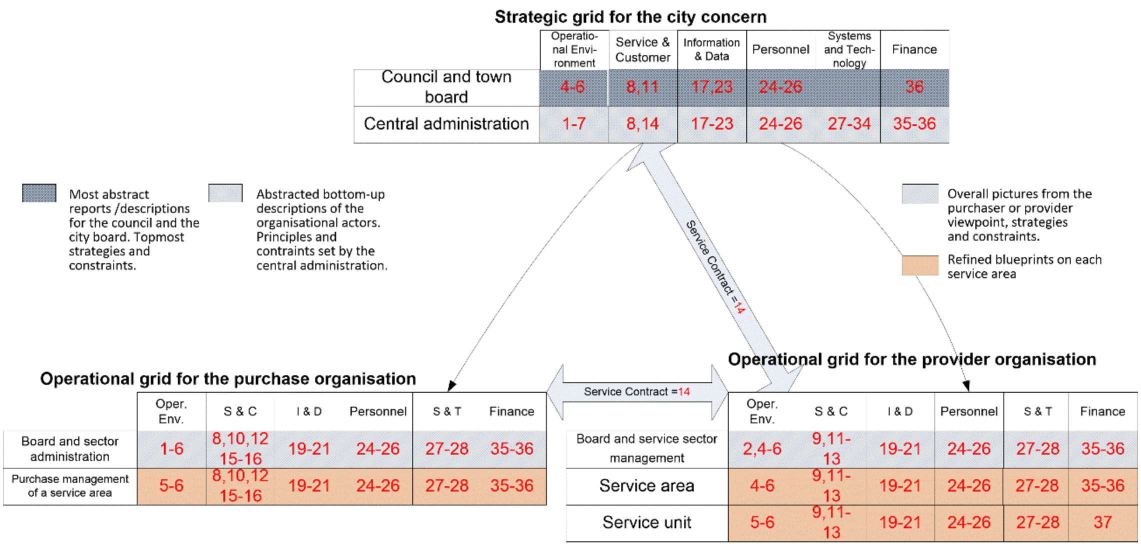

FIGURE 8 *Kouvola Geagam beta*-version (Article VI).

TABLE 2 The GEA description models in Kouvola Geagam beta (Article VI p. 365)

Operational Environment	Service & Customer	Information & Data	Personnel	Systems & Technology	Finance
1 Laws, decrees and (national) standards 2 Organisational actors and stakeholders 3 Reference architecture and strategies 4 SWOT factors/trends 5 Strategy goals and roadmaps 6 Business requirements 7 Architectural principles	8 Government operations model 9 Business model 10 Client segmentation and structure 11 Service map and catalogue 12 Process map and descriptions 13 Services vs. production processes 14 Service contract 15 Customer needs analysis 16 Client or Life even process vs. used services mapping	17 Strategic and mana-gement processes map and descriptions 18 Information flow 19 Processes – information 20 Organisational actors - information 21 Information portfolio and information struc-tures 22 Logical information assets 23 Semantic concepts (definitions and bywords)	24 Organisation diagram 25 Job descriptions 26 Processes – Job descriptions' roles	27 Systems – information – 28 Process-systems – 29 Systems require-ments 30 System services specification 31 Constrains 32 IS portfolio and IS map 33 Data dictionary 34 Logical systems	35 Cost-benefit analysis 36 Budget 37 Costing model

The rest of the viewpoints mostly represent traditional EA viewpoints. The Kouvola Geagam beta version reflects organisational evaluations in situ and was done to better support the design of different organisational reforms, not only IT-mediated ones. The *Information & Data viewpoint* refers to information and data architectures and their corresponding descriptions, which are rather settled. In Article III, one finding was that the management and strategy process descriptions were generally lacking in the public sector. Therefore, here, they were added explicitly to the Information viewpoint, as they were interpreted more as process descriptions of data processing and information management, beyond decision making. *Personnel* and *Finance viewpoints* were not changed in the beta version, further presenting employee and cost information. *Systems & Technology* viewpoint combines IS and IT architectures' descriptions providing the conventional descriptions of both.

Method

The study describes the second ADR cycle of the constructive case study in Kouvola City. The reiterated construct of the *Kouvola Geagam beta* reflects the adaption up to that moment in the city, the concurrent knowledge from ongoing national EA development and the latest EA literature. The first two authors worked as strategy designer and CIO in the city, respectively. In 10 mutual workshops, they re-iterated the Kouvola Geagam dimensions to the GEA description roles of the functional managers. They thus fine-tuned the GEA viewpoints and depicted the dependencies of the GEA descriptions (cf. Figure 16 in App. A.5) that they situated in the Kouvola Geagam. Focus group discussions of the results of the adaptations took place in semi-structured group interviews. The focus group consisted of the IT coordinators (the IT team). Detailed notes and memoranda were kept by the doctoral candidate about the used references, discussions and unfolding conclusive outcomes. The doctoral candidate was responsible for the research setting, acting as principal researcher and author.

Significance

The report provides another description of an original case study in a further stage. Strategy architecture development as recursive artefact development was concurrent with the grid adaption observations, providing embedded current state strategy descriptions updated in annual planning and organisational changes. Hence, the study enlightens strategy architecture formation versus organisational transformations. However, not many generalisations in the theory are to be made based on the article as a descriptive report.

Relevance as part of the thesis

For the thesis, the article describes the beta version of the Kouvola Geagam with related (implicit) GEA grid adaption principles. The article presents the reconfigured *next best explanation* (Levin-Rozalis, 2009) of the national EA grid adaption in an administrative ecosystem with local government as the unit of analysis. National EA description recommendations applied in situ provide the wider set of data as recommended in the abductive logic of reasoning in (Levin-Rozalis, 2009).

5.3 Results of the Reflection and Learning

We summarise the articles of the reflection and learning phase of the abductive evaluation. To find the crystallised adaption principles for the evaluation, the previous work was carefully subjected to under textual analysis. This was done to verify some of the emerging EA grid adaption principles for situational adaptations in PA. The validation of the results would still require further investigation, however. This section presents one results article and two implication articles based on the dissertation results and research triangulation concerning Finnish EA adoption. The articles are referred to as Article VII (Valtonen, 2017), Article VIII (Valtonen et al., 2018) and Article IX (Nurmi et al., 2019).

5.3.1 Article VII: Management Structure based Government Enterprise Architecture Framework Adaption in Situ

Research question

We wanted to look at the question of how to adapt the GEA grid for change and coherency management in a public corporation. The thesis aims to define some EA framework adaption principles for the public sector. Article VII was intended to evaluate and reiterate the Geagam adaption principles proposed in previous research cycles. This was done by analysing how the current state architectural information got organised in a deep corporate hierarchy and what management needs emerged in reorganising the content of those descriptions.

Results

Based on the analysis of the Kouvola City case study in Articles V–VI, we noticed the following issue. When the GEA grid is adapted situationally for a public corporation, there are typically several management structures with which to organise the EA information (Fig. 9). The article contemplates how it is inadequate to classify the current state GEA model elements in 2- or 3-dimensional frameworks, because there were many organisational management hierarchies in the case, whether for practical or theoretical management purposes. These were reflected in the management requirements of the data processing. In conclusion, the article claims that, in the adaption of the GEA grid in a public corporation (and further, possibly in any public ecosystem), the classification of the current state GEA model elements should situationally reflect the prevailing real-world management structures of the adopting organisation.

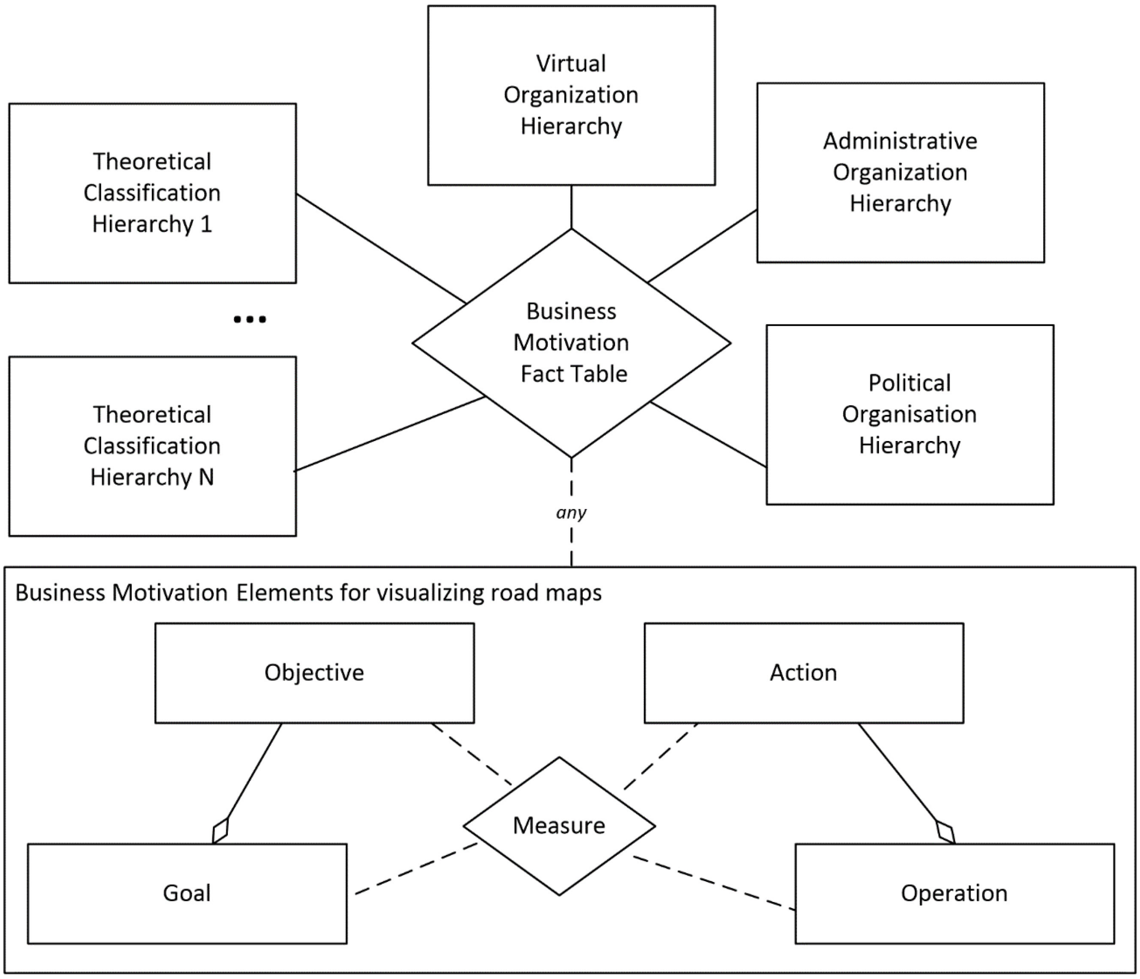

FIGURE 9 Analysis results of the reverse-engineering process (Article VII, p. 274).

Method

Architectural modelling and visualisation of the general management strategy plans, along with the corresponding database development for the strategic management from 2008–2015, form the primary data of the study. The Finnish Geagam described in Article IV guided the development of the strategy architecture of the city. The GEA grid adaption principles, that where tailored for the city as Kouvola Geagam, instructed the description hierarchies, e.g. the navigation structures of the strategy descriptions repository, and the recategorisation requirements of the strategy architecture descriptions and information of the parallel database development. The GEA grid adaption principles are evaluated and reconsidered based on the aforementioned modelling and development work. The executed data analyses were the following: 1) the reverse engineering of the implemented strategy database schema, 2) chronological analysis of the navigation structures of the strategy modelling repository versions, 3) chronological analysis of the annual changes in the city corporation organisational structures (cf. App. A.1) and 4) cross-analyses of the latter two. The article presents the reflection and learning phase of ADR research in Articles V–VI.

Significance

The reflection and learning raised questions about the EA framework concept and the use of the framework. The study suggests differentiating the current and target state GEA framework adaptions as concepts for situational adaption. Division of the EA methodology according to current or target state purpose was communicated, e.g. in (Hoogervorst & Dietz, 2015). Kotusev, Singh and Storey (2015) contemplate EA frameworks' purpose either for the current or for the target state use. As a practical measure, we proposed implementing the GEA current state information in a dynamic data model of the current management structures, i.e. along the government structures and frameworks prevailing in the current state. The dynamic data model might mean having to implement the GEA framework of the current state GEA as a hypercube-type solution. That, we believe, would facilitate a deeper understanding of the prevailing organisation structures and their dependencies, and enhance the GEA method as a strategic tool of the general management. This would presume the GEA information (e.g. EA information, EA model elements and EA model templates) to be associated with the management structures through various associations, in order to provide transparency and resiliency to the management throughout the corporation. The idea of the practical implication is elaborated more in Articles VIII–IX. The suggested approach comes somewhat closer to model- and content-driven EA approaches (Buckl, S. et al., 2008; OMG, 2014) and model-driven architecture (OMG, 2014), which presume presenting model and model element dependencies.

Relevance as part of the thesis

For the thesis, this is the key results article. The results contribute to the knowledge base as principles of utilising the GEA grid in practice. The report presents the reflection and learning phase of the ADR cycles in the Finnish local government from 2008 to 2015. The study comprises an abductive evaluation of former findings from the Finnish state government. The reflection and learning phase of the ADR study resulted in this 'result article' for the thesis. However, it was the most introspective part of the dissertation. The student worked mostly independently, alternating between Malawi Kalibu Academy and University of Jyväskylä.

We must acknowledge the restrictions of the study, as for the generalisability of results. The results are restricted to current state GEA management, and are based on two case studies. The generalisations and implications may be viewed as audacious to some extent. However, due to the abductive nature of the study, the next best explanations are given as explanations in order to guide the research further in selection of even wider contexts for further studies and wider data sources. This is required in order to test, confirm, redesign or dismiss parts of the indicated explanations.

5.3.2 Article VIII: Envisioning Information Systems Support for Business Ecosystem Architecture Management in Public Sector

Research question

We suggest what kind of IS is needed in a complex socio-technical government ecosystem for real-time current state analysis. In addition to that, we consider what a tentative design process of the target state of the government ecosystem EA could look like. The aim is to encourage evolutionary studies and pilots, especially constructive ones, to reach out to the specifications and design principles of the management methods and tools of the government ecosystem EA (GEEA).

Results

The article outlines the vision of the overall ontology-based shared EA repository for current state descriptions of the whole-of-government in order to create and maintain the as-is GEEA. The article presents design principles and some central functional requirements of the ontology-based real-time as-is ecosystem architecture (OREA) repository that is meant to be applicable to any chosen whole-of-government. The article illustrates some potential use cases of the system. The solution would provide the current state GEEA descriptions accessible to the automated updates of in the government ecosystem. The design principles outlined in the paper are the following: automatically or semi-automatically produced *dynamic as-is contents*, *scalability* at various government levels, *open access EA information* for ecosystem partners and citizens, and *plug-in architecture option* for private partners to join in the ecosystem development. Basic functional requirements that were given are as follows: 1. *Modelling and meta-modelling functionalities*, 2. *Agile analyses and comparison tools for GEEA* contents and 3. *Dynamic situational EA frameworks* of the as-is descriptions according to the user organisation. The GEEA target state design is described in more detail concerning Article IX, where it has been further affirmed with another set of data.

Method

The work is constructed as a design research, based on the authors' observations in Finnish public administration EA adoption and the literature's anticipations of the future EA in business ecosystems, e.g. (Drews & Schirmer, 2014). The IS vision stands for the design artefact in terms of (Hevner et al., 2004). The IS vision is presented as the hypothesis to be evaluated in future studies in government ecosystems, e.g. in a municipal corporate or a national government. Beyond the EA research endeavours, the design artefact is built on the personal research and development endeavours of the authors in the Finnish public sector. In addition, it includes the latest enterprise modelling and architecture knowledge such as (Bakhtiyari, 2017; Bernus et al., 2012; Bernus et al., 2016; Buckl, S. et al., 2008; Dietz et al., 2013; Drews & Schirmer, 2014; Graves, 2008; Kotusev et al., 2015; Lankhorst, Marc, 2013; Lapalme, James et al., 2016; OMG, 2014; Sandkuhl, Stirna, Persson, & Wißotzki, 2014; Tolvanen & Kelly, 2010).

The article is based on EA studies in Finnish public administration over a long period. The basic research strategy in the paper is triangulation on a large scale, i.e., beyond the data and case study triangulation, to the triangulation of the researchers and authors. The paper intertwines two evolutive and constructive research lines. The doctoral candidate was the main designer in the OREA vision. The co-authors contributed by outlining the GEEA target state process, based on their results in national EA management in Finnish EA Research (FEAR) project.

Significance

The proposed OREA solution's implementation as an IS should provide several practical benefits. The system can maintain transparency and comparability across the entirety of the government, eliminate duplicate work and enhance the sharing of best practices. Perhaps, most importantly, the shared architectural knowledge might support the co-evolution and recreation of the government ecosystem and its structures towards higher coherency and synergies. The IS vision and OREA repository are supposed here to meet the practical problems according to (Drews & Schirmer, 2014), by offering the modelling and EA tool capabilities they found lacking in their study on business ecosystem EA (BEEA).

EA methodologies fall short in bridging internal and external environments and in involving customers, suppliers, business partners and other stakeholders for building successful ecosystems (Shah & El Kourdi, 2007). We highlight the concepts of complicated and complex problems (hard and soft ones) concerning BEEA. We suggest that current state BEEA modelling should follow the engineerable path as a complicated problem by semi-automated or automated real-time updating models of the as-is state, whereas the target state design of BEEA should be left for situational, heuristic practices, benefiting from the up-to-date as-is repository. The solution would meet the challenges perceived by (Goerzig & Bauernhansl, 2018; Shah & El Kourdi, 2007) as for the lack of the capabilities in EA methodologies for BEEA analysis and design. This might be a direction to re-conceptualise EA methods and tools, as recommended by (Korhonen, Lapalme, McDavid, & Gill, 2016). They urged adaptability as a capability of the methods for reacting to internal and external changes.

Relevance as part of the thesis

For the thesis, this is an implication article based on the results of Article VII, and suggests some practical implications for government ecosystem-wide practices. After the results Article VII, the writing of the introductory to the dissertation Articles I–VII turned out difficult, because it was impossible to put out few lines of the thoughts that implied. Thus, the idea of the OREA and its IS support were born, and luckily, wonderful co-operation could take place and was formed in Articles VIII–IX. We recognise the far-reaching nature of the vision. The results validation presume further abductive studies on the best design for such a system, and design of a future common, wider ontology of the public administration sector and concepts. Application of ontology engineering knowledgebase in further development and research of the subject could be beneficial, cf. (Leppänen, 2005).

5.3.3 Article IX: Ecosystem Architecture Management in Public Sector – From Problems to Solutions

The article is based on the article VIII that was presented at the Workshop on Resilient Enterprise Architecture as part of the International Conference on Perspectives in Business Informatics Research. The contribution of the doctoral candidate is same in the article IX as in the article VIII. However, by including this article here we wish to show that the key implications have been published in journal level. The co-authors have enlarged their contriution here by additional data and argumentations. They used another data from Finnish national EA studies to enforce the common ideas presented in the article VIII. Short summary is included below.

The study discusses the development of the EA management tools for government ecosystem management and design. We look at following questions:

1. What kind of requirements and design principles could be recommended to the GEEA information system for the current state analysis of the complex socio-technical government ecosystem in real-time?
2. What kind of GEEA management model could be suggested for the GEEA target state design?

We outline a vision of an overall Ontology-based, Real-time and shared EA (OREA) repository for current state descriptions of the-whole-of-government. We present the design principles and main functional requirements of the ontology-based as-is government ecosystem architecture repository (OREA) that is meant applicable to any whole-of-government. The functional requirements ane some potential use cases are described (cf. 5.3.2). The proposed solution has several anticipated benefits. The system might maintain transparency and comparability across the entirety of the government, eliminate duplicate work, enhance the sharing of the best practices and support the co-evolution of PA structures towards higher coherency and synergies.

A management model for target state GEEA is discussed as a tentative design process for co-creating of the new services as a shared endeavor. Shared as-is EA descriptions would support further co-creation and co-evolution of the ecosystem.

The OREA, the envisioned supporting IS and the presented tentative GEAA management model stand for the design research artefacts of design research, based on cross-triangulation of authors and case studies from two inter-linked research paths in Finland. The articles VIII and IX suggest the GEAA management model and target state design that are principally based on the EA management model research cycles in other case studies in Finnish national EA adoption (Liimatainen, Heikkilä, & Seppänen, 2008; Nurmi, Penttinen, & Seppänen, 2019).

Sometimes the best solution is ideal, but the implementable solutions require further studies. The aim of the study is to encourage evolutionary studies, and pilots, especially constructive ones, to reach out to more specific specifications and design principles for GEEA. OREA solutions might benefit of the design of a future common, wider ontology of the public sector and its concepts. This implies application of the ontology engineering knowledgebase in further development and research of the subject (cf. Carter, 2016; Leppänen, 2005). The tentative target state design process should also be tested in a real environment, and further enhanced based on the results.

5.4 Summary of the results and contributions

Table 3 presents overview of the articles along the research timeline and consecutive case studies. The principal method and results are pointed out in regard to author's contribution. In the preliminary explorations, inferences are drawn from comparative analyses of the ISD method engineering to EA method engineering in articles I –II & IV. This results in EA method selection criteria, EA method engineering contingencies, and the first GEA framework adaption model as the initial explanation. Business architecture requirements for GEA method engineering are inferred and cross-analyzed with e-government literature in the article III. The author was the principal designer in the design science constructions, and the principal analyst in the interpretative and conceptual-theoretical analyses of the explorative studies. The author acted as the principal research setting and artefact designer in the iterative and recursive artefact constructs throughout the abductive studies in the articles V-VI. The findings are evaluated and re-iterated in the final results article VII, as suggestions of GEA grid adaption principles for PA coherency management. The evaluation is based on the recursive development of the town strategy architecture, principally designed by the author. In the implications articles VIII-IX, the author provided requirements and design principles of the IS that would support government as ecosystem with current-state EA descriptions. The results are restricted due to restrictions known to case studies, e.g. (Runeson and Höst, 2009). For the contribution of the co-authors, co-researchers, and co-workers as practitioners, please see more detailend description of the co-operation in sub-sections of Chapter 5.

TABLE 3 Overview of the articles in the dissertation.

Article	Research phase	Publication	Principal methods	Authors' Contribution
I	Preliminary explorations	ECIME 2007	comparative literature analysis	Analysis and comparison of Finnish EA ME requirements specifications with those of ISD ME.
II	Preliminary explorations	IRIS 2007	design research, comparative literature analysis, participatory observations	Design of the EA method engineering contingency model.
III	Preliminary explorations	ISD 2008	transcriptions and interpretive analyses of the participatory observations	GEA method engineering requirements for the PA business architecture development.
IV	Initial explanation	HICSS 2009	design research	GEA grid adaption model (Geagam) for Finnish public sector.
V	Next best explanation	HICSS 2010	action design research	Kouvola GEA grid adaption model (Geagam) for multi-domain city concern.
VI	The re-enforced next best explanation	ECIS 2011	action design research	Extended Kouvola GEA grid adaption model (Geagam) for multi-domain city concern populated with government EA descriptions.
VII	Evaluation and re-iteration of the explanation	POEM 2017	action design research, triangulation of consecutive case studies of the thesis	GEA grid adaption principles evaluation based on their application in the iterative strategy architecture development in the case study organization.
VIII	Anticipated implications	CEUR 2018	design research, triangulation of NEA case studies	Design principles and a few requirements of the IS support for the as-is GEEA repository, concluding with the need of contextual ontologies.
IX	Affirmations for anticipated implications	CSIMQ 2019	design research, triangulation of NEA case studies	Same as in Article VIII.

6 DISCUSSIONS

According to the current EA theory, EA descriptions are organised in EA frameworks that may seem like some abstract lists of the EA description models. We explored how the EA framework should be adapted to the special characteristics of PA for CM. During the journey, the concept of GEEA emerged to cover the context area. To find a proper organisational adaption at a large scale for the EA frameworks in PA, we executed a sequence of case studies in the Finnish PA, first, in the state administration, and after that, in a city corporation that consisted of several service domains. We utilised the Finnish EA Method version 1.0 to create an adaption model for the government ecosystem of the state administration as the unit of analysis. Second, the adaption model was adopted and further reiterated for a city corporation in situ. Post-analyses on the inherent EA framework adaption principles were executed in the reflection and learning phase of the second case study with cross-case analyses. We were seeking to determine how the current state architectural strategy architecture descriptions got organised in the deep corporate hierarchy in practice, and what the emerging management needs were for reorganising the content and information of the descriptions. The case study data confined the resulting propositions to the *current state government ecosystem EA*. As a conclusion we provide the answer to the main research question.

RQ: How do we adapt the enterprise architecture framework for public administration as a government ecosystem for coherency management?

Based on the Articles IV-VII *we propose conceiving the EA framework not as a static grid, but as a dynamic data model of the current state management structures amongst the GEEA actors*. To achieve this, we suggest the following design principles:

Principle 1: *Modelling the as-is GEEA should happen using primary elements*, i.e. the EA models and descriptions should be composed of the structural data or other forms that can be processed in future databases. Thus, Principle 1 should facilitate Principle 2.

Principle 2: *Modelling the as-is GEEA should happen automatically, based on the everyday governance data,* e.g. by the artificial intelligence or, if needed, semi-automatically to start with.

Principle 3: *Modelling the as-is GEEA should provide mapping of the primary elements to the prevailing management structures*, where the management structures of the ecosystem may refer invariably to any structural forms of the organisation or other management classifications prevailing in the current state. This should facilitate complicated analyses of the current state ecosystem.

Principle 1 must be given as a prerequisite for the implementation of Principle 2, i.e. the automation. Automatic creation of EA descriptions and information from administrative work requires a lot of new modelling and artificial intelligence innovations in both the substance domains and functional management in order to model and design matching information systems and databases. In Principle 3, we suggest that the EA framework should be differentiated for current state EA information and descriptions, where the dimensions of the framework are confined to the prevailing current state organisation and management classifications. In this manner, the EA framework of the current state descriptions would itself project the prevailing organisation and management structures, preferably in real time, as suggested by Principle 2. The classification of the EA descriptions and model elements through multiple EA framework dimensions is not new, as even in ISO/IEC/IEEE 42010 standard, the dimensions have been added to the EA meta-model, and there can be several dimensions of the EA framework. In the study, we propose application of the EA framework separately for the current state of the government ecosystem, which should help to explicitly map elementary architectural information to the prevailing organisational structures and classifications. Next, we consider the theoretical and practical implications due to the proposed principles, as well as the limitations of the study and some of the required further studies.

6.1 Theoretical implications

During the research period, EA theory and methods have been applied and suggested to more innovative use cases, e.g. to CM and adaptive co-evolution with organisations' environment (Lapalme, James, 2012). This has challenged EA theory, methods and IT tools. This is an area where this study also contributes its part. The study raises ontological questions as to what the EA framework represents. For example, we would like to see the EA framework as a set ontologies to help overcome the challenges of organisational and semantical interoperability. As to the current state EA descriptions, we propose considering the framework not as a static grid, but as a dynamic data model of the current management structures: a data model that classifies the descriptions and metadata of operations, information and systems through associations to the prevailing management structures.

Most typically, in EA theory, no specific difference is made between the current or target state use of the EA framework. The results tend towards differentiating the current state GEEA methodologies from the target state EA planning and design methodologies. The current state framework might be mapped to the prevailing management and government dimensions of the given ecosystem in real time. If the current state of GEEA management evolved in this direction, it might shift the as-is GEEA grid notion towards adaptive EA frameworks (Lankhorst, M., 2009; OMG, 2014). According to Buckl et al. (2008), the EA frameworks are often too abstract for real use as such, or they may be too massive for practical deployment. As a solution, they present paths and dependencies between EA models to rearrange them according to management requirements (Buckl, S. et al., 2008). This thinking resembles the experience of the study in managing the requirements of the strategy architecture descriptions of a corporation. As a prerequisite for reorganising the architectural information and respective descriptions according to different management requirements, presenting the model and model element dependencies is presumed as in model-driven architecture (OMG, 2014).

Discussing the EA grid adaption for the target state is beyond the thesis, since the primary data of the GEEA grid adaption evaluation concerned the creation and maintenance of the current state strategy architecture. However, the situational EA grid adaption by (Hoogervorst & Dietz, 2015) might suit the target state GEEA development in each project. Kotusev (2015) classifies EA management methods as traditional ones for current and target state EA management mentioning (e.g. Bernard, 2012; The Open Group, 2011; Whitehouse, 2013; Zachman, John, 1997) and more flexible ones that concentrate more on the target state EA implementations (e.g. Ross et al., 2006). Even though his literature analysis concerns IT architecture management methods, the results can be considered indicative of the suggested theoretical implication of differentiating the theories for the current and target state GEEA management.

6.2 Practical Implications

In this section, some practical implications are considered for the development of future EA tools (6.2.1), for government ecosystem EA management (6.2.2) and for the public sector management generally (6.2.3).

6.2.1 Future EA tools development

Meta modelling of the description languages as well as incorporation of the model elements into code provision and automation are common practices (cf. OMG, 2014, 2017; Tolvanen & Kelly, 2010). The implementation of the current state EA descriptions, with references to the management frameworks, can be seen as an application of the ISO/IEC/IEEE 42010 standard that supports any dimension in an architectural framework. We suggest developing a real-time IS support of the as-is GEEA descriptions, their elements and metadata, to be associated (with various associations) to several, unlimited numbers of prevailing management structures. This is illustrated in Fig. 7 as a conceptual data warehouse model. If GEEA model elements and models were situationally related to the prevailing management structures, it might presume hypercube data warehouse implementation according to Fig. 10.

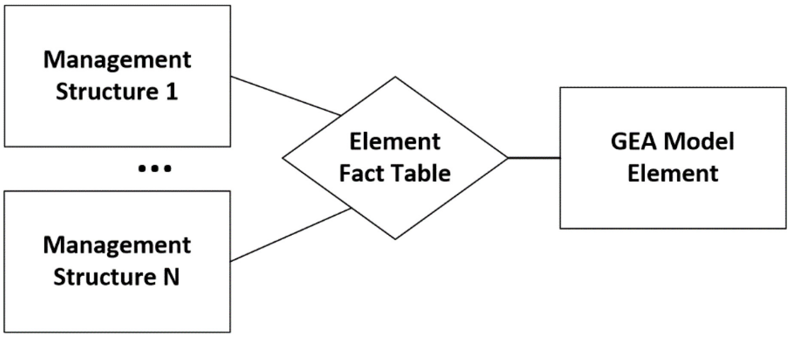

FIGURE 10 Generalization of the results as a conceptual model (Article VII, p. 277)

This type of development of the current state GEA management would provide opportunities to have almost unlimited applications. In next sections, we mention just a few. This type of as-is real-time architectural management of GEEA information could facilitate the design of the common contextual ontology covering public ecosystem actors and concepts. This could benefit use of the ontology engineering knowledgebase (cf. Leppänen, 2005) for further development and research of the topic.

6.2.2 Implications to GEEA management

Public administration at any level, even at the national level, might benefit from systematic government ecosystem level EA concepts and methodologies. In the study, we presumed the GEA as a strategic public corporate management tool. The purpose of the GEA was considered as a means for strategic change and CM. The government EA framework or Geagam was constructed for that purpose. We anticipate that the coherency of the public sector could be enhanced by providing transparency to often tacit, overlapping and even contradicting management structures in some cases. Zachman (2009) speaks of public administration as a complex entity whose change management requires descriptions of the current state as prerequisites. Public functions share legislative and political guidance from the ministries, committees, common and variating funding mechanisms etc.

To tackle the value network in the government ecosystems, EA methodologies and tools have to extend their techniques and models even beyond the current state-of-the-art models, even though EA already has reached strategies, business models and value networks, e.g. extended EA in (The Open Group, 2011). Some of the newest EA methodologies address the CM and co-evolution of the organisation with its environment (cf. a modest review in

Lapalme, James, 2012). The dissertation thesis intended to confront the issue of the transparency of the current state public ecosystem, with the intention of outlining the overall picture of it (or of the given part of it), according to the prevailing management structures, even those that are beyond the official organigrams.

If GEA information followed the prevailing management structures in real time, the prevailing management structures would appear transparent, and the understanding of organisation ecosystem could be enhanced. This is essential amongst organisational actors that are presumed to appear interoperable. Transparency of the prevailing management structures would help to develop the consistency and coherency of the ecosystem. It seems that GEEA should evolve as a tool for corporate and ecosystem management in order to support the rationalisation of the organisation, architectural structures and dimensions.

Analogically to practical use case suggestions by Buckl et al. (2008), we list here some further examples of queries that might be answered of the common as-is GEEA descriptions repository, e.g. using one reminding the OREA:

- Who is financially responsible for *(given)* services *(in each municipality)*?
- Who is responsible of the development of *(given)* services (*in each district*)?
- How are *(given)* activities organized in *(given)* organizations (*e.g., in certain agencies or municipalities*)?
- What functions and tasks have been hidden in the structures so that they are unseen to overlap?
- What does (*a given*) unit /domain cover in terms of their products, enterprise knowledge, personnel, and finances (etc.)?
    - Please list (*given*) unit's tasks, processes, personnel, financial plan, information systems and financial development.
    - Please visualize, e.g. according to (Lankhorst, M., 2009).

Silo-like corporations and ecosystems include inherent architectures embedded in each structure, where sandbox managing can prevail with independent processes, knowledge and systems. In this type of organisation, no one has the overall picture of the entirety. These challenges may occur in management practices or attitudes; however, one of the main reasons seems to be the lack of time for information sharing, and therefore some new efficient information management tools are urgently needed.

6.2.3 Implications to public sector management

As EA has been evolving as practice and a theoretical concept since late 1970s, the evolving purpose of it has to be noticed. EA has roots in IS science (ISO/IEC/IEEE 42010, 2011), the credit for formulating the concept going to Zachman (1987). However, the deficiency in the concept seems to have been its restriction in a solid enterprise within its architectural boundaries (Zachman, John, 1997). Value networks and value chains have since directed the need of enterprising towards ecosystems. From a life cycle and life-event viewpoint, to cover the customer’s life processes, an entire government ecosystem is required.

In its aim to provide the citizens services during their lifetime, the public sector has evolved in the Western world as a multi-layered, multi-domain and multi-organisation function. PA has become a complex entity in most Western countries. The complexity is due to numerous actors at several administrative levels, whether central, regional or local. PA consists of co-dependent organisations, with multiple tasks, business domains and geographically distributed infrastructures to build and maintain. PA has increasing customer demands with fewer resources, not to mention political conflicts. Even consumers and suppliers seem 'one and the same' in the end. (Zachman, J., 2009) Janssen et al. (2006) describe PA as a complex adaptive system. When silo thinking amongst public organisations is added (Lankhorst, Marc & Bayens, 2009), some consequences evidently may follow, e.g. e-government efforts end up sparsely structured and based on ad hoc cooperation (Hjort-Madsen & Burkard, 2006). The actors may have various, possibly conflicting or overlapping, tasks or goals.

The two consecutive case studies in the dissertation thesis show analogies between each other. They show expanding business services over time, and dependency on changing political powers, which makes it difficult to achieve long-term visions and goals. Transparency of the ecosystem architecture in real time is therefore essential. In Articles VIII and IX we presented a vision of the IS support for OREA. The OREA requires more elaboration and pilots with artificial intelligence and automatisation.

Reorganisation and restructuring of the PA ecosystem are not typically based on profound systematic analysis and design (Hammerschmid et al., 2016). According to our observations during the study, the current state organisational structures form a hindrance to the transformation efforts, and possibly cause an ongoing treadmill. In a network of organisations or government ecosystem, the management structures and management organisers should be transparent at high usability levels, to enable the comparative analysis of the as-is corporate structures of the ecosystem, before the designing of the common goals and structural implementations. The Finnish Information Management Act 2011 necessitated PA actors to model publicly their EA over a period of a few years. However, despite of the serious endeavours in launching the shared EA modelling tools amongst PA actors, the open sharing of the EA descriptions did not reach a very high level. Innovations and best practice sharing have to be based on mutual agreement on a personal level first. The search algorithms and comparisons are not profoundly supported through the ecosystem and with enough accuracy, e.g., in model element level. Furthermore, as administrations are trending towards citizens-as-partners type practices in service development, the customers and citizens might form a remarkable resource in innovating public services and structures, based on an open-source GEEA descriptions.

6.3 Limitations of the study

Validity has been adapted specifically to design science research as a construct, e.g. by (Larsen, Lukyanenko, Mueller, Storey, VanderMeer, Parsons, and D. Hovorka, 2020). We present some considerations on the subject below concerning the thesis results and their implications.

Internal validity refers to the truth value that is assigned to the conclusion about the cause-effect relationship within the context of the particular research setting (Brewer and Crano, 2000). ADR views design as a situated process in an organizational context as a process that generates prescriptive design knowledge about a class of artefacts to address a class of problems (Gregor, Chandra Kruse and Seidel, 2020). In this case, the class of artefacts is the GEA framework, that should solve the problem of in-coherent EA descriptions (and organization structures) of the public administration ecosystem. However, since we have been using the abductive logic of reasoning, these instantiations have not solved yet the class of problem, but only provided feed-back on EAF theory as initial an next best explanations in a specific case organisation. Therefore we cannot not whether the true instantiation of the suggested theoretical principles and OREA solution would solve the coherency of the government ecosystem (internal validity).

As the thesis' results we suggest a theorized solution that seems ideal at the moment to solve the problem. However, it is crucial, whether the suggested solution really solves the given problem (internal validity). Sometimes the best instantiation may be a theoretical on, since in the reality legislation or other prohibitions may prevent the ideal instantiation. In this case, the OREA information system as an instantiation of the suggested dynamic datamodel of the as-is GEEA, would probably be problematic from the legislative point of view with the overly transparency it insists.

External validity. We can know even less, whether the suggested solution would also work in some other countries (external validity). *External validity* refers to the generalizability of the causal finding, whether it can be hold across different setting (Brewer and Crano, 2000). The suggested results are presented with an understanding of their restrictions, the primary data concerning the strategy architecture development as a partial architecture in the case organisations. Even though, according to the observations, the management requirements for reorganising the description contents seemed to hold for other architectural viewpoints. A municipality is an extraordinary case organisation for PA studies. It has a vast geographical service outlet, multiple service domains, deep hierarchies in dual official organisations, various enterprise forms, and typically a separate corporate management. As such, it shares structural analogies with the state government. However, two case organisationa, principally one researcher and a single partial architecture set limitations on the generalisability of the abductive evaluation results. Consequently, the results cannot be externally valid based on this study.

Realiability. We have transparently formulated different solution models and tested them recursively by modelling the strategy architecture of the town for longer period. Each artefact has been published in a form or another. In this manner, the research seems rigorously done, beacause it can be interpreted following the induction-deduction cycle specifically provided for design principles use and formation by Gregor et al. (2020, p. 17). This can be seen as enhancing realiability of the study. To enhance the reliability of the results, a few practices has been implemented.

1. Throughout the case studies, the results and minutes of the workshops and meetings were systematically submitted to participants to also avoid subjective interpretations. The strategy artefacts and excerpts were published as open data for reliability in (City of Kouvola, 2014), as well as strategy plans and annual evaluations in the form of the city budget and audit books. However, the results can still be considered only initial and tentative, which is typical of case studies.

2. The rationales between the data analyses and provided proposisiont are illustrated with conceptual models to make the inferences transparent and arguable. According to the abductive logic of reasoning, further cases and data sets are needed to gain convergence of the explorations to achieve validated explanations. The construction of artefacts is never subject independent. The interpretation of the design artefacts as the primary data source is therefore challenging. In this study, the use of recursive artefacts exponentiates the challenge. However, the authentic positioning of the study in situ in a recurring annual strategy management process with embedded evaluation practices enhances the credibility of the given further proposition as a valuable next hypotheses or next-best explanations (Levin-Rozalis, 2009).

3. Triangulation has been executed beyond the research cycles in order to substantiate the suggested as-is GEEA description principles and their suggested practical implications (the ontology and IS support). In the Finnish EA research, design science has been executed on EA management models (Seppänen, 2014). The triangulation of the researchers and design research artefacts of the various Finnish EA case studies have been utilised in order to support the next-best explanations concerning some shared research interests. Triangulation results are presented in the implication Articles VIII and IX, where the practical implications are elaborated.

6.4 Further studies

More use cases and case studies are needed in validating the results. Trying the suggested 'next-best explanations' in wider data sets and use cases is further suggested using the abductive logic of reasoning (Levin-Rozalis, 2009). Various public ecosystems on a smaller scale (e.g. local corporations, city corporations, and state agencies with their local offices) could try modelling their GEA elementarily and semi-automatically, mapped to the prevailing management structures. Developing a contextual ontology is another effort, let alone the shared IS support for common public ecosystem. The context is given as a distinctive factor in understanding an ecosystem (Chandler & Vargo, 2011). Considering context is given as a means to break down existing 'EA myths', i.e. factors that restrict EA from fulfilling its promises (Gong & Janssen, 2019). Piloting is recommended in these huge efforts. In short, the dissertation leaves many more questions than there were before it was started. For the organisation and EA researchers, this can be seen as a fruitful ground for further studies. Especially case studies and dismounted research practices in situ in organisations are recommended. Ethnographic and other social science methodologies might help opening up the key ontological concepts in these studies. The common aim should be bringing the GEA practices and principles closer to users, employees and employers. We owe the wealth society to 'make it great again'. This is done by finding common, transparent ways to develop it together through each stakeholder role.

In the second ADR cycle, we end up presenting descriptions of clients and other environment aspects in the PA, such as client groupings, client life cycle, stakeholder strategies, laws and regulations (Article VI). The corporate management viewpoint in the adaption of the Geagam underlined the further need to extend the variety of EA descriptions. In various management areas, such as human resource management, the roles and task of the personnel are the focus of interest, while in financial management, it is the graphs and comparisons amongst various periods. These require much wider modelling practices to be developed compared with the traditional viewpoints and areas covered by standard modelling practices. Lacking modelling practicing, languages and tools, as well as the interoperability of the EA models and descriptions concerning various functional management areas, could be some of the future research problems. In the future information society, the EA models and applications should be followed by modelling standards and tools for design changes with interoperability amongst special functionalities reflected in various models and notations.

Beyond as-is ontologies and hypercubes, further studies in GEEA target state design are needed to facilitate public reforms. Experiences of both successful and unsuccessful public sector reforms have been collected by Hammerschmidt et al. (2016). In Finland, the reforms can be perceived in the government pursuits to run the governance of the PA in larger units in all measures, e.g. by budgets, geographical responsibility and number of citizens. In Denmark, the number of the municipalities was reduced approximately to half in one night. Typically in Finland we follow the commonly evolving Nordic trends in public sector reforms. At the same time, the provision units of successful domain areas were corporatised countrywide. Wider responsibilities and fusions subject the new administration to new governance challenges. On one hand, the governance gets more complex, and on another hand, visibility of the corporatised units or wider responsibility areas gets typically harder and less commensurate. At least, in the beginning of mergers, the visibility and transparency should be crucial elements in successful change management. Suggested ecosystem ontologies and common repositories could be piloted in these types of changes where the need is evident. Reforms should also be evaluated more systematically afterwards, to enhance the change methodologies and reiterate the results. Currently, it seems that the reforms are hazardous attempts by various organisations and management models, such as in purchasing – provider model, political leadership and select committees (cf. Hammerschmid et al., 2016). The golden bullet would be to find how the entirety of public services could be reformed to fulfil the mission in servicing the citizens. The suggestions for capturing and further managing the as-is GEEA could be key to CM in the lifespan of reformed public ecosystems. This would entail more properties from current state repositories, and target state planning databases and information systems.

7 CONCLUSIONS

The study presents a longitudinal case in Finnish public sector, comprising of two consecutive case studies. The first one is considered as the explorative, and the other as the abductive part of the study. The research question is how the enterprise architecture framework should be adapted for coherency management in a government ecosystem. Solutions are sought through constructive methodologies, where main methodologies are DR and ADR. In the abductive part of the study, the researcher has actively built artefacts in a city corporation from 2008–2015, iteratively participating in the design of the outcomes. The evaluation has taken place as the ensemble practice. The suggested EA design principles have been elaborated by using abductive logic.

The EA design principles that are provided suggest that the current state GEEA descriptions and information are formed elementary and such that they can be automatically updating in real-time. As to the categorisations of the current state EA descriptions and models, it is considered essential to map the EA descriptions and information to the prevailing management structures, whether they be some form of hierarchical organisations, or other management classifications. This suggests further studies in forming a contextual ontology of the entirety of the given government ecosystem. In addition, it requires practical design of the IS support for processing the GEEA descriptions, their elements and information amongst the actors of the government ecosystem. The results suggest the implementation to follow some type of hypercube at a conceptual level with analytical tools to cross-analyse the data with various dimensions. This type of IS support would benefit the public ecosystem management by providing transparency and manageability, as prerequisites to CM. We anticipate that the coherency of the public sector could be enhanced by providing transparent and comparable information of the often tacit, overlapping or contradicting structures of the ecosystem. Heuristic target state planning and structural refinement of a complicated system is possible only based on accurate and real-time current state descriptions that can be analysed in chosen detail and from different viewpoints. This would be possible since the as-is management structures would be made transparent in real time and in relation to the elementary architectural details.

For the further studies, the study raises ontological questions as to what the EA framework stands for. As to the current state EA descriptions, we propose conceiving the framework not as a static grid, but as a dynamic data model of the current state management structures: A data model that classifies the descriptions and their contents of the government ecosystem through associations to the prevailing management structures. This type of notion could lead to the future development of EA tools, modelling and IS support and further to automatically maintained as-is GEEA architectures. In public administration, organizational change seems to have come to stay for good. Bigger changes are not just being made every other year with annual modifications; there has been talk of structural and organizational transformations along the budget year. This rapidity in structural changes demands much more of the prevailing technologies to keep as-is information updated and analyzable as the new reforms take effect. As a result from two Finnish cases, the results in the dissertation thesis should still be considered initial and tentative and demanding further investigations.

A APPENDIX

This appendix clarify some parts of research and construction process. In Section A.1 we give a short summary of the organizational change process in the research period 2009-2014. This is relevant, since the new Kouvola city was formed by a merger in 2009. The organizational change became 'everyday' practice. In Section A.2 we describe the practical problems inspiring the development of the strategy architecture and its IS support. Sections A.3 and A.4 describe shortly the development of the strategy architecture modelling repository and the related relational database. Section A5. provides the inter-depencies of the GEA descriptions included in Kouvola Geagam. Section A.6 presents the physical implementation of the strategy database in 2013, as it forms part of the primary data of the study. Section A.7 presents some categorizations of EA scope and purpose for EA methodologies, further elaborating the tables by (Lapalme J. 2012, Drews & Schirmer, 2014).

A.1 Organizational formation of the city in the research time-span

In the research time in city of Kouvola, we developed too strategy architecture artefacts. In the end, the artefact evolution during the research cycles were to be analyzed against changes in organization structures. The following analysis of the organizational change was carefully analysed during the reflection and learning phase of the ADR study based on the public documents of the town during the research period, i.e., on the Financial statements from 2009-2012 and budgeting books from 2009-2013 of the city.

The focus in the ADR study was on a single town organization, albeit the complexity of it was high. The new City of Kouvola was formed in 2009 by a merger of six municipalities, and three district wide service providers owned jointly. By 2015, even more organizations were merged to the new city, e.g. the district hospital in 2011. The city ended up with ca. 90,000 citizens on area of 3,000 km2, 6,500 city employees, and annual expenditure well into 500 million euros. Services offered in that situation were those of all education from nursery to secondary schools, all health care services despite a university hospital, business support services for entrepreneurs, including farmers, social services to citizens, water supply and sewerage as well as planning, building and maintenance of land, city infrastructure and town buildings. This resulted in e.g., a pretty high organizational hierarchy to manage with variety of organizational forms and regulation systems. The city administration governed also town subsidiaries, e.g. for the supply of electricity, housing companies, theatre. The expenditure the corporation with the subsidiaries was annually well into 700 million euros.

Since beginning, the newly implemented town organization structure was continuously changing, resulting in three major structural changes in research timeline for 2011, 2013, and 2015. There were two continuous trends: a gradual change towards process organization, and gradual outsourcing of the prominent business areas exposable to market competition cf. NPM (Cordella, 2007)).

The new merger started in 2009 with provider and purchaser units (Fig. 11). The purchaser organizations were responsible of 'ordering' the services from the providers in the boundaries of the given budget, and for monitoring the services' compliance to the regulations. The providers were mostly internal units, some of them in-house enterprises and some subsidiaries. Both type of organizations had board of their own for political decisions consisting of politically merited residents. However, in the long run no basis for the real resource allocation by agreement was found in-between the provider and purchaser. The resources remained thus principally shared by the central management (CM) through traditional kind of negotiations. Consequently, the process organization started to emerge gradually since 2011 instead.

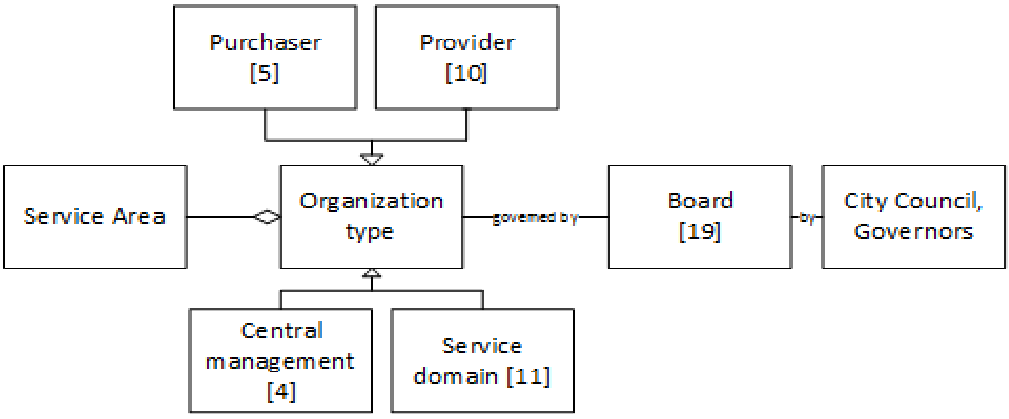

FIGURE 11 The newly implemented organization types in 2009. Numbers refer to the number of instantiations of each type in situ.

The organization types in 2009 are illustrated in Fig. 11. In the starting point, there was no organizational unit that was not categorized into purchaser or provider type in the accounting system. All types or organizational units were further divided in smaller service areas and even further in hierarchy, especially for those having up to tens of geographical locations like schools or seniors' homes.

By 2015 the provider organizations were dismissed (Fig 12). They were absorbed into the emerging process organization or transformed into in-house enterprises, and thereafter sold, transformed or merged into subsidiaries. The change between 2009 and 2015 simplified the organizational structure. The organizational units were the central management, two in-house entrepreneurial institutions for infrastructure services, and two holistic service domains, those of 1) the city-planning, covering the life-cycle of environmental and building infrastructures, and 2) the wealth, covering the life-cycle of citizens. The latter was characterized by the major expenditures of the city budget, a very deep management hierarchy due to the variety of services and service categories and with geographical locations dispersed in a wide area. Central management was responsible for the town strategic management, strategic CxO functions, financial and capital planning, corporate governance, and decision making support for the political organization, also with guidance and funding of the business development services and entrepreneurial development projects in the district. CM tasks were shared to a bunch of senior managers (CxO:s) and their expertise teams.

In spite of pretty radical philosophical change in organizational thinking, any radical change in decision making structure did not take place (Fig. 12). Amount of the boards did not reduce much beyond dismissing the purchaser boards. Board structure became more aligned to management structure however, since service domain alignment with the boards resulted in one-one bonds in the most costly wealth domain.

Concurrently along the organizational changes, business process architecture was modelled and depicted, informed by the organizational change. Process architecture is considered as the secondary data in the study.

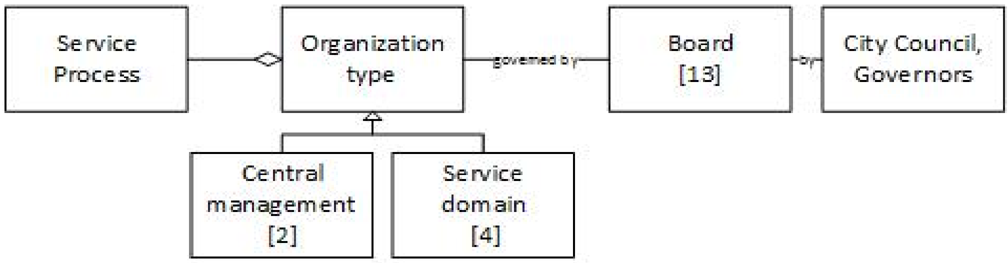

FIGURE 12 Meta model of the process organization starting from 2015. Numbers refer to number of organizational instantiations in situ.

Administrative tasks and functions evolved along the organization structure. However, concerning the central management and administrative processes, no remarkable process enhancement was implemented. This is due the municipal administrative traditions in Finland.

A.2 Practical problems in City strategy institutionalization

In Finnish town organizations, the law sets requirements for annual financial planning and reporting. With budget euros of any organizational level and sector included in the budget, there are the operational goals and objectives expressed. Financial Statement 2009 shows an example excerpt of the practice as it was before strategy team interventions (Fig. 13). The original tables were produced in autumn 2008.

In the strategy institutionalization of the city, the objectives charts by each organizational actor/board were collected as text editor formats as in Fig. 13. It was a laborious task in a multi-faceted multi-domain multi-agent city corporation. It demanded upto a couple weeks secretarial work during creation of the budget book, and the same time for quarterly reports and the financial statement. As administrative workforce has been greatly reduced in Finnish towns, this was intolerable.

Vuositavoitteiden toteuma (sitovat)

Ta 2009	Tavoitetaso 2009	Mittari	Toteuma
Henkilöstöstrategian ja -suunnitelman laatiminen	Henkilöstöstrategia ja -suunnitelma valmistuvat vuoden 2009 aikana	Suunnitelmat valmiit	Henkilöstöstrategia /-ohjelma laadittu ja toteutussuunnitelmat valmisteilla. Henkilöstösuunnitelma toimialojen valmistelussa.
Innovatiivinen ja yhtenäinen organisaatiokulttuuri	Innovatiivisen organisaatio-kulttuurin edistämistä tukeva hanke	Hanke käynnistetään	Hankkeen käynnistysseminaari pidettiin 29.10.2009.
Henkilöstöresurssien tehokas käyttö	Ura- ja tehtäväkiertojärjes-telmän luominen	Henkilöstömäärän kehittyminen	Henkilöstön vapaaehtoinen urapalvelu on otettu käyttöön huhtikuussa.
Kannustavien ja kilpailukykyisten palkkausjärjestelmien luominen	Tehdään työn vaativuuden arviointi ja palkkojen harmonisointisuunnitelma	Arviointi ja suunnitelma valmiit	Työn vaativuuden arviointi tehty syksyllä 2009. Palkkojen harmonisointisuunnitelma valmistelussa.
Muutosvaiheen johtamisen tukeminen	Kaikki esimiehet osallistuvat esimiesten muutosvalmennukseen	Esimiesten osallistumis-%	Esimiesten osallistuminen muutosvalmennukseen: 1. koulutuspäivä 70 % 2. koulutuspäivä 60 % 3. coaching 50 %. Yhteinen esimiespäivä "Muutoksen johtamisen jatkot" pidetty 29.10.2009.
Henkilöstön terveyden ja työhyvinvoinnin edistäminen	Työhyvinvointia tukeva hanke käynnistyy vuoden 2009 aikana	Sairauspoissaolot henkilötyövuosina, Varhe-maksut/vuosi	Osallistuminen henkilöstön arvoa kuvaavien tunnuslukujen kehittämishankkeeseen

FIGURE 13 Example of objectives, goals, measurements and reports on their realization in 2009 Financial Statement of the city.

The beginning of the new administration in 2009 showed that strategy institutionalization data was insufficient and inconsistent. Financial and operational planning practices were regulated by the law and the tradition of the municipality sector. Word editors did neither allow fluent reporting to reflect the town strategy success, nor revealed dependencies between different goals and managerial interests. Objectives were detached from the town strategy and each other. Their editing was laborious and risky with e-mails to and fro with many domains and sectors. Managers had in mind the long tradition in municipality field where objectives in financial plans and reports was rather independent, freely formulated, and abstract. Lack of central management's coherent direction towards the service domains caused confusion and overly work load at service sectors. The institutionalized goals lacked proper follow-up information. The laborious editing ate up the time from attempts to analyze the data to leverage it. The problem of poor strategy institutionalization data was identified back to the strategy practices and lacking IS support. The assumption was, that embedding new modelling and analyzing practices in management and possibly software support the problems could be helpful (Table 4).

TABLE 4 Problems with existing strategy institutionalization practices and ISs

Problems	Traditional practices
Objectives were detached of the town strategy goals (in-coherency)	Objectives were loosely connected to town strategy objectives, and presented as separate service domain specific tables.
Objectives Detachment of the annual goals from of the goals of the other organizational actors (in-coherency)	Institutionalization of the strategy was formulated in isolated manner by each management team. Every team presented their own suggestions for the annual budget and goals. Dependencies between objectives were not coordinated.
Lack of visualizations	Lack of visualizing tools for analysis and decision making. No facilities for presenting objectives as hierarchies, networks, or maps of goals e.g. strategy map (Kaplan and Norton, 2000).
Non-existent support for different functional management roles in central management.	No chance to group objectives by focus of interest, e.g. by HR management.
No facilities for grouping the objectives from different viewpoints.	Objectives were formulated as presentations (.ppt), worksheets (.xls) or text (.doc). There was no chance to categorize them in different manner without un-realistic work load.
Lack of transparency and therefore usability of the strategy institutionalization information.	Central management prioritization was unsufficient resulting in overly work load 'in the front line' at service domains. Sector organizations complained of siloed instructions from central management senior officers. The information requests were not timed in relation to other functional management teams' requests.
Inconsistent or lacking data	Objectives setting and reporting was not coherent - someone wrote objectives in measurements column in the template and vv. Strategy team's time was spent in chasing for the lacking data or ensuring the quality of the data.
Non-existent follow-up of goals	Given measures for the objectives were hazardous and changing regularly. You were not obliged to give any target level, nor any realization values. Reporting was manual - e.g., the realization percentage had to be deduced manually out of written reports. Exact statements of the state of the objective were lacking, i.e., if the goal was fulfilled or not. If annual goals were not accomplished, they were sometimes merely repeated in the budget book for the next year.
Non-existent 3 year goals of organizational actors.	Long term follow-up of town's direction was hard with incompletely and differently filled templates. Budget included 3 years estimate for costs, but not any 3 year objectives beyond free text.
Low accomplishment percentage of the objectives by each organizational actor.	In average the goals were accomplished approximately in half, for recurrent years.
Laborious and risky editing and harmonization of word editor data.	End-users and owner of the data had always to be consulted, if inconsistent or lacking data had to be completed. This caused much e-mails to-and-fro. You always had to think where the latest version is. There was no time in governance left for strategic operations.

A.3 Development of the Strategy model repository

For the strategy modelling, town specific semantics were created for three model types, those of road maps, risk maps and measurements map. A process architecture modelling and navigating tool was applied and adapted for these model types. In the end of the research period, strategy modelling repository consisted sets of the road maps along the management hierarchy for each experienced organization structure. Figure 14 presents an example of the road maps, indicating the vision, mission, linkage to the town strategy goal, dependent long term objective of the organization unit, measures, and operations, as well as optional sub-model for the action plans navigable from the existing model. The strategy model types evolved in time regarding to the contents, semantics and concurrent organization structure.

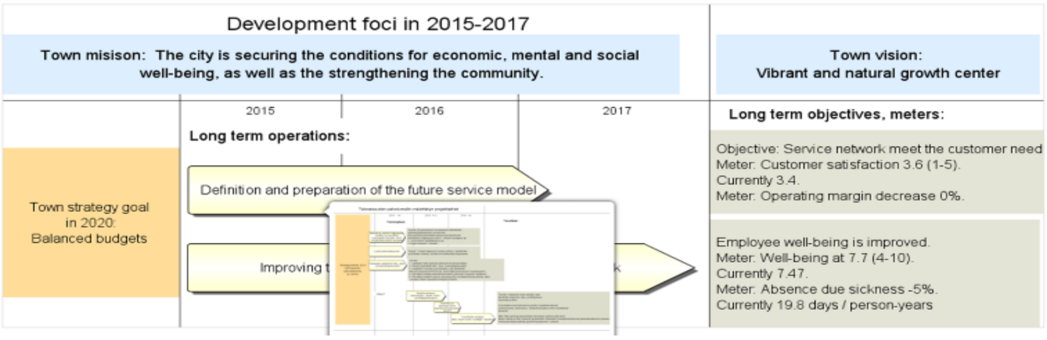

FIGURE 14 A road map instance in strategy model repository (Article VII, pp. 273)

For measurements specification, Kouvola city participated 2013-2014 in a national measurement research project. In the project, the city targeted specially in determining the coherent measurement levels for the town, and in developing a consistent measurement sets for the pilot service domain and its subsequent services. These were depicted as measurement maps. In 2014, also the risk analyses was given as a new task to strategy team, resulting in risk analyses workshops at the two highest decision levels and mutually created risk maps as new descriptions. The excerpts of the management organization road maps, and top level risk pie were included in the budget book for 2015.

The town sub-strategies, even though at abstract and high level, were tens in number. Beyond the town strategy, the central management functions had their sub-strategies, like human resource management and development strategy, security strategy and IT strategy. Also the service provision, having deep and detailing service structure, and being nationally regulated, had the need to align service domains, processes, and services to national reference strategies and to form themselves specific service visions and strategies. Current situation was unbearable, and reflecting clear in-coherency, since the holistic picture and follow-up of these were impossible. The situation resulted in mutual in-consciousness and even overlaps in terms of development efforts. The modelling of these sub-strategies was launched. Their mutual hierarchy was depicted into model repository as user interface for the road maps of these sub-strategies. This was considered the third dimension in our modelling framework Kouvola Geagam already in 2009, but this aspect was not published before.

All in all, the created strategy models yielded a hierarchical set of descriptions, where the hierarchy resulted in from the hierarchies of consecutive organization transformations and other management classifications. Some political organizations had their own roadmaps depicted during the research period along the political organization structure.

A.4 Development of the Strategy database application

Automatic visualization of the road maps in (Fig. 14) was one of the aims in the strategy database development. The development effort yielded in Ratsu Information System based on open source technologies, and resulting in open source code publication (City of Kouvola, 2014). The application was iteratively developed from 2010 annually, and taken into use in annual strategic planning and quarterly follow-ups. The management used it to formulate the measurable objectives for the given time period with operations and actions. These were given in relation to the town strategy, sub-strategies, measurements, and the organization structures. However, the time period for the objectives remained bound to one year, as typical for the public financial and operational planning. The results of the planning were annually included in the budgeting book.

The application offered a platform to test strategy information in relational database, facilitating database queries and excerpts to budget book and executive reports. The elaborated idea of the strategy database is illustrated in (Fig. 15) as a conceptual diagram, as a result of the reflection and learning phase of the study. Business motivation (The Open Group, 2011), as one of the ‘building blocks’ of EA (Bernard, 2005) covers basic strategy entities, such as objectives, goals, actions and long term operations. Measurements could be attached to any of these. Details are omitted, such as attributes and relations among the entities.

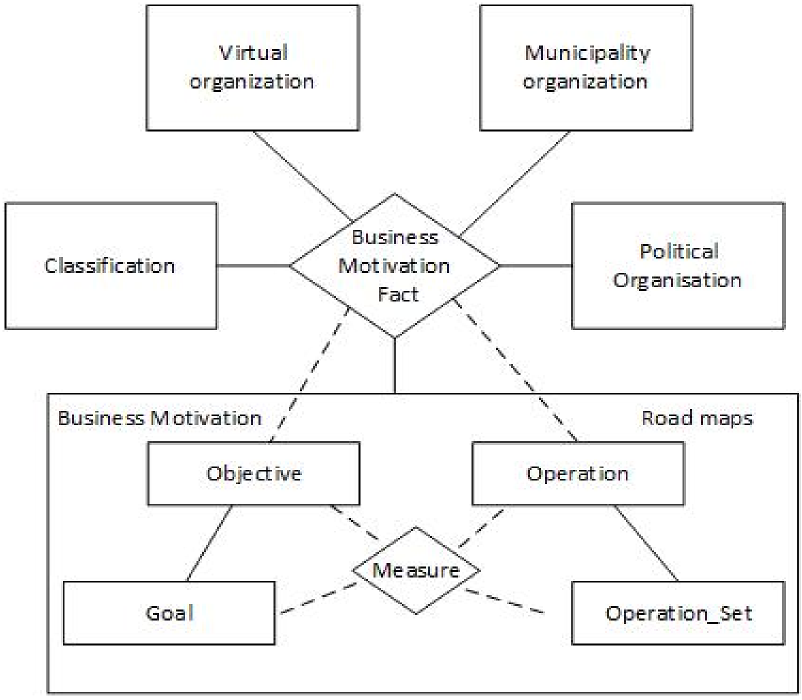

FIGURE 15 The ideal conceptual model of the strategy database (Article VII, p. 274).

The conceptual model in (Fig. 15) illustrates the management structures and frameworks dictating the management information needs concerning strategy information. Business motivation is presented as a fact table in a star model, where various municipal organization structures, management classifications and frameworks are signified as dimensions. There were basically three types of municipal organization structures. Political organization is the hierarchical structure of the city council and the boards under it. Municipality organization refers to factual organigram of the corporation and its service domains and processes. Virtual organization refers to various often continuous strategic development efforts or programmes of the town, typically governed by a virtual organization for each. Classification refers to any theoretical management frameworks in use, such as strategy viewpoints like the Balanced Scorecard (BSC) of (Kaplan and Norton, 1996), or the EA viewpoints such as (The Open Group, 2011). Sub-strategies have typically their own classification for the business motivations. Also CxO's had their special classifications for the objectives related to their expertise. Classification could be hierarchical containing sub-classes. Other details or entities (like Date, Time) have been omitted.

A.5 Kouvola Geagam: inter-dependencies of the GEA descriptions of the city

In Article VI we promised to further publish the suggested dependencies among the local government descriptions. They are presented in Fig 16. We have followed here the research setting and methodological steps as described in article VI. The picture was constructed along the article VI, i.e., the Kouvola Geagam beta version. It was supposed to be included in the article, but was omitted because of space limitations. Many of the enlisted EA descriptions (Fig. 16) are based on the earlier version of (FINEA 2017) as it was in 2010 during the time of the research workshops.

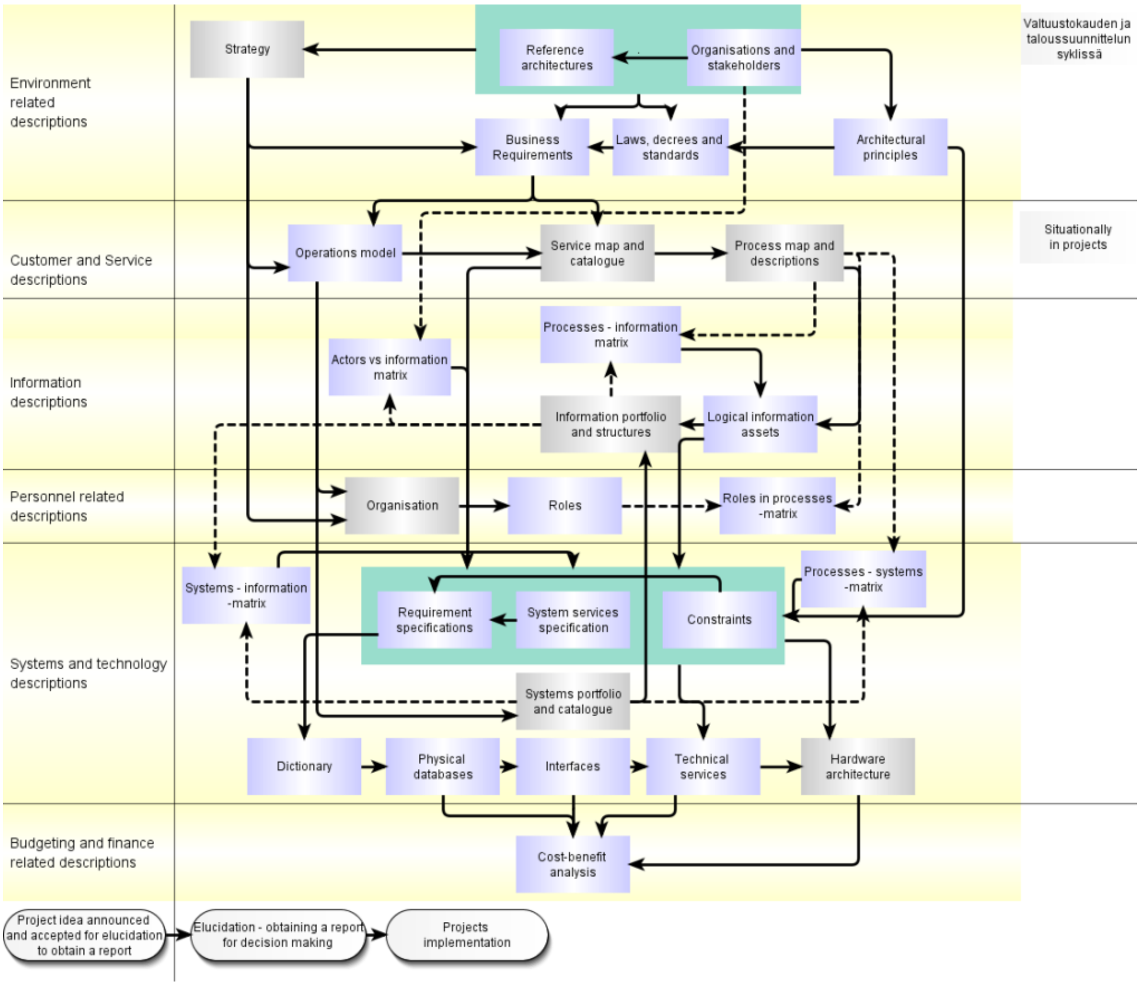

FIGURE 16 Kouvola Geagam beta-version: previously unpublished part of the research group work for article VI.

A.6 Ratsu Information System's Physical Database Scheme

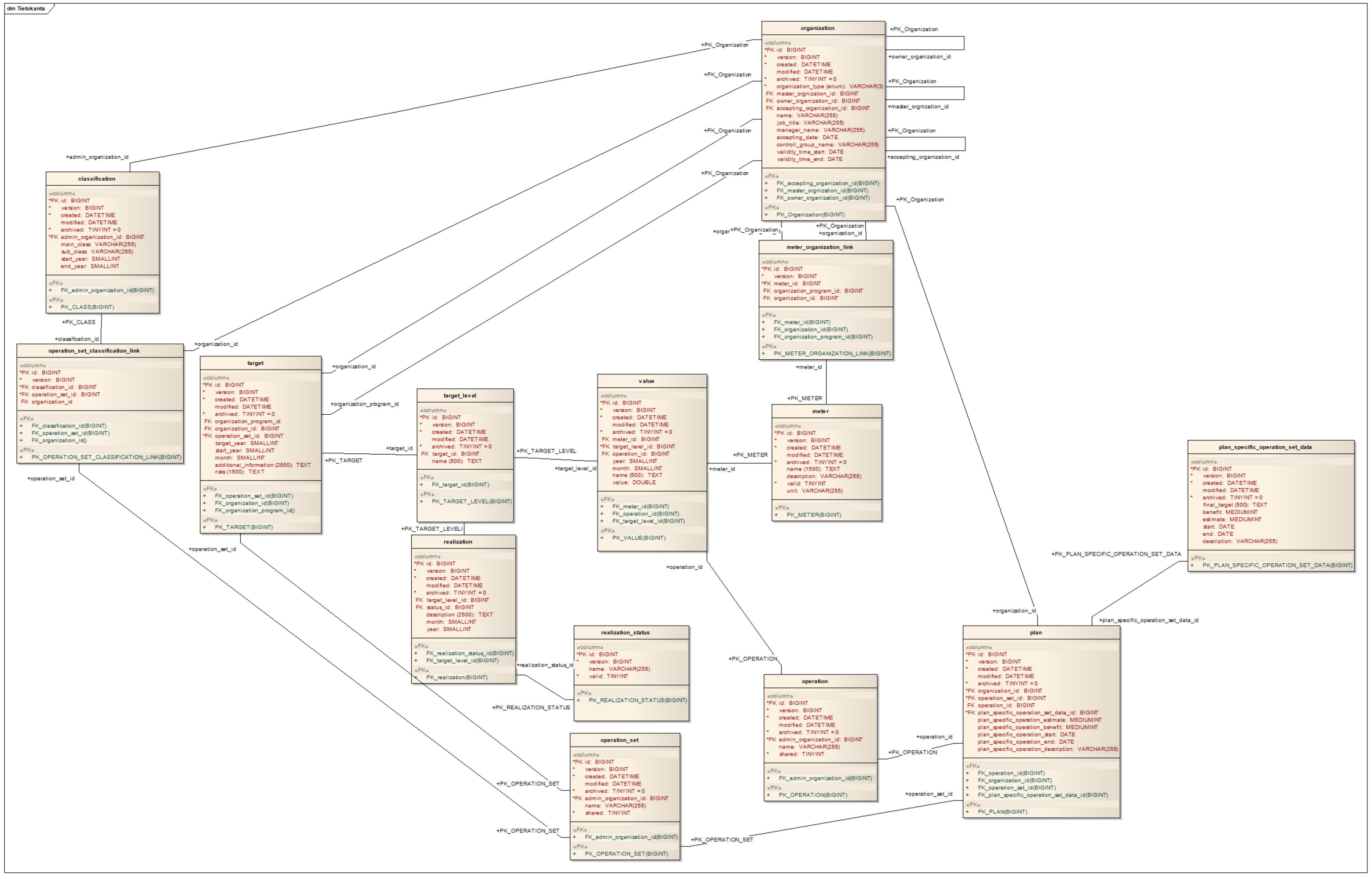

FIGURE 17 Strategy database instantiation in 2012 was a normalized physical database (City of Kouvola, 2014).

A.7 The scope and purpose of EA methodologies

TABLE 5 EA methodologies' scope and purpose

Scope	**Purpose**
IT management areas - organization wide	Business – IT alignment for IT mediated business
socio-technical system - organization wide	Coherency of the parts of the organization, agility, assurance, and alignment
socio-technical system - organization wide - and environment and surroundings	Adaptive and learning organization, co –evolution with customers or other environmental factors
socio-technical system - relevant organizational areas negotiated with the business partners	Interoperability at any level, e.g., a common inter-organizational process
business /government ecosystem as a set of organizations - organization wide for all members in ecosystem	Transparency, traceability, sharing of knowledge, data mining, follow-up, current state analyses

YHTEENVETO (SUMMARY IN FINNISH)

Länsimaiden julkishallintoa on uudistettu ja tehostettu rakenteellisin muutoksin, mm. otettu käyttöön yksityisen sektorin johtamismenetelmiä. Tulosten saavuttaminen ei ole ollut suoraviivaista. Julkinen hallinto koostuu erilaisista hallintojärjestelmistä, jotka ovat erilaisissa riippuvuussuhteissa toisiinsa. Nämä voivat kansallisia, alueellisia tai paikallisia. Julkishallinnon koherenssi (engl. *coherence*) tarkoittaa sen osien järjestäytynyttä ja loogista suhdetta kokonaisuudeksi. Rakenteelliset muutokset ovat jatkuneet kultajyvää löytämättä, myös palvelujen sähköistämisessä on ollut epäonnea. Muutoksia ei aina toteuta ja arvioida systemaattisesti. Zachmanin mukaan monimutkaista kokonaisuutta on mahdotonta muuttaa, ellei sen rakenneosista ja näiden suhteista ole nykytilan kuvauksia, joiden kautta voidaan tarkastella erilaisia näkymiä kokonaisuudesta. Kokonaisarkkitehtuuria on esitetty välineeksi julkishallinnon reformeihin, mm. koherenssin ja yhteentoimivuuden suunnitteluun ja hallintaan. *Kokonaisarkkitehtuuria* (KA) on käytetty yrityksen osien ja näiden suhteiden kuvaamiseen ja suunnitteluun. Kokonaisarkkitehtuurista tuotettu tietämys ei kuitenkaan ole yhtenäistä eikä se välttämättä sovellu sellaisenaan julkishallinnon ekosysteemisiin kokonaisuuksiin. Julkishallinto koostuu laajasta joukosta erilaisia organisaatioita, jotka voivat olla keskenään hierarkkisia, rinnakkaisia tai verkostoituneita. Julkishallinnon missio on kansalaisen hyvinvointi ja kansantalouden elinvoimaisuus. Sen ansaintalogiikka on erilainen kuin yksityissektorilla. Kokonaisarkkitehtuurin sovittamisesta ja soveltamisesta julkishallinnossa tarvitaan erillistä tarkastelua. Tutkimme tässä, miten KA-viitekehys olisi sovitettava julkishallinnossa laajemmin koherenssin hallintaa varten.

Tutkimus muodostuu kahdesta peräkkäisestä tapaustutkimuksesta: 1. valtakunnallinen KA-menetelmän kehittämishanke, sekä 2. Kouvola-konsernin KA-kehittäminen. Ensimmäisessä syntyi esitys Suomen julkishallinnon KA-viitekehyksen sovittamismallista, jota käytettiin lähtökohtana Kouvolan kaupungin toimintasuunnittelututkimuksessa. Siellä mallia sovellettiin ja iteroitiin abduktiivisen päättelyketjun mukaan. Tutkimustulosten syklinen tarkentaminen ja arviointi perustuvat strategia-arkkitehtuurin kehittämiseen Kouvolassa vuosina 2008-2014. KA-viitekehystä tulisi tutkimuksen nojalla kehittää käsitteellisesti ja käytännöllisesti siten, että nykytilaa koskevat KA-tieto ja -kuvaukset jäsennetään myös toimintaa kulloinkin ohjaavien hallintorakenteiden mukaan. Tällöin KA-viitekehys nykytilatiedolle voi olla reaaliaikaisesti päivittyvä tietomalli ekosysteemistä ja voi palvella julkishallinto-ekosysteemin nykytila-analyysejä aiempaa laajemmin. Tämä saattaa edellyttää julkishallinnon yhteistä kontekstuaalista ontologiaa. Käytännössä tämä edellyttää yhteistä tietojärjestelmää ja mahdollista tekoälyä tämän tueksi. Abduktiivisen päättelyn luonteen mukaan emme esitä tässä lopullisia totuuksia. Tuloksten validointi edellyttää niiden testaamista muissa käytössä olleen aineiston kaltaisissa tapauksissa ja sekä laajempaa jatkotutkimusta muissa käyttötapausaineistoissa.

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ORIGINAL PAPERS

I

SELECTION CRITERIA FOR ENTERPRISE ARCHITECTURE METHODS

by

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Selection Criteria for Enterprise Architecture Methods

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This study proposes key selection criteria for enterprise architecture methods based on a case study of the Finnish National Enterprise Architecture (NEA). Enterprise Architecture (EA) planning is increasingly important as ICT is today a strategic business enabler. Enterprise Architecture is a managerial tool to align ICT with business development and a communication tool to ensure commitment and to prepare for organizational change. A multitude of EA methods have been proposed and some of them have also been adopted in practice. However, no market leaders or standard EA methods have emerged. The approaches of different EA methods vary, and their support for EA planning varies accordingly. Therefore, the EA method selection has substantial consequences for the organization. Evaluating and selecting the best suitable method is the highly important first step in EA planning initiatives. This case study collects evidence from a large EA method development project within a government ICT management program for the entire organization of the Finnish Government. The conducted requirements analysis for the EA method in this project as well as previous studies in EA and method development indicate that the most important criteria for EA method selection are related to the fundamental role of EA as a communication tool. Complexity and abstraction level of an EA method should strongly correlate with the EA experience of the future EA method users. We assume that these key requirements are common to most organizations, because they are related to the main purpose of the EA method and framework: communication. This study is based only on one, but a large organization with several units representing different domains. In some requirement areas, different organizations likely have divergent requirements. An important future research goal is to construct a general-purpose set of criteria for EA method selection and its validation in various business fields.

Keywords: Enterprise Architecture, Method, Method Selection, Evaluation, e-Government

1. Introduction

With the “information society” or “knowledge economy” targets, the public sector information management is under several pressures. Provisioning of services between administrations, or to citizens, businesses and other institutions, is expected to be as efficient as the commercial offerings. However, the administration budgets are tight and also other resources for the ICT development are limited. Meanwhile, access to digital data networks is being diffused and the readiness to use digitalized services is steadily growing. There are also significant savings to achieve when setting up services accessible over data networks. In several countries, there are programs to develop and support the use of information and communication technologies (ICT) for the benefit of the society and all its functions. Indeed, ICT today has a great potential to improve and enhance various public services. Dealing with civil service departments over data networks can save costs on both service providing and service consuming sides. Further, e.g. in health care or services to the ageing, significant cost savings and improvement in the quality of the services would be possible. However, all this requires careful planning of the information systems, infrastructures and their management in the administration at all levels.

The EU is pursuing the benefits of ICT and collaboration over computer networks in administration with the IDABC –programme (Interoperable Delivery of European eGovernment Services to public Administrations, Businesses and Citizens, http://ec.europa.eu/idabc/). This requires from the national governments work at the national level to provide interfaces for this international collaboration. Both at the national, and the international level, the information management needs to address the interoperability of systems. The potential benefits can be achieved only with integrated information systems, well organized master data storages and harmonized data in the administration databases. For all this, the management of the ICT, meaning both systems applications and the technological infrastructure requires a coherent approach.

To start with, the information regarding the systems and the data in administration has to be consistently presented and made available for the planning of the development steps, e.g. regarding integration or providing of open interfaces. Legal issues and let alone information security requirements assume transparency in the systems and infrastructures. Enterprise architecture (EA) has been established as a comprehensive "magna charta" for the challenges of the comprehensive management of all ICT in use in an organization. The EA was introduced in the US Federal Government after the enactment of the so called Clinger-Cohen Act in 1996 that requires among other things that the information technology architectures and the information in public administration databases are made transparent and manageable.

This paper discusses an effort in the Finnish state government to develop a method for the EA planning. An ICT strategy outline for the State, government has been issued and as a part of it, to meet the EU requirements, an interoperability program has been launched. Enterprise architecture is one focus area, aiming at a consistent EA definition, management, planning and development approach for the government. As one of the first set of projects in the program, an EA planning method development project took place from November 2006 to April 2007. The project was conducted by TietoEnator, the leading Nordic ICT services provider.

The EA planning methodology is developed in a collaborative effort, involving the participation of representatives from the stakeholder groups that will be using the methodology. This follows the principles of the so-called people oriented methodologies (Avison and Fitzgerald 2003:449). Action Research (AR, Baskerville and Wood-Harper 1996) is used as the approach both to the methodology construction (Jayaratna 1994) and the research (Kawalek and Jayaratna 2003). This paper reports the first phases in the AR cycle, where the action, i.e. the implementation of an EA methodology is planned. Prior to this, the EA approach has been chosen as the state government information management model. For this, the EA method selection is the next step reported in this paper. The study results besides to an adapted EA methodology for the case organization, also to general criteria for method selection applicable to other similar organizations adopting EA approach, or consultants and IM functions considering different EA methodologies. The criteria are rather general and guide to adapting the method to the user organization. The criteria find support in the information systems science literature focusing on method selection. In the following AR cycle phases, the method is implemented, the implementation results are evaluated and reported, which leads to the next AR cycle with new problem definition.

The structure of the paper is as follows:
Section 1 introduces the study area and scope
Section 2 discusses literature background
Section 3 presents method development approaches
Section 4 describes the research approach and collected data
Section 5 analyses the results of the study
Section 6 summarises the main points

2. ICT architectures

ICT today is a fundamental enabler of organizational processes and novel or enhanced services. Few administration services are provided today without any computerized system being used, and the systems in use may have the potential to give direct access to the services by those consuming them.

ICT and organizational activities are so tightly intertwined that any desired development in one necessarily leads to the need to revise the other. The EA planning can be seen as a collaborative effort where the organization, the organizational processes and structures are revised together with the possibilities that ICT offers today to reorganize and cut costs. The services provided by the organization can be redesigned and rationalized. To achieve sustainable new structures and organization, this planning effort needs to be undertaken collaboratively by the ICT professionals - often consultants are hired, but also the own information management function needs to be tightly involved – and the operations experts and office managers in the administration domains. This sets specific requirements to the methods used in the planning since several interest groups with different backgrounds are involved.

In the next section, EA concepts are presented and methodic approaches are discussed for the purpose of organizational development together with the supporting ICT.

2.1. Enterprise Architecture and related concepts

Enterprise Architecture (EA) planning is the effort to plan and design development steps to be undertaken in the information and communication technology support for the activities of an enterprise. The EA planning presumes that the information systems and the infrastructure currently in use are described as the current state of the EA. From this starting point, development steps can be planned and further realized in development projects.

The *enterprise* means in this context a company or a public sector organization, technically taking "a group of people organized for a particular purpose to produce a product or provide a service" (O'Rourke et al., 2003). To this should be added the economic accountability of the organizational unit. The significant meaning of *architecture* is to provide an overall view to the structure of a complex entity for the purpose to plan, manage and control it (Rechtin 1992). According to a standard, architecture means "the fundamental organization of a system, embodied in its components, their relationships to each other and the environment, and the principles governing its design and evolution." (IEEE 1471-2000). In this case the main components are the organization of the business, the information, and the systems in use to process the information, and the technologies deployed for the infrastructure and the applications.

Since there are several views to the EA, and the planning and management is necessarily a collaborative effort, a core issue is to define a common framework of reference that enables the communication on the EA and related issues. A framework is “a static model, through which the meaning of a range of interrelated concepts, their interdependencies and hierarchies can be conveyed” (Jayaratna, 1994). Several reviews of frameworks have been presented (Whitman et al. 2001, Schekkerman 2003, Arbab & al.) but they alone do not give advice as to which one would be suited for an organization

The EA work is tightly related to organizational development that is enhanced by collective reflection and organizational learning (Argyris and Schon 1978). An EA framework is a means of communication in the activities concerning the management and planning (Schekkerman 2006). Frameworks are used firstly, for the purpose of categorization, and secondly to communicate the content of individual concepts and issues. Thus there are two types of EA frameworks. Firstly, there are conceptual frameworks that only establish the categories and serve as an outline, leaving the detailed interpretation to those deploying the framework. Secondly, there are frameworks richly populated with definitions, descriptions, guidelines, principles, models, examples and best practices.

Of the first type, the Zachman Framework of Enterprise Architecture (Zachman 1987, Sowa and Zachman 1992) is the most prominent one. There are different versions as to with what kind of EA descriptions this matrix should be populated. A multitude of commercial EA frameworks follows this principle. Based on a review of the Zachman Framework and several other frameworks or models of this type, a common core of four viewpoints and three abstraction levels have been established as the EA Grid (Hirvonen and Pulkkinen 2004).

The Open Group Architecture Framework (TOGAF, The Open Group 2003) is an attempt to standardize the second type of frameworks. It is largely based on the EA work undertaken in the government of the United States, but also other EA efforts have been incorporated to this comprehensive EA knowledge base. At the heart of the often domain specific, “rich” type of frameworks, there is also a basic set of views. The four architectures, business, information, applications and technologies are the major architectural views that can be found in the second type of frameworks. Besides, these frameworks often outline the process for EA management. The architecture development method, ADM is the EA process description in TOGAF. Several other processes have been suggested for EA work (Pulkkinen and

Hirvonen 2005) that provide methodic support for EA work. Methodology questions for EA need some specific attention.

A *methodology*, (or method, the terms are often used interchangeably, cf. Olle et al. 1988; although Avison and Fitzgerald propose different interpretations 2003) is in the context of information systems development (ISD), a process with defined inputs, outputs or deliverables. The methodology guides the breaking down of the overall task to stages, subtasks and suggests roles and management policies for the tasks and the overall effort (Avison and Fitzgerald 2003:528).The information systems development methods consist of two major components: the deliverables and the process (Koskinen 2000). The Unified Modelling Language (UML) is an example par excellence of a consistent collection of deliverables. The related Unified Process (UP, or as a version of a software development tool vendor, the Rational Unified Process RUP) is a well known example of a process model.

An overall framework is recognized as a possible component of ISD (Avison and Fitzgerald 2003:497). However, in practice the frameworks are in the background and method process is the frame followed in the development process. However, because of the variety of viewpoints and various stakeholder groups, a framework is an essential element and a starting point for EA methodology development. The framework ties together the EA deliverables that represent different architectural viewpoints for various stakeholder groups at different abstraction levels. Therefore the methodology development starts out with the selection and adaptation of a framework to serve as a common framework of reference in the EA work. EA methodology development strongly relies on the tradition on information systems development methods, although these as such are not applicable as EA methods. However, EA method developers can utilize the ISD process models and related findings.

2.2. Method evaluation

As far as we know, the EA literature provides neither criteria for EA method evaluation nor steps for EA method selection. There do exist some lists of criteria for EA development tool selection (e.g. Schekkerman 2007) and EA element selection in the EA development (e.g. Agilense 2007), but these are only partly applicable in EA method selection. Hence, the criteria constructed in the study and the steps performed for the EA method selection are reflected with research in other fields. Method evaluation and selection has been an important research issue since 1980's in the ISD and ME fields (see reviews, e.g. Aydin 2006, Leppänen 2005). The ISD literature suggests a broad array of criteria for the evaluation of methods or parts thereof (e.g. Blum 1994, Bielkowitch 2002, Moody 2003a, Moody 2003b, Gemino & Wand 2004).

Method selection typically begins with the characterization of the context and its contingent factors and ends with making a decision on appropriate and applicable method(s). More specifically, the steps are: (1) characterize the evaluation context at hand, (2) search for potential methods, and (3) carry out the evaluation (e.g. Jayaratna 1994, Offenbeek & Koopman 1996, Leppänen 2005). The first step means analyzing the goals, target and constraints of the evaluation, deciding which features are important to the evaluation, and specifying evaluation criteria. It is possible to set weights or priorities to reflect the relative importance of each feature and the degree of support that is required for it (e.g., Law 1988).

3. Method development as organizational development

The people oriented methods and the organizational-oriented methods (Avison and Fitzgerald 2003:449ff.) with high end-user participation, often involving group activities, collective reflection as well as group decision making, take into account the need for simultaneous organizational development and the organizational issues involved. Such IS development methods are e.g. the Soft Systems Methodology (SSM, Checkland and Scholes 1990) and Soft Information Systems and Technologies Methodology (SISTeM, Atkinson 2000). Jayaratna (1994, 2003) illustrates well the collective reflection process and the forming of a shared understanding that is common to this type of methodologies. This supports also the deployment of a method and reduces the resistance as the method users are involved and learn to know the method in its creation already. The underlying assumption is organizational learning through collective reflection (Argyris and Schon 1978). The principles established in OL are utilized in the action research model (Baskerville and Wood-Harper 1996) that is recommended for efforts involving method development. This study follows the NIMSAD framework (Jayaratna 1994) for method evaluation that leads to the selection and adaptation of a method as organizational learning in and action research effort (Figure 1). The same model is well applicable since the AR serves also well as a research process model.

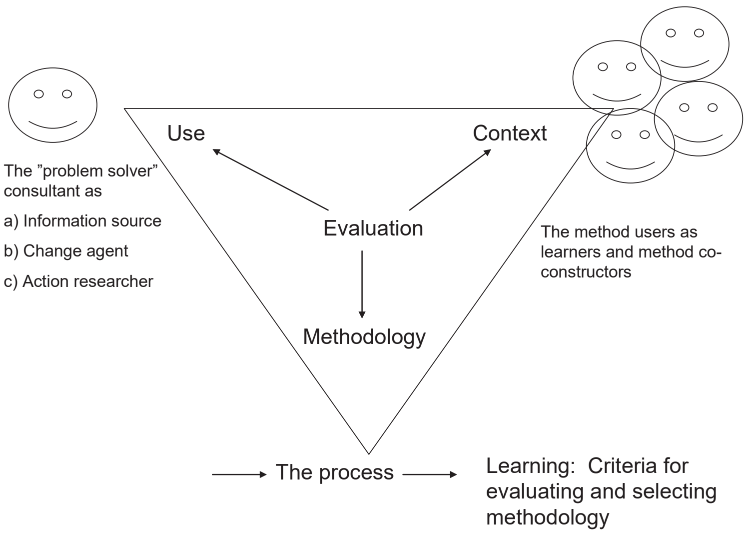

Figure 1: The method evaluation and selection process and the research process (adapted from Jayaratna 1994 and Kawalek and Jayaratna 2003).

Since the EA planning means combined organizational development and planning of ICT developents, the chosen approach seems to be the perfect fit. As the process is learned in the method selection and later method development and implementation steps, the same process model can be used in the later development efforts as the method process. The suggested “problem solver” (Jayaratna 1994) is in this case the consultant who is assigned with the method selection or development for the end-user organization. This role involves firstly, providing of information on what is required from an EA planning method in general, and on the existing frameworks and methodologies. Secondly, in this role the consultant is a change agent that triggers the organizational change process needed for the methodology adoption. Thirdly, in this role the consultant has the action researcher’s view to the process (Kawalek and Jayaratna 2003). As opposed to a technology driven style that sets emphasis on the expertise and skills of the ICT specialists, this model of method evaluation and selection empowers the method users. They introduce to the effort their deeper understanding of their organizational context and organization specific requirements of the method and have genuine influence in the process. This distinguishes such effort from process frameworks with high participation like SSM or Multiview 1 and 2 (Avison and Fitzgerald 2003:497ff.). The role division comes closer to the SODA (Strategic Options Development and Analysis, Avison and Fitzgerald 2003:510) framework that specifies the role of a “consultant” as a facilitator of the process carried by the organization members.In the other ISD approaches, the ICT specialists take the role of process owners, who can regulate participation of the end-users. This gives room to possible estranging of the method users from the process and the method itself. However, in this case not an IS development method is constructed but an EA methodology which has far broader range as it encompasses all ICT in use in the whole enterprise.

4. Research setting and collected data

This study is based on a case study of the Finnish National Enterprise Architecture (NEA). The project is one in a program currently run in the Finnish national government unit for the development of administration that is hosted by the Ministry of Finances based on the government decision about government ICT development and is one of the parallel spearhead projects developing different aspect of NEA. In addition with methodology project architecture project consisted of EA governance process development, current state analysis, integration architecture development and analysis of the Finnish central registries.

Table 1: The process of EA methodology selection (ValtITa 2007). After this phase the project continued with 12 planning workshops.

TASK	DATE	TOPIC	OUTCOME
Homework/consultants: study of methodology alternatives and requirement candidates. Homework/Government: answers to methodology requirement questionnaire	6th Nov-24th Nov 2006	Preparations, collation and analysis of information	Candidate frameworks, methodologies and requirements. Government organisations descriptions about the requirements
Workshop 1	24th Nov. 2006	Requirements analysis	Analysed frameworks and methodology requirements
Homework/Government: analysing methodology priorities Homework/Consultants: analysing alternatives based on requirements	24th Nov.-11th Dec. 2006	Requirements prioritization	Requirement priorities
Workshop 2	11th Dec. 2006	Framework and methodology selection	Project group proposal about the framework and methodology
Coordination group	9th Jan. 2007	Review of the framework and methodology analysis	Parallel projects perspective to framework and methodology analysis

The target of the methodology project was to analyse, select or construct an EA methodology, and to create the high level target state architecture description in the selected NEA areas. The methodology development started with the requirements and methodology analysis (table 1). In addition to project group, a generic questionnaire was sent also to whole government organisation to collect all relevant EA methodology requirements. Different methodology selection criteria were collected from the literature and the project group. Totally 41 requirements were identified. These were subject to workshop discussions about criteria priorities. Finally, the most important requirements were selected (see table 2). Based on the selected and prioritized criteria, EA methodologies were evaluated and selected. Thus this evaluation process used follows the common method evaluation process presented in 2.2. As mentioned before, there are numerous different EA methodologies with different development focus. One common feature and also differentiator in EA methodologies is the framework. An EA framework sets the scope and content of EA methodology. Therefore EA frameworks were selected as a key evaluation perspective.

In this project no clear match to the requirements was found. Instead, many methodologies partially support the requirements. Therefore TOGAF, which was one of the best fits with the derived selection criteria, was selected as a starting point for the EA methodology development. Some parts from other methodologies were chosen to supplement TOGAF. The first version of Finnish NEA methodology is now ready. This study focuses on EA methodology selection criteria and analyses the most important selection criteria found in the Finnish NEA project. The criteria are presented in Table 2 below.

The project group consisted of practitioners from different administrative branches in the Finnish government. For some project members EA was already familiar concept and for others it was new. Consultants brought in their previous experience from EA development and also previous studies on EA methodology development (Hirvonen 2005).

Researchers form University of Jyväskylä participated in the workshops. All the workshop discussions were recorded, written and later reviewed by the workshop participants.

Table 2: The most important EA methodology requirements selected by the project group (ValtITb 2007)

The framework should be extensive enough
The framework should contain technology, systems, information and business views
There should be a place for standards in the framework
The framework should support different decision making levels
The framework should be simple and easy to understand
The framework should support communication to different stakeholders
The framework should include development methodology
The framework should support continuous development and long term planning
The framework should support interoperability
The framework should be public

5. Analysis

The EA method requirements elicitated in this study are first discussed here in more detail to categorize and clarify their meaning, and secondly, to compare them with method evaluation and selection criteria in the ISD and ME fields. The classified criteria are presented in table 3.

Some of the requirements were directly related to government goals and values. Support for *interoperability* is necessary because of European targets to enable seamless information exchange between administrations. European Interoperability Framework guides this development (IDABC 2004). *Publicity* of government decisions is a common principle in Finland, and therefore EA framework and methodology should also support information transparency. This is also related to government procurement principles. Government organisations make EA related *decisions at many different levels* in organisations and therefore the EA framework should apply to all the levels. *Extensiveness* was essential for the Finnish NEA method due to the large variety of the future utilization in a number of organizations, user groups, EA development purposes and properties as well as variations in EA maturity levels.

General EA development related requirements are another group of requirements. *Support for all four EA views*, *need for a development methodology* integrated to the EA framework and *support for tactical and strategic development* are requirements in this group as well as the *management of standards*.

The third requirement group is related to the *understandability* of EA methodology. EA is a managerial tool which should *align selected issues* across the whole Finnish government. This is possible only if all individuals dealing with ICT and business decisions can understand common EA descriptions and common ways of planning. Therefore understandability is the first prerequisite in the EA development and also the most important requirement. If the other requirements are fulfilled but understandability requirement is not, the methodology adaptation will likely turn out not successful. I was previously mentioned that there are a lot of different EA frameworks for different purposes. Some of the frameworks are very concrete and others are abstract. Some of the frameworks are complex whereas others are simple. From the understandability perspective, it is more likely that concrete and simple frameworks are easier to understand compared to abstract and complex. Abstract and complex frameworks need more experienced users to be applied and understood. Further, there have been prior experiments of EA development in the Finnish government organizations, and competence varies from experienced to novice. Some organisations have not started any activities yet but some have already been running EA projects a few years. In general, most of the future users have no experience in EA development and therefore, understandability in this case is even more important. Hence, the most important EA framework and methodology selection criteria are, expressed as more concrete requirements: high simplicity and concreteness.

To contribute to the IS methodology body of knowledge, out of the generic ISD method evaluation criteria applicable in the EA area or its subareas like BPR, the most comparable ones for EA method requirements were chosen here as comparison criteria. These are presented in the second column of the table 3. Across the two domains to be compared, the notion of the system may differ. In other words, there is a shift to be done when ISD conceptions are interpreted for the EA area, for example when considering the notion of "system". In ISD, the system most typically refers to an information system (IS) when in EA, system refers to the enterprise as a system of organizational actors, organizations, client groups, stakeholders, their interoperable structures and combinations of such entities. Having this in mind, there can be seen strong and weak connections across the domains.

Strong connection means here the possibility to further redefine and construct justified and generalized EA method selection criteria by upgrading and using the ISD criteria as reference as well. Most comparison criteria in the table 3 can thus be seen forming strong connection between the two areas: *Integration* (Moody 2003b) in original paper means consistency of data model with the rest of the organization data. Different aspects of extensiveness can be seen in such ISD criteria as comprehensiveness, support for different design phases and completeness. *Comprehensiveness* (Blum 1994) presumes no discontinuities in the formal reasoning chain. *Support for early design phases* (Blum 1994) brings along the time aspect of the development and its phases. *Completeness* (Moody 2003b, Gemino & Wand 2004) refers to adequacy of information required to support the required functionality of system. *Support for various IS viewpoints* includes viewpoints of information, process, and interaction operations (Bielkowitch et al 2002). *Simplicity* as the number of entities in the models (Bielkowitch et al 2002, Moody 2003b), *understandability* (Moody 2003b) as ease with which the concepts and structures can be understood, *effectiveness* as quality of models (Moody 2003a) or, as a means of clear communication of the application domain among stakeholders (Blum 1994, Gemino & Wand 2004), *ease of use*, *ease of learning* as well as *comprehension* (Gemino and Wand 2004) can be directly comparable to the EA method evaluation criteria of understandability. The further redefinement, upgrading and construction of general EA method selection criteria, however, are not in the scope of this paper. Weak connections were seen between *implementability* of ISD method (Moody 2003b) and methodical support for EA method, as well as between *flexibility* of ISD method (Moody 2003b) in organizational changes and support of EA method for continuous development and long term planning.

Table 3. Analyzed EA method selection criteria and their comparison with ISD method selection criteria.

Criteria related to government goals and values	
The framework should support interoperability	*Integration* (Moody 2003b)
The framework should be public	--
The framework should support different decision making levels	*Levels of detail* (Gemino & Wand 2004)

The framework should be extensive enough	*Comprehensiveness* (Blum 1994) *Support for early design phases* (Blum 1994) *Completeness* (Moody 2003b, Gemino & Wand 2004)
Criteria related to EA development	
The framework should contain technology, systems, information and business views	*Support for various IS viewpoints* (Bielkowitz et al 2002)
The framework should include development methodology	*Implementability* (Moody 2003b)
The framework should support continuous development and long term planning	*Flexibility* (Moody 2003b)
There should be a place for standards in the framework	--
Understandability	
The framework should be simple and easy to understand	*Simplicity* (Bielkowitz et al 2002, Moody 2003b) *Understandability* (Moody 2003b)
The framework should support communication to different stakeholders	*Effectiveness* (by Blum 1994) *Ease of use*, and *ease of learning* (Gemino & Wand 2004). *Comprehension* (Gemino & Wand 2004)

6. Conclusions

Since the EA planning means intertwined planning of organizational structures and activities and the supporting and enabling ICT systems and infrastructures, a major requirement for a successful EA method is the collaboration aspect. In the case presented, the method was introduced and developed in a collaborative effort. The alternative would have been that the consultant analyzes the organization, compares available methods and selects and adjusts it using criteria known to him/her. The resulting method would appear as new and strange to the organization, which would likely lead to resistance. The effort, however, was following the action research principles tested in previous research efforts for both information systems methodologies (as the soft systems methodology) and EA method creation. The NEA planning method development project was involving a group of people from the method deploying organizations that was as representative as possible. The chosen method elements are based on collective reflection and decisions. The participants have had the possibility to learn and to build their own mental constructs along the way. Thus, the project results will appear familiar as the method is rolled out to be used in the organization.

A multitude of EA methodologies and the increasing importance on EA development makes the EA methodology selection and development process a critical success factor in organisational ICT development. This study concentrated on the first phase of the methodology construction, where existing methodologies are studied and choices made as to what approach to adopt Methodologies and requirements were analysed in the project, but no direct match was found. In this case most of the becoming users have no experience in EA development and therefore understandability (e.g. requirement to have simple and concrete methodology) was identified as the most important one. TOGAF was selected as a starting point for methodology development. Later phases of the effort will include method deployment and evaluation in practice. Follow-up studies will establish the robustness of the selection phase.

In the evaluation of EA methods the most essential method component to be evaluated seems to be the EA framework. This is not typical in ISD method evaluation, since there the most typically evaluated methods components are models, such as conceptual models, process models, organizational and business models etc. The EA framework constitutes the common framework of reference for the stakeholder groups dealing with EA issues, and is therefore of great importance.

The criteria found for the EA framework selection may be found useful by organizations developing their EA methodology, and for consultants working with EA methods in different types of organizations. Correspondence between EA method evaluation criteria and ISD method evaluation criteria, both strong and weak ones, were found. The constructed EA method selection criteria and the comparison of them against ISD criteria offers good starting points for further refinement and research of the EA methodology evaluation. As the focus of application in traditional ISD method development is enlargening more and more towards modelling the whole organisation (Aydin 2006), introducing this knowledge in the context of EA planning and development seems natural continuation and certainly opens new research questions considering knowledge transfer and fit to the emergent area of EA.

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II

TOWARDS A CONTINGENCY FRAMEWORK FOR ENGINEERING AN ENTERPRISE ARCHITECTURE PLANNING METHOD

by

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Towards a Contingency Framework for Engineering an Enterprise Architecture Planning Method

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Abstract. Enterprise architecture (EA) has a key role in managing and relating business strategies and processes, information systems, and IC technologies. EA planning devises an EA plan with development steps to make necessary enhancements to the current state of the affairs in EA. Accomplishing EA planning in a systematic and efficient manner requires the availability of frameworks and methods suitable to the situation at hand. The selection and adaptation of these methodical artifacts for the use of EA planning is often quite challenging in practice. We argue that the contingency approach can help in these activities of method engineering (ME), and present a contingency framework (named here EACon, EA Contingencies) for engineering an EA planning method. The framework is composed of three layers: the topmost layer pertains to a method engineering context, the next lower layer corresponds to an EA planning context, and the lowest layer stands for an EA development context. Due to the largeness of the framework, this paper focuses on the topmost layer. The contingency framework has been derived from ISD contingency factors, conceptualizations of the ME domain, EA critical success factors, and experience obtained from a large national project of engineering an EA planning method for state administration.

Keywords. Contingency Framework, Enterprise Architecture (EA), EA Planning, EA Development, Method Engineering, EA Method Engineering.

Introduction

In the past few years enterprise architecture has become an increasingly important means to cope with the complexity faced in managing business strategies and processes, information processing and IC technologies. *Enterprise architecture* (EA) is seen as a collection of artifacts that define and describe the structure and processes of an enterprise (a private company or public organization), the information being stored, processed and communicated in this enterprise, the systems used for these activities, and the technologies and infrastructure that the systems are implemented with. These descriptions can take various forms, such as models, figures, tables, matrices and textual representations. *Enterprise architecture planning* stands for the activities that aim at improving the current state, in other words devising development steps to make enhancements to the present ICT infrastructure, systems, information management and also the organizational processes and structures. This emphasizes the simultaneous development of the business and organizational activities, on one hand, and the ICT systems and architectures, on the other hand (Applegate 1994). *EA development* means the realization of an EA plan, or part thereof, in some organizational unit(s). EA development is an effort limited in scope and time, typically conducted as projects either by the end-user organization IT function or by an ICT provider (Pulkkinen and Hirvonen 2005b).

Several frameworks, models and methods have been suggested for the EA planning and development (e.g. see reviews e.g. Whitman et al. 2001, Schekkerman 2003, Pulkkinen and Hirvonen 2005a). The Open Group Architecture Framework, TOGAF, version 8, “Enterprise Edition” together with the Architecture Development Method (ADM) collects the best practices from a large number of efforts, among the most influential ones being the US Federal Government Enterprise Architecture Framework (FEAF) and domain specific frameworks that were created for different government sectors (The Open Group 2003). Situations in EA planning differ greatly from one another, implying that there is a need to carefully consider which kinds of strategies, approaches, frameworks and methods should be applied in each of them. The EA field is evolving rapidly, and hence new methodical artifacts and new variants of the existing ones are needed. Due to the novelty of the EA field, engineering these methodical artifacts is quite challenging. To support the selection, construction and customization of methodical artifacts for EA planning, some kind of contingency framework would be of great help. There are some lists of success factors for EA planning (e.g., Ylimäki 2006), but, as far as we know, no contingency frameworks are available.

Method engineering (ME) means all kinds of actions by which a new method, or an improved method, is developed, customized and configured to fit the needs of a domain, an organization or a project (Leppänen 2005). The ME literature suggests a number of strategies, meta models, techniques and procedures to support this engineering work (e.g. Kumar et al. 1992, Harmsen 1997, Tolvanen 1998, Ralyte et al. 2003, Kelly et al. 1996, Leppänen 2005). Although these artifacts have been originally crafted for the use of engineering information systems development (ISD) methods, they are, to some extent, applicable to EA method engineering as well. Contingency frameworks have been commonly deployed in ISD (e.g. van Slooten et al. 1996, van Offenbeek et al. 1996, Kettinger et al. 1997, Hardgrave et al. 1999, Backlund 2002), but no frameworks are available for ME, and even less for EA ME.

This paper suggests a contingency framework, called the EACon framework, for engineering an EA planning method. This framework is composed of three layers: the topmost layer pertains to a method engineering context, the next lower layer corresponds to an EA planning context, and the lowest layer stands for an EA development context. Due to the largeness and complexity of the framework, this paper focuses on the topmost layer. The construction of the contingency framework has followed three strategies. First, based on a certain kind of analogy between EA planning and ISD, we have derived contingency factors from those suggested in ME and ISD literature. Second, we have utilized the literature on critical success factors of EA planning (e.g. Ylimäki 2006) to find out which of aspects in EA planning are crucial. Third, we have exploited our experience from a large national project of engineering an EA planning method for state administration.

The remainder of the paper is organized as follows. First, we shortly discuss EA, method engineering and contingency approach. Second, we describe the research framework and process. Third, we present contingency factors of the topmost layer for EA planning method engineering. The paper ends with the summary and conclusions.

Basic Concepts

Enterprise Architecture and its Planning

Enterprise architecture involves both enterprise management through the management of its ICT support, and the development and maintenance of the information systems in use in the enterprise. *Enterprise* (The Open Group 2003) means an organized group of people working towards a common goal such as production of products or services, and may mean either a commercial or public organization. *Architecture* (O'Rourke et al. 2003) is commonly understood as the description of a structure, its parts and their interdependencies. The dual reference to the enterprise and its information systems is captured in the definition:

> "Enterprise architecture (EA) identifies the main components of the organization, its information systems, the ways in which these components work together in order to achieve defined business objectives, and the way in which the information systems support the business processes of the organization. The components include staff, business processes, technology, information, financial and other resources, etc. Enterprise architecting is the set of processes, tools, and structures necessary to implement an enterprise-wide coherent and consistent IT architecture for supporting the enterprise's business operations. It takes a holistic view of the enterprise's IT resources rather than an application-by-application view." (Kaisler et al., 2005).

Comprehensive architectures can be described only taking different viewpoints (Zachman 1987) that enable the consideration of an aspect in detail by excluding other aspects. All viewpoints together constitute the architecture. The enterprise architecture viewpoints that are generally chosen for EA methods are business, information, systems and technology (NIST/Fong and Goldfine 1989, Armour et al. 1999, Hasselbring 2000, The Open Group 2003, Perks and Beveridge 2003). These viewpoints are also found in several commercial EA methods (e.g. META Group 2002), and usually they are called Business Architecture (BA), Information Architecture (IA), Systems or Applications Architecture (SA) and Technology Architecture (TA).

Business architecture means the descriptions of the organization of the business: the business processes, structures and services. *Information architecture* depicts the information model and flows of information within the enterprise at a high abstraction level. To detect business potential of information, sometimes the concept of information value chain is used. *Systems architecture* stands for the portfolio of applications in use in an enterprise and the interconnections between the applications. These can be concretized in information systems architecture diagrams or integration architecture descriptions. *Technology architecture* consists of technologies including software, hardware and data communication connections..

The set of four architectural viewpoints meets both the needs of EA management, and the planning and development projects targeting the modification or enhancement of the current EA structures. EA planning has its roots in the concept of information systems planning (Olle et al. 1988) meaning a phase of comprehensive planning of the enterprise systems prior to a development project of a system. With today’s integrated and interdependent information processing infrastructures, an architectural approach is needed instead of considering isolated systems and their development schedules. From early on, the idea of different abstraction levels was found necessary in EA planning (Zachman 1987). Based on studies of practical EA work, three levels were found necessary in EA planning cases for different decision making levels in the enterprise (Hirvonen and Pulkkinen 2004, Pulkkinen and Hirvonen 2005a). The business decisions and the overall information management decisions come from the top managerial level and the strategy process concerning the whole enterprise, thus called the enterprise level. However, for more concrete practical planning, considering different domains within the enterprise is undertaken at the domain level. Since the EA development in practice can only be done incrementally, the enterprise is divided for planning and development purposes into domains with closely related information processing needs. A business unit can be a domain, or a cross-organizational business process (The Open Group 2003). Whereas at the *enterprise level*, EA principles and guidelines are outlined for the whole enterprise, at the *domain level*, practicable plans are made in the forms of business process definitions, information models, divisions into information storages, information systems deployment plans to technology infrastructures, integration architectures etc. At the third and most concrete level, the *systems level*, the plans are translated to systems design descriptions and further refined with systems development guidelines (Hirvonen and Pulkkinen 2004).

An example illustrates the treatment of a viewpoint, business architecture: at the enterprise level, the core business processes and the support processes are outlined as a coarse grained chart. The domain level description defines each process at the level of the business operations. The systems level description of a process guides the development of a supporting system for this process. The business architecture view at systems level means the business requirements for the systems to be developed. In one enterprise, the enterprise level architecture descriptions are binding for the whole enterprise. There are parallel domains, and the enterprise level EA work means also the coordination of the possibly concurrent planning and development efforts in different domains. Similarly, the systems level EA work means coordinating the development efforts with any system in the enterprise (Pulkkinen 2006).

A large number of frameworks, models, methods and processes have been suggested for the EA related work (Pulkkinen and Hirvonen 2005a). The earlier frameworks are consistent with the so-called waterfall model of information systems development, where the business needs come first, the logical structures are planned then and only at the final phases, the technological implementation takes shape. However, today the activities of any organization are to such an extent dependent on information systems, that the enabling IC technologies as well as the systems currently in use have to be considered already in the initial planning phases and together with the strategic business development plans. Thus, the *EA planning* is a demanding collaborative effort where the current state of the EA (i.e. the comprehensive ICT systems and infrastructure) and the business development visions are considered together. Among other business environment factors, the new technologies as possible business enablers are taken into account. For the domain and the systems level, the planning means materializing the strategic enterprise level decisions with concrete, practicable business and systems development plans. Often alternative plans are made, and planning projects deliver also evaluations of e.g. applicability and cost of different solutions and technologies, the business implications etc.

EA development may follow the planning effort, however, most commonly as a separate project after one of the alternative plans is chosen. In a development project, detailed architecture is designed for at least one domain, and preparations are made for system implementation or integration, meaning either launching a systems development project or an integration project.

Method Engineering

A *method* means generally a collection of approaches, beliefs, principles, models, techniques and procedures to carry out a development effort. It is some kind of carrier of collective knowledge and experience that are made 'visible' in order to enable its exploitation and advancement in forthcoming situations (Tolvanen 1998, Fitzgerald et al. 2002). Methods carry four kinds of knowledge (Leppänen 2005): knowledge of development process, knowledge of application domain, knowledge of IC technology, and knowledge of human and social issues. We can distinguish between four types of methods depending on how generic or specific is the knowledge on development they contain: generic methods, domain-specific methods, organization-specific methods, and project-specific methods. *Generic methods* provide general support for development endeavors in a wide range of contexts. *Domain-specific methods* offer more special support in particular domains. *Organization-specific* and *project-specific methods* provide customized support for a specific organization or project, correspondingly.

For software engineering (SE) and information systems development (ISD), a multitude of methods have been constructed since the 1960's. Recently, special methods have been engineered for particular domains such as BPR, ERP, CRM and EAP. Yet more methods are needed due to changes in business and its environment, application areas, and approaches and technologies of development environments. Constructing a new method is not a simple task. It comprises the elicitation and analysis of requirements for a new method, the evaluation of current method(s), and the design and implementation of a new method, as well as the assessment of the method under engineering in each of the stages. We use the term '*method engineering*' (ME) to stand for all those actions by which an ISD method is developed and later customized and configured to fit the needs of a domain, an organization or a project (Leppänen 2005).

We distinguish between three main strategies of ME: creation from scratch, integration and adaptation. *Creation from scratch* is applied when no existing methods is suitable. *Integration* implies that a new method is engineered through assembling parts, called method components (e.g. Gupta et al. 2001, Leppänen 2005) or method fragments (e.g. Brinkkemper et al. 1999, Ralyte et al. 2003), from other methods. *Adaptation* is deployed when some method is available for the customization for the needs of an organization or a project, by dropping off or modifying some parts of it, or extending it with new parts (Ralyte et al. 2003, Karlsson et al. 2004). ME approaches can be categorized, for instance, based on the degree to which practical and theoretical knowledge is applied (e.g. consultancy approach, method engineering approach and system development research in (Kaasboll & Smordahl 1996); deductive approach and inductive approach in (Fitzgerald et al. 2003)), or how urgently a new method is wanted into use (e.g. "typical" approach with pilot projects, "fast" approach with greater risks in Kruchten 2000).

The ME literature suggests a large variety of strategies and approaches (Kumar et al. 1992, Ralyte et al. 2003, Harmsen 1997), meta models (Heym et al. 1992, Kelly et al. 1996, Jarke et al. 1995), techniques (e.g. Kinnunen et al. 1996, Saeki 2003, Domingues et al. 2007) and procedures (e.g. Song 1997, Harmsen 1997, Tolvanen 1998, Leppänen 2005) for the engineering of ISD methods. Most of these suggestions are general-purpose and applicable to engineering methodical artifacts in other domains as well. Regardless of what strategy or approach is applied, the selection of ME artifacts and their customization are highly based on the recognition of and reasoning from essential features of the ME situation at hand, as well as the features of those contexts, called the target ISD contexts, for which a method is to be engineered. This is considered in more detail in the next section.

Contingency Approach

Contingency approach is based on the idea according to which there is no universal 'solution pattern' that would fit every problem situation. Instead, there is a need to select a pattern which has the best fit with the situation at hand. For this purpose, *contingency factors*, or situational factors, are used to characterize the situation and match them with the properties of the patterns. The contingency approach has been first applied in organizational design (e.g. Galbraith 1977, Pfeffer 1982, Kast et al. 1981, Drazin et al. 1985). In ISD, some of the first suggestions for contingency factors were presented by Naumann & Davis (1978), McFarlan (1981), Davies (1982), Iivari (1983) and Burns et al. (1985). Later, a large array of contingency frameworks (e.g. van Slooten et al. 1996, van Offenbeek et al. 1996, Kettinger et al. 1997, Fitzgerald et al. 1999, Hardgrave et al. 1999, Backlund 2002, Mirbel et al. 2006, Iivari et al. 2007) has been proposed to support the selection and construction of ISD approaches, models, techniques and methods. There are also different ways (e.g. Zhu 2002) and procedures (e.g. van Offenbeek et al. 1996) of applying the contingency approach. Regardless of some critics against the contingency approach (e.g. Lyytinen 1986, Avison et al. 1991, van Slooten et al. 1994, Avison 1996) it is widely applied in a number of fields.

The contingency factors in the ISD field are related to those aspects of an ISD project and its environment, which are seen important to making decisions on which kind of ISD approach is selected, which kinds of models are deployed, how the ISD process is structured, and how end users participate in the process. Typically factors include, for example, management commitment; size, and complexity of a project; availability, clarity and stability of goals; motivation, skills and experience of stakeholders, and business and technology innovativeness. We have constructed an integrative view of ISD contingency factors given in literature and present it in a structured form in Appendix 1. It goes beyond this paper to discuss them here.

The ME literature does not suggest any contingency frameworks for supporting decisions in method engineering. However, there are conceptual foundations with concept categories (e.g. Harmsen 1997, Leppänen 2005) and descriptions of ME projects in practice (e.g. Alderson et al. 1998, Fitzgerald et al. 2003, Karlsson et al. 2004) which can be used to elicit characterizing factors. In addition, based on the perceived analogy between ISD and ME (e.g. Olle et al. 1988, Kumar et al. 1992) we can derive ME contingency factors from those defined for ISD. Resulting from the latter, we can recognize generic contingency factors such as commitment of management, motivation, skills and experience of ME stakeholders, size and complexity of an ME effort etc. Of course, there are also factors that are specific to ME, such as level of generality and desired lifecycle of the method under engineering.

Research Framework and Process

This study aims to derive a preliminary set of contingency factors to be applied in the engineering of EA planning methods. These contingency factors refer to features of EA method engineering that have affects upon decisions on which kinds of ME approaches, ME principles, ME procedures and EA frameworks should be applied in a particular EA ME situation (shortly EA ME). In order to have a full support for these decisions, it is, naturally, necessary that ME artifacts are equally characterized with properties which can be matched with the contingency factors, and that there are empirical evidence on certain fits between the properties of ME artifacts and the contingency factors. The discussion of the properties of the ME artifacts and the 'fits' goes beyond this study.

Contingency factors can be derived in two manners, inductively and deductively. The former means that ME situations in practice are analyzed to find out which kinds of features of the situations are determinant in making decisions on approaches, principles, frameworks, and procedures. The latter implies that contingency factors are derived from existing literature. This literature covers proposed contingency frameworks, conceptual works and descriptive case studies. This study applies both of these manners, as shown in our design-theoretical research framework (cf. Hevner et al. 2004) in Figure 1. The contingency framework produced stands for a design artifact in the terminology of Hevner et al. (2002). It is composed of three layers. The topmost layer, shortly EAP ME, corresponds to a situation where a method for EA planning is engineered. The next lower layer (EAP) stands for a situation where an EA plan is produced. The lowest layer means the realization of an EA plan, or a part thereof. This study covers the topmost layer.

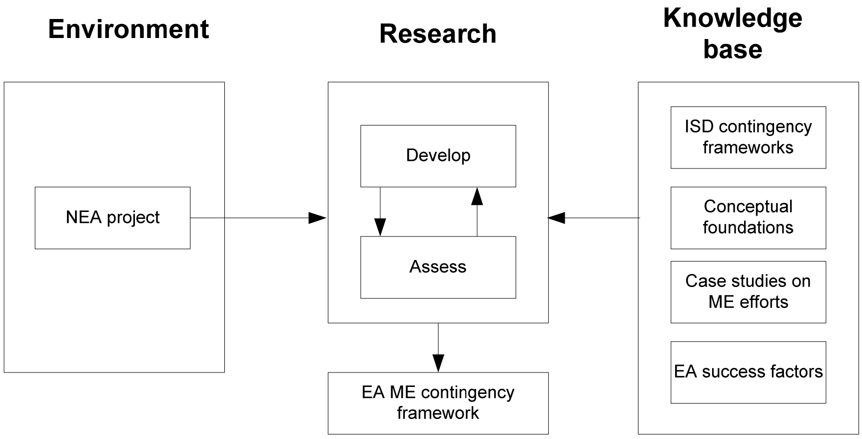

Figure 1. Research Framework

Knowledge base contains literature on ISD contingencies, conceptualizations of the ME and EA domains, descriptions of ME efforts in practice, and EA critical success factors. The research process has progressed as follows. Since the literature does not provide any contingency factors for EAP, not to mention for EAP ME, we paid attention to those ISD contingency factors that are generic enough to apply to EAP. The rationale behind this is that there is, on general level, an analogy between ISD and EAP situations. Second, we fleshed out the set of contingency factors with characteristics underlying suggestions for critical success factors for EA. Third, we derived from and compared to experience obtained in a large EA ME project, i.e., the Finnish *National Enterprise Architecture* (NEA) *project*. The project has involved a large number of representatives of state administration, consultancies and vendors. One of the subprojects of the NEA project has been aiming to engineer a generic EA method for state administration in Finland. Thus far, the first version of the EA method is under testing. One of the authors has participated as an active observer in workshops which evaluated existing methods and engineered a new one by integrating and adapting some of the selected methods. Also another subproject crafting the EA Capability Maturity Model (EACMM 2007) has affected the EACon framework constructed in this study. The more general mission of the NEA project is to advance the development of the public administration and its abilities to provide customer-oriented and flexible services and to increase the productivity of service production.

EACon framework - Contingency factors of EA Method Engineering

In this section, we first present a conceptualization of EA method engineering (EA ME) on a general level and then bring out potential contingency factors organized in accordance with this ontological structure (see Figure 2).

An *EA ME endeavor* means an effort to produce a new or an improved *EA method*. It can be organized as a project, or as a more or less non-structured action. It involves a single *enterprise* or a cluster of enterprises, which can be commercial or public organizations. A *cluster* is established around the endeavor, for instance, to create new networked services among them. The ME endeavor may deploy any variation of ME strategies and processes, e.g., construction of a generic EA method, EA method adaptation for a specific situation, situational EA method selection or modular method construction.

The EA ME endeavor is guided by *EA method goals* that are derived from requirements reflecting the views and needs of the members of the cluster. Reaching the goals requires the availability of *resources* including money, manpower, locations etc. The EA ME endeavor is constrained and directed by *EA principles* pertaining to architectural standards and decisions made in the organizations (Janssen and Hjort-Madsen 2007). Potential differences between local principles among members should be recognized and harmonized to yield a shared collection.

Some enterprises may have EA management of their own as a part of the strategy processes of the organizations. *EA management* targets the future strengthening and success of the enterprises (Pulkkinen and Hirvonen 2005b, Pulkkinen 2006). In the ME endeavor, the EA management of all the involved enterprises should be reconsidered in order to achieve a shared understanding of the future EA management. EA governance, in turn, is the annual process of maintenance (Jansen and Hjort-Madsen 2007) that supports the day-to-day operations and provide information for the strategic planning and management of the EA (Pulkkinen and Hirvonen 2005b).

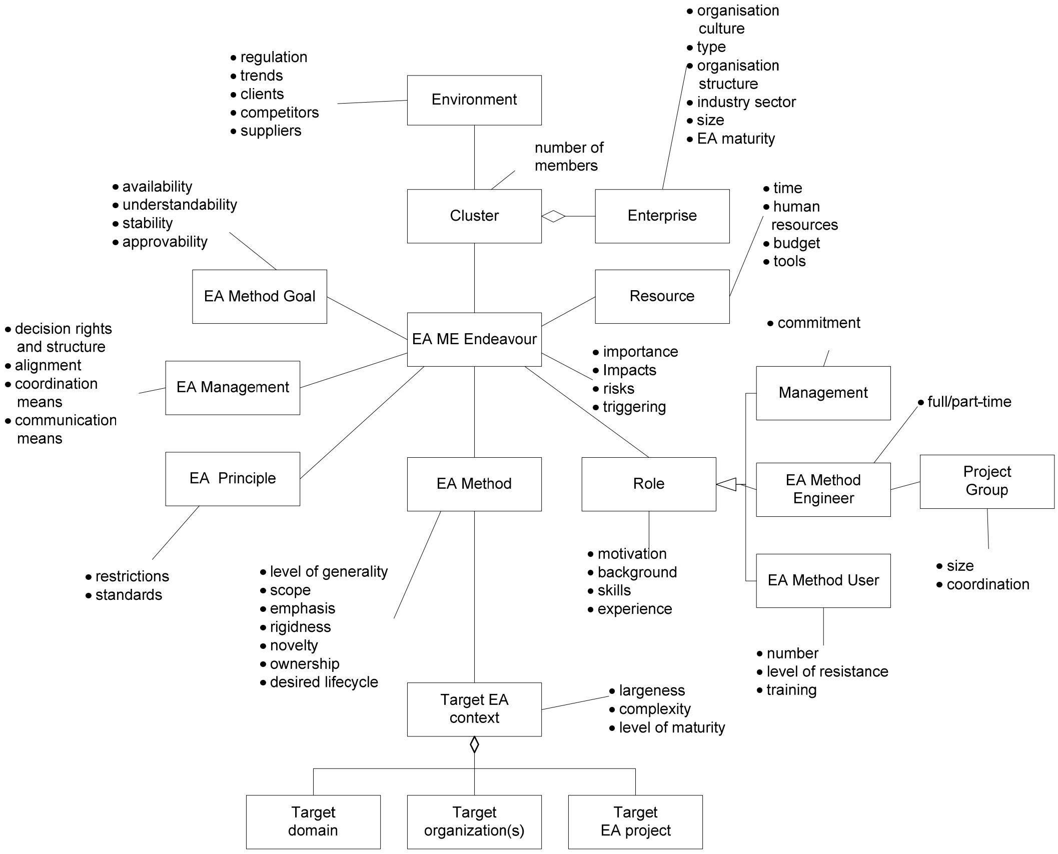

Figure 2. Contingency framework of enterprise architecture method engineering (EA ME).

An EA ME endeavor involves a number of persons in different *roles*. The typical roles in the EA ME are those of management, an EA method engineer and an EA method user. *Management* means here a role person who is in charge of making decisions on the launching the endeavor, allocating resources and approving the outcomes. Persons in this role may be representatives of top management, IT management or operational management. An *EA method engineer* stands for a role person who is engaged in selecting, analyzing, designing and implementing an EA method. The role can be played by an enterprise architect, a vendor or a consultant, each of them equipped with necessary expertise in business, information systems, ICT, ME tools, and/or EA methods. An *EA method user* means a role person who will deploy the EA method under engineering in forthcoming EA planning efforts. If engineering work is carried out in an organized form, a specific *project group* is established to include persons in the aforementioned roles. The EA method under engineering is targeted at some context, called the *target EA context* which is determined by a certain kind of domain, organizations, and EA planning projects, depending on whether the EA method is domain-specific, organization-specific or project-specific.

Next, we introduce contingency factors which can be used to characterize EA ME endeavors.

Characteristics of the enterprises in the cluster are organizational culture, type, organizational structure, industry sector, size, and EA maturity. *Organizational culture* is reflected by management structure and ways of making decisions (cf. Iivari and Huisman, 2007) and is manifested, for instance, as certain attitudes towards changes and ways of communication (Ylimäki 2006). *Type* means business, public administration or the third sector (Janssen & Hjort-Madsen 2007). *Organization structure* may, at its worst, reflect, e.g., silo thinking and strict profit responsibilities of an organization which can cause barriers to EA success (Ylimäki 2006). *EA maturity* means the awareness of, the attitudes toward, and the abilities to the management and development of EA in parallel to business management. EA maturity is seen, for instance, in how organization strategy and IT strategy are aligned (Hirvonen & Pulkkinen 2004, Ylimäki 2006).

EA management, and EA governance as a part of it, can be characterized by e.g. decision rights and structure (Janssen & Hjort-Madsen 2007), alignment (e.g. funding process), and communication and coordination means (Ylimäki 2006) *Decision rights and structure* includes the EA governance process, its roles, tasks, responsibilities and authorizations (Ylimäki 2006). From the EA ME viewpoint, the decision rights and structure tell who budgets the EA ME endeavor and who makes the final decisions about it. *Alignment* means the extent to which EA governance is integrated with Business Management Process, such as investment process or strategy refinement process (Ylimäki 2006). *Communication and coordination* are crucial for EA planning and governance (EACMM 2007), since the goal is to align large strategic entities in the enterprises, which requires intrinsic internal communication. Which kinds of communication channels are available, whether a common language including key concepts is defined (Ylimäki 2006, EACMM 2007), and whether coordination tools such as groupware and shared working places are in use affect on how an EA ME endeavor can be accomplished.

EA work is affected by many regulations and standards, which should be taken into account in engineering an EA method. *Regulation* include e.g. legislation, EU directives (IDABC 2004), national restrictions and agreements (e.g. Juhta 2007) and requirements for compatibility with other international or national models and instructions (EACMM 2007, Ylimäki 2006). *Restrictions* include, e.g., enterprise level architectural decisions, reference and model architectures to cope or follow (EACMM 2007). Reference architectures, for instance, may dictate how to view and act if interoperability between the target domain and that of the reference domains is demanded. *Standards* can be organizational or inter-organizational, and they can pertain to standard business processes, standard technical building blocks, or interfaces and interactions patterns (Janssen and Hjort-Madsen 2007).

The EA ME endeavors differ from each other in terms of their importance, impacts and risks, as well as why they are triggered. *Importance* means how far-reaching is it to have a new EA method. *Impacts* imply which (possibly) positive consequences result from using a new EA method. Every effort, including EA ME efforts, has some *risks* that should be recognized and taken into account (Ylimäki 2006). There are many kinds of reasons behind *triggering* an EA ME endeavor. There may be problems in EA planning and in the use of an EA method, and a new method is desired to solve these problems. Or a novel technology, a new application area, or a new approach to EA planning may require a new kind of methodical support.

Goals of the EA ME endeavors may diverge from one another in how *available*, *understandable*, *stable* and *approvable* they are, as well as what kinds of benefits are pursued. EA ME may appear to be an abstract entity for which it is difficult to set goals and express them in a way, which is understood by the stakeholders (cf. Ylimäki 2006). The larger the number of the involved stakeholders is, the more difficult it is to reach an agreement on the goals. Goals can be expressed in different ways, for instance, in terms of benefits to be reached or problems to be solved.

Success of any effort is dependent on the qualities of stakeholders participating in it. Attached to the notion of role we distinguish contingency factors such as *motivation*, *background*, *skills* and *experience*, related to EA, EA planning and EA method engineering. Particularly important is *commitment* of management on the EA ME endeavor. Also the degree of how intensively (i.e. full-time, part-time) stakeholders in their roles can contribute to the endeavor impact on the ways of working, organizing, controlling and coordinating EA ME. Resources are commonly measured in terms of *time*, *human resources* and money (*budget*). Other resources include *tools* and facilities, e.g. a shared dictionary, visualization techniques and tools (Janssen & Hjort-Madsen 2007),.

The EA method under engineering can be characterized by a level of generality, scope, emphasis, rigidness, novelty, ownership and desired lifecycle. A *level of generality* means the categorization into generic, domain-specific, organization-specific and project-specific EA methods. The *scope* and *emphasis* of the method can be expressed in terms of four architectural viewpoints (i.e. business, information, systems, and technology) and three levels (i.e. enterprise, domain, systems). *Rigidness* means how formally the models, techniques and process is to be specified in the EA method and how strictly they are to be followed in EA planning. *Novelty* refers to innovations expected to be in the EA method compared to existing methods. *Ownership* and *desired lifecycle* are important aspects in making decisions on the usage of ME resources.

Target EA context in Figure 2 is used to build a bridge to the EAP layer in the contingency framework. Factors related to it are general characterizations of aspects that are considered in more detail on the consequent EAP layer. Of the large variety of aspects we only mention three, largeness, complexity, and level of maturity. *Largeness* and *complexity* are qualities for characterizing how large and complex are EA planning efforts that are to be prescribed by the EA method under engineering. *Level of maturity* refers to the degree to which EA planning related work is expected to be familiar in the target contexts.

Summary and Conclusions

This paper has presented a contingency framework, called the EACon framework, which is composed of factors for the characterization of a situation in which an enterprise architecture method is engineered. To construct the framework we first defined the basic concepts for enterprise architecture, method engineering and contingency approach. Contingency factors were derived from literature on ISD contingency factors, conceptualizations of EA and ME, case studies on method engineering, and EA critical success factors. We also deployed the experience obtained from a large project of engineering an EA method for state administration. The contingency framework is composed of three layers, of which we focused on the topmost layer pertaining to an EA ME situation.

The framework can be applied to support the selection and adaptation of EA method engineering strategies, approaches, models, techniques and ways of organizing an EA ME effort in a situational manner, as well as to carry out the retrospective analysis of accomplished EA ME efforts. For instance, the situation in the NEA project can be characterized by the following features: high importance of EA work to the interoperability of information systems of state administration; a large set of stakeholders on various administration levels; a need to have such a general-purpose method for EA domain, which could be later customized into organization-specific and EA project-specific methods; the absence of a suitable EA planning method. These situational features, among other things, affected that the EA ME endeavor was organized in the form of a specific project which involves a large number of representatives of state administration, applies a mixed ME strategy of integration and adaptation, and uses pilot projects to refine the method. Experience got this far from the project suggests that most essential contingency factors to be considered in the customization of the EA method for an organization are industry sector and EA maturity of the enterprise, scope and emphasis of the EA method, and skills and experience of EA method engineer and EA method users.

The results of this study are preliminary and the subject of the future research. First of all, the definitions of the current contingency factors should be elaborated by literature reviews and a more detailed analysis of the experience from practice. Second, the contingency framework should be extended to cover the two other layers concerning an EA planning situation and an EA development situation. Third, in order to fully utilize the EACon framework it is necessary to specify basic properties of EA ME artifacts and 'fits' with the contingency factors.

Fourth, the framework should be equipped with concrete instructions for how to deploy it in EA ME efforts in practice. Fifth, empirical studies in different fields are needed to validate the EACon framework.

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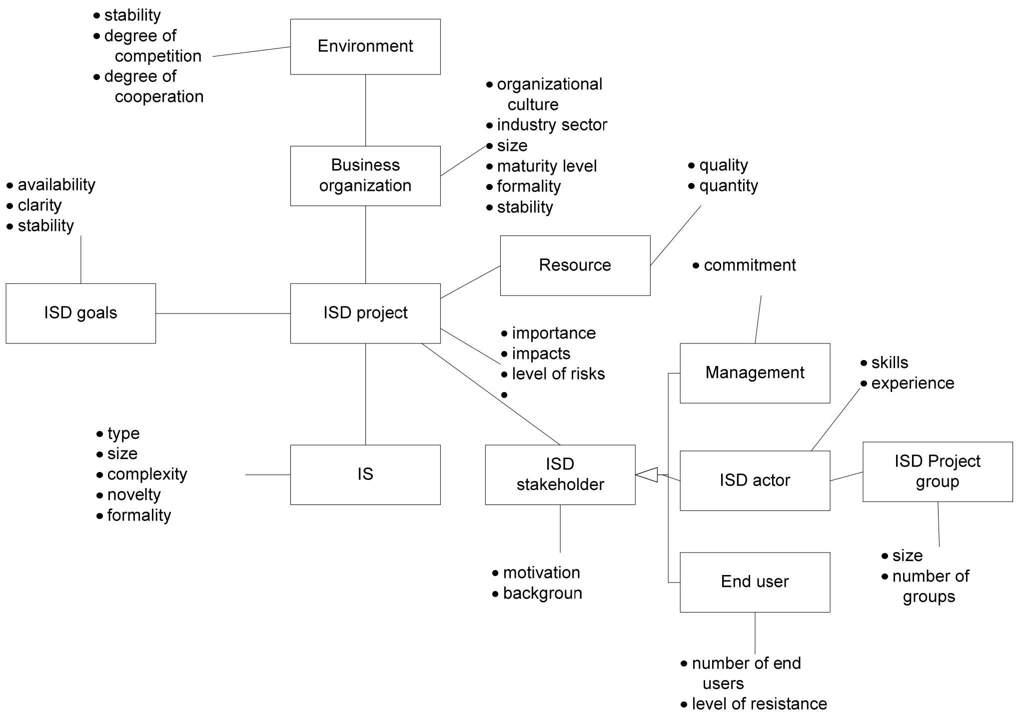
Appendix 1



ISD contingency factors

III

BUSINESS ARCHITECTURE DEVELOPMENT AT PUBLIC ADMINISTRATION – INSIGHTS FROM GOVERNMENT EA METHOD ENGINEERING PROJECT IN FINLAND

by

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Business Architecture Development at Public Administration – Insights from Government EA Method Engineering Project in Finland

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Abstract. Governments worldwide are concerned for efficient production of services to customers. To improve quality of services and to make service production more efficient information and communication technology (ICT) is largely exploited in public administration (PA). Succeeding in this exploitation calls for large-scale planning which embraces issues from strategic to technological level. In this planning the notion of Enterprise Architecture (EA) is commonly applied. One of the sub-architectures of EA is Business Architecture (BA). BA planning is challenging in PA due to a large number of stakeholders, a wide set of customers, and solid and hierarchical structures of organizations. To support EA planning in Finland, a project to engineer a government EA (GEA) method was launched. In this paper, we analyze the discussions and outputs of the project workshops, and reflect emerged issues on current e-government literature. We bring forth new insights into BA at PA and formulate them into suggestions for government BA development.

1 Introduction

The diffusion of e-commerce technologies in the private sector has made public administrations (PA) foster e-government initiatives and programmes (Cordella 2007). E-government refers to the deployment of Information and Communication Technologies (ICT) to promote more efficient and effective provision of high quality government services (Punia and Saxena 2004; Cordella 2007). This means a wider array of services for customers, as well as better and more secure communication between customers and government agencies. E-government is expected to bring administration closer to citizen's everyday life (Peristeras and Tarabanis 2000) and make government more accountable and transparent to customers (Punia et al. 2004; Janssen and Cresswell 2005).

Implementation of e-government is challenging in many ways. Much of government work is carried out by multiple government agencies working as vertically rigid ‘silos’ (Punia et al. 2004; Tarabanis, Peristeras and Fragidis 2001). This results in poor coordination, poor performance and poor quality of services. For mature e-government development, there is a need for a sophisticate and centrally managed strategy function (Peristeras and Tarabanis 2004) based on a comprehensive view of processes, information, systems and technology in PA. This kind of view is provided by the notion of Enterprise Architecture (EA). *Enterprise architecture* is seen as a collection of artifacts that define and describe the structure and processes of an enterprise, the information being stored, processed and communicated in this enterprise, the systems used for these activities, and the technologies and infrastructure that the systems are implemented with (Leppänen, Valtonen and Pulkkinen 2007). Here, an enterprise is regarded as a public organization, a private company, or a virtual organization in the form of a network of organizational actors aiming at a common goal.

Enterprise architecture planning and development is difficult particularly in PA, due to a large number of government agencies, a wide and heterogeneous set of customers, as well as a formal, hierarchical structure of authority with a detailed, rationalized division of labor. *EA planning* means the definition of the overall target state of an enterprise including the transition plan as a road map of the transition projects to achieve the target state (Pulkkinen and Hirvonen 2005). *EA development* refers to an execution process of one of the transition projects for new EA arrangements, either as new organization structures, processes, information assets, eBusiness solutions, information systems, technology platforms etc. *Business architecture development* focuses on designing and implementing transitions (e.g., in services, structures or processes).

Various frameworks, models and methods have been suggested for EA planning and development (e.g., see reviews in Whitman, Ramachandran and Ketkar 2001; Schekkerman 2003; Pulkkinen et al. 2005), some of which have been largely applied at PA as well. Due to differences in laws, organizational structures, degree of privatization, culture etc., no framework or method as such is applicable in all the countries or even among various branches of administration, but they have to be customized.

In Finland, as part of the Interoperability Development Programme (IDP) at the Ministry of Finance, five subprojects were launched to implement the government policy decision on the development of IT management (Ministry of Finance 2006). In one of the subprojects a method for government EA (GEA) development was engineered, called the GEA method in this paper. The project group consisted of representatives from Finnish state administration, municipalities and consultants. The GEA method is composed of a large conceptual framework, a general-level process model and normative instructions for how to apply the framework. The framework covers four EA viewpoints and three description levels to be adapted in GEA modeling. The viewpoints cover four inter-related sub-architectures, namely business architecture (BA), information architecture (IA), systems architecture (SA) and technology architecture (TA).

Due to the strict time limit provided for the method engineering, the outcome can be seen as a first version of the GEA method for Finnish PA. The intention by the Finnish state government has been to develop the GEA method further, for instance by applying it in pilot projects. In this paper, our purpose is to search deeper insight into BA development especially in PA, and suggest improvements into methodical guidelines of BA development. We do this by analyzing the recorded and transcribed discussions in the workshops of the GEA method engineering and by comparing the emerged BA development related issues with conceptions and ideas presented in the literature. In this way we pursue to bring forth new ideas to be included in any EA method. Our analysis here covers only a small part of themes considered in the workshops. We focus on BA visions, customer activation at BA design, and BA implementation models.

The remainder of the paper is structured into four sections. In Section 2 we outline the GEA method engineering project and the GEA method. Section 3 describes the research method used in the study. In Section 4 we analyze issues raised at the project workshops by comparing them with conceptions presented in the literature. In Section 5 we present, as implications from the analysis, suggestions for improvements into methodical guidelines of BA planning. The paper ends with a summary and conclusions in Section 6.

2 CASE: the GEA Method Engineering Project

In autumn 2006, Interoperability Development Program (IDP) was launched at the Ministry of Finance in Finland to implement government policy decision on the development of IT management (Ministry of Finance 2006). The program involved five sub-projects: (1) to analyze the state of the art of the information systems architecture of the state government, (2) to engineer a government EA (GEA) method and to make a high level description of the target architecture, (3) to develop a GEA governance model and a GEA maturity model, (4) to model logical integration architecture for the target state, and (5) to analyze obstacles and potentials for reusing the current central state repositories and databases.

Here, we focus on the project pursuing the second goal, the GEA method engineering (ME) project (also described in Hirvonen, Pulkkinen and Valtonen 2007). The project group consisted of representatives of Finnish PA (i.e. the Ministry of Finance, ITM of the Council of State, Population Register Center, National Board of Taxes, Finnish Road Administration and ITC Management of the Ministry of Justice), a municipality (i.e. Turku town), a university, and the liable consultancy (TietoEnator Oyj), all bringing their expertise on different fields to the project. The work in the project comprised five tasks: (1) selection of a EA method, (2) adaption of the EA method for Finnish PA, (3) making a user manual for the GEA method, 4) applying the GEA method to a small-scale case and thus producing an exemplar document of the method use, and (5) high level target architecture planning and description. The project was organized into 15 workshops led by consultants.

As the project output, the GEA method was produced. It is composed of a conceptual framework (the GEA grid), a process model with stepwise and normative instructions for proceeding, and an array of description models. The GEA grid is structured by three description levels and four architectural viewpoints (Table 1). The description levels are: PA, domains (e.g., a branch of administration) and subdomains (e.g., a government agency). For the description of the target state EA, the domain level was thought to be, for example, a common goal of a network of organizations (called ‘cluster’ at the GEA method document and at the workshop). Subdomains in that case were, respectively, the subareas of the development goal of the cluster. The EA viewpoints correspond to four sub-architectures: business architecture (BA), information architecture (IA), systems architecture (SA) and technology architecture (TA) (cf. TOGAF, Open Group 2003; Hirvonen and Pulkkinen 2004). The sub-architectures include descriptions, for example, of stakeholders, customers, organizations, services and processes for BA, strategic data warehouses, information assets and vocabularies for IA, IS portfolios, IS lifecycles and systems services for SA, and technology policies, standards and reference models for TA.

Generic GEA grid in Finland	BA	IA	SA	TA
PA level				
Domain level				
Sub-domain level				

Table 1: Overview of the GEA grid.

The GEA method is meant to be applied situationally (Ministry of Finance 2007). This signifies that a suitable approach to the situation at hand is to be selected. If the process-driven approach is selected, the first steps are taken to develop BA and IA focusing on services, processes and the information related to them. If the system-driven approach is more suitable, the EA development may start with describing current information systems and how they might be harmonized or integrated. The domain level of development is defined to meet situational needs. The process model is composed of three phases: (1) outline a target state and the current state, (2) make plans toward the target state, and (3) make plans for implementation. In the first phase, the scope of the EA work is defined, descriptions of the current EA and needs for the changes are collected, the vision for the target EA state is outlined, and the development project is established. The second phase is to produce primary EA designs from the selected viewpoints and on the selected levels. This means that stakeholders are identified and analyzed, suitable description models are selected, issues affecting the EA at hand are analyzed, the EA is modeled, the EA vision(s) are reconsidered, and the defect analysis is carried out. The last phase aims to make plans for implementation projects (so called road-map), assess their benefits and risks, prioritize them, and distribute the outcomes of EA planning to the stakeholders (Ministry of Finance 2007). This process is applied either for EA planning or EA development. Regardless of the selected approach, an EA development process iterates through several viewpoints and description levels to implement a stated EA vision.

3 Research Method

This study was conducted as a case study (Yin 2003) to reveal the intricate phenomenon of BA development at PA, and by reflecting the case on e-government literature, to suggest improvements into methodical guidelines of BA development.

*Data gathering and validation***.** The primary data was collected by the first author who was acting as a participatory observer at 13 workshops of the GEA method engineering project. The researcher acted partly as an outside observer and partly as an involved researcher commenting on issues (cf. Berger and Beynon-Davies 2004, orig. Walsham 1997). Discussions were written down as field notes in the first four workshops and tape recorded in nine consequent workshops. The recorded discussions (in average ca 3 h) were transcribed (altogether ca 500 pages) and coded during data analysis. As secondary data, the project documentation, minutes of meetings and results of the workshops were extensively exploited in data synthesis and analysis. In addition to these, all material of the overall interoperability program and its subprojects was available in a shared workspace offered by the Ministry of Finance. The researcher could not attend two of the workshops, and some of the tapes suffered from minor technical problems. Although the work at the consultancy could not be followed, outcomes were reported in the workshops and shared at the workspace. The primary data was in most cases checked by the group members in the beginning of the workshop that followed the one where the data was collected. All the delivered data was shared for the group members also in a shared workspace, and corrections were welcomed also by email. This arrangement enabled the validation of the data regardless of time and place.

*Data analysis***.** The primary data was subjected to in-depth textual analysis. Secondary data allowed cross checking with the aim of a stronger substantiation of analysis and conclusions (cf. Berger et al. 2004). The primary data was organized as a thick text repository and analyzed interpretatively by semi-open coding to uncover the salient issues in the workshops. Therefore, a process of quoting, coding and categorizing was carried out in an iterative and converging fashion, forming the final themes by confirming or absorbing the previous ones. By a theme we mean a bunch of categories and their attached quotations which have been formed iteratively and converged based on the whole database. Representative quotations were selected by the authors. The results were validated by stakeholder reviews and by comparing them with the results of a parallel qualitative study at Finnish state administration with independent data set (Isomäki, Liimatainen and Valtonen 2008). The results in this paper are in accordance with those got from the aforementioned study.

4 Results

In this section we bring forth e-government issues related to business architecture planning based on interpretative analysis of workshop discussions, document analysis of the GEA method, and e-government literature. Issues are organized into three themes: (a) e-government business models, (b) customer-driven development, and (c) business process modeling

4.1 E-government Business Models

A large variety of e-business models have been suggested for private sector in the literature (e.g., Weill and Vitale 2001; Rappa 2002; cf. a review in Hedman and Kalling 2003). In the recent years, e-business models have excited interest in public administration as well (Janssen, Kuk and Wagenaar 2005; Lee and Hong 2002). E-business models reflect the core business of an organization and describe the organization from the perspective of its main mission, and the products and services that it provides to its customers (Janssen, Kuk et al. 2005, orig. Wand, Woo and Hui 1999). Applying an e–government business model helps to define service strategies, to identify, categorize and structure the services, and to view the service production as a more organized set of processes. It may lead to changes in functions, roles, responsibilities, organization structures and infrastructures (Vitale, Ross, and Weill 2002) also in public administration. Janssen, Kuk et al. (2005) discuss the e-business model taxonomy of Weil et al. (2001) applying it for e-government. In the following, we shortly describe some of these e-government business models.

Based on the *full service provider* model, a full range of services is provided to an internet user in one service domain (e.g., health domain), directly or via allies. The aim is to own the primary consumer relationship. The *value net integrator model* supports establishing the coordination of processes across a value net by gathering, synthesizing and distributing information. Applying the *content provider* model means that information, digital products and services are provided via intermediaries. The content comes from one single organization and can be customized. Weil et al. (2001) also suggest the *direct to consumer model*, which provides "goods or services directly to the customer, often bypassing a traditional channel (Janssen, Kuk et al. 2005)". For a Finnish customer**,** this kind of service already exists**,** for example, a tax deduction card can be ordered online by-passing officers as a matter of course. In the *virtual community model,* an online community of people with a common interest enables interaction to enhance service provision. This has mainly potential in future until internet users are getting more accustomed to advanced services (e.g.., eBay: Resnick, Zeckhauser, Swanson and Lockwood 2006; future service production: Bjoern-Andersen 2007).

In the project, e-government business models were not explicitly mentioned although several examples of online services were highlighted to illustrate the goals and possibilities of e-government. For instance, a way to on-line support the various phases of building process was outlined. This e-service would collect information, such as blueprints by the design firm, and support license case processing actions of builders and officials. A consultant: "It is known, that with the help of an electrical desktop you can nicely try to guide or even force making of more thorough applications, i.e., collecting information. Thus, you get more prepared text and the officials for the supervision of the building might concentrate more on assessment… and not using their time on information collection and chasing it after". The GEA method does not refer to any specific e-government business model either. The vision of the target state BA can be created using a scenario technique described in the GEA method. Thereafter, to put it simply, the GEA method guides BA development (a) to take legislation, visions, trends and strategies as a starting point, (b) to identify customers and their needs, and (c) based on these needs, to outline services for customer profiles. Guidelines for e-government business models should be an integral part of any GEA method. The scenario technique, for example, might present different choices for e-government business models. This might provide managers with an analytical tool set for thinking through potential e-government business models and the consequences for realization. Weill et al. (2001) suggest this kind of approach as a tool for enterprise managers. E-government business models can also be seen to have clear impacts on how business processes should be structured, interrelated and designed.

4.2 Customer-Driven Development

The importance of customers' role in the development of e-services and processes is commonly recognized (Vitale et al. 2002). Also the literature on e-government brings forth this issue, for example, customers' needs-to-services mapping (Peristeras, Tarabanis and Loutas 2007), and involvement of potential users in the co-production of new content and services (Janssen, Kuk et al. 2005). Application of the customer-driven approach manifests itself, for example, as the provision of pro-active services. Web sites could be personalized in such a way that an email alert is got before the expiration of one's driving license (Janssen, Kuk et al. 2005). At the workshop discussions and in the GEA method a PA customer is referred as a citizen, a private sector organization, a non-profit organization, or another government agency inside PA. The government agency can act either at a local, state or European Union level (Peters, Janssen and Engers 2004).

The customer-driven approach was seen quite essential to BA development during the workshop discussions. The recognized dimensions of customer-driven development were transparency, automation of the non-value adding actions, pro-activity of services as well as the mapping of provider and customer processes during the BA development. Transparency of services was seen beneficial since it enables a customer to follow up steps by which her/his service request proceeds in a network of government agencies: ”If it's a lengthy process, like applying an exceptional permit for a summer cottage, which may take even a year … I would have liked to see, if the case is at a standstill there at the municipality.” Automation of service processes was seen as a means to eliminate the demand to execute non value-added operations. A citizen could be, for example, automatically subsidized by housing allowance, or at least informed about this possibility, if her/his income meets the stated income limits. The subsidy could be even channeled directly to her/his lessor: ”They know it very well who owns the rental apartment, and the money can go straight to there.” Several cases related to pro-active services were also discussed. For example, a security guard might routinely make an offer to help a victim in making the report of an offence. Special attention was given to the notion of life cycle in the context of customer-driven approach. E-government should be challenged to implement services based on the life-cycles of the publicly maintained information. For instance, based on the life-cycle of a building, several services were identified, for example counseling the construction planning, location registration, license services, accepting the building process supervisors, and customer involvement in the local area development planning. A life-cycle view may thus help to recognize essential life events (Trochidis, Tambouris and Tarabanis, 2007) to be implemented as e-services.

The customer-driven approach is clearly visible in the GEA method (Ministry of Finance 2007). The method guides principally to take customers and their needs as a starting point in the identification of customer profiles and service portfolios. Services would then be described, and among other things categorized into different service types (like core online service, information service or other). Services can also be characterized, for example, in terms of iterativeness measuring the number of interactions between customer and officials needed to conclude one case (Ministry of Finance 2007).

4.3 Business Process Modeling

Public administration is commonly afflicted by separate silos, having negative influence on the performance of processes and their coordination (Punia et al. 2004; Tarabanis et al. 2001). Many services require actions from more than one agency. To cope with that, the agencies have to be interoperable, not only at the technological level, but at the semantic and organizational levels as well (e.g., Peristeras et al. 2007). Co-operative service production and delivery requires cross-agency processes, or inter-organizational processes (IOPs) (Janssen and Cresswell 2005). The IOPs (or cluster processes, as the group also put it) were largely discussed in the workshops. An IOP was defined to mean a process which crosses the boundaries of branches of administration or service provider organizations. A service provider could also be a private or non-profit organization. ‘Silo’ problems were recognized to be quite recurrent, as noticed: “At present, the processes break immediately when the boundary of an organization is encountered. … the responsibility is passed to a customer who is expected to act respectively [i.e. to trigger a process with another agency]”.

There are many challenges related to the implementation of the IOPs. Firstly, it is difficult to define a strategy for an IOP, as stated in the group: “Even if a [IO] process was identified, it has no formal strategy.” The group concluded that when developing an IOP co-operatively, you have to take into account and adapt the different BA requirements originating from several strategies of participating organizations. A PA representative: “But how do you cope with that in future, if you have a priority of one organization, and still all the others are supposed to act accordingly?” The consultant: “Then you have performed the requirements engineering and management wrong. You have to specify all the stakeholders and users, whether it is a bunch of three organisations or actors…”

Secondly, special principles are needed to implement an IOP. Punia et al. (2004) list three ways to structure workflows in IOPs**.** In *sub-process integration* organizations link their sub-processes together creating a new process that spans all the organizations. Alternatively, a new *public process* is developed in the organizations, or bought from a third party, for linking their internal sub-processes. Sub-process execution could also be implemented *through bidding*. Organizations that want to use a service providing a sub-process make bids, and organizations that want to sell, respond to the bids. For us, it seems that implementation of a public process would result in extra administrative work in a long run, whereas integration of sub-processes, although more demanding for developers, would enhance and smooth current processes.

The group elaborated also another notion, called shared process, to promote organizational interoperability. A shared process means a chain of operations which are executed in the similar way in several agencies. Examples of typical shared processes are case processing, licensing (i.e. certification, cf. Peristeras et al. 2004), and financial administration. It was seen important to harmonize current practices through a process which could be shared, supported and possibly automated by a centralized system. For instance: ”the process related to a building license is actually a generic licensing process containing parts that could be reused”. Of course, implementation of a shared process into an agency may necessitate its re-localization, possibly re-configuration. One should, however, be aware of risks resulted from going too far in this kind of centralization, as experienced in the NHS project in England where local socio-technical needs were not allowed in local implementation of the process, even though it would have been possible technically (Eason 2007).

The GEA method guides to categorize business processes into two process types, core processes and support processes. A core process refers to a way how an organization aims at fulfilling its purpose of existence. A support process creates good conditions for core processes. In addition, management processes are mentioned but neither defined nor discussed. Each process is to be identified, represented in a process chart, and described in a process diagram containing sub-processes, customers, service provider roles, services and information system(s). The GEA method recognizes IOP’s (called cross-agency processes) and shared processes but no instructions are given to identify, organize and implement those processes. We suggest that any EA method should advice how to select a suitable implementation strategy for IOPs and shared processes. A choice is situational and depends, for example, on stated goals and applied e-government business models.

Furthermore, we suggest that any EA method should address how to identify and model, not only “coal-face processes” but also management and strategy processes (cf. Ould 2005). As noticed in workshops**:** ”Through [EA] descriptions [e.g., process maps] we are aiming at understanding. … to make better decisions. … Details, however annoying, have to be brought forth somehow, since they have to be EXECUTED somewhere”. Especially describing the management and strategy processes were seen a tricky task: ”There are some issues, for instance planning, monitoring, concern reporting, and official statistics,.. such things where this kind of [administrative] hierarchy –a state administration, a branch of administration and an agency – creates us services which transfer information and understanding from a hierarchical level to another. And where have we described them? It is as they would not exist at all.” Although these issues were recognized in workshops, neither are they mentioned in the GEA method nor operationalized into instructions for the identification and modeling of management and strategic processes. We suggest that a normative technique (cf. Ould 2005) would be exploited for this purpose.

Including the coal-face, management and strategy processes in BA description would increase understanding, for example, of what kind of structure and implementation strategy would be beneficial when a IOP or shared process are to support an applied e-government business model. In IOP planning an implementation strategy should be chosen in a deliberate manner in order to involve and commit the concerned parties with sufficient resources. Developing shared processes implies the centralization of IS support with few alternative options. One can aim to harmonize the way of action among all the parties in order to deploy one IS for all, or, alternatively, to harmonize the process to a chosen level and support it by a configurable system that might take into account local socio-technical needs (cf. Eason 2007).

4 Implications

Based on discussions in the workshops, the analysis of the GEA method, and literature on e-government we conclude with the following suggestions for business architecture development.

Elaboration of a shared vision among the involved organizations. A number of studies (e.g., Scott, Golden and Hughes 2004) show that technology-driven e-government implementation fails because of stakeholder resistance at the time when changes in processes and organizational structures should be made. We suggest the use of e-government business models as a means to direct discussions toward strategic issues in order to establish a shared vision at the organizational level among the concerned government agencies and business enterprises. E-government business models may guide the concretization of the selected vision into new arrangements of organizational structures and processes. In addition to those referred to in Section 3 (Weill et al. 2001), the literature provides other e-government business models (e.g., life-event portals and one-stop-shops, cf. Chatzidimitriou and Koumpis 2007; Momotko, Izdebski, Tambouris, Tarabanis, and Vintar 2007) that might be considered in a situational manner.

Customer-driven requirements engineering. In order for e-government to provide customer-oriented services, requirements engineering should be carried out in a customer-driven manner. We suggest that the notions of life-cycle process and life event workflow are used to find a proper match between the customers' view and the provider's view in the following manner: (1) Model the service provider's view (i.e. life-cycle process) and the customers' view (i.e. life-event workflow) and try to find out which part of the life-cycle maintained by PA should be supported by online services for the customers, i.e. mapping the customer process and the provider process to support the design and implementation of both views. (2) Look for "blind spots" in the customer process that could be smoothed. Typically these are situations, where the customer is obligated to patronize with several officials or agencies in order to get one single case to be handled. (3) Ask the customers how they could be served pro-actively by relevant information, products or services. (4) Ask the customers, to which information they would like to have an access through electronic self-service channels, such as internet, mobile phone, or digital television.

Identification and description of processes. One of the conclusions from the GEA method engineering project was lack of understanding of business processes, especially management and strategy processes. We suggest that the identification and modeling of the management and strategy processes is supported by a systematical approach developed by Ould (2005).

Planning inter-organizational processes. To support the planning of inter-organizational processes in situations where service production necessitates cooperation between several agencies, or even private organizations, we suggest that inter-organizational processes are carefully planned based on a specific implementation strategy. As mentioned above, there are many alternative strategies (e.g., integrating sub-process, public processes, and e-marketplaces by Punia et al. 2004).

Designing IS support for shared processes. One of the issues discussed in the GEA method engineering project concerned shared processes and how these are recognized and re-designed in local agencies and municipalities in practices. IS support for shared processes may mean (1) the use of the same IS to enforce the agencies to act in the same way in service provision operations, (2) the use of the same IS to support different instances of a shared process differentiated by customers' needs, and (3) the use of different IS implementations based on socio-technical factors and adapted situationally from one common IS (cf. Eason 2007).

5 Conclusion

Enterprise Architecture planning is a big challenge in public administration due to a large number of stakeholders, a wide set of customers with heterogeneous needs, and solid and hierarchical structures of organizations. To support EA planning in Finland, a project to engineer a government EA (GEA) method was launched in 2006. A part of the discussions in the workshops of the project addressed one sub-architecture of the EA, namely business architecture (BA). In this research we have analyzed those discussions and the GEA method documents, and reflected emerged issues on current e-government literature. Our aim has been to find new insights into BA and formulate them into suggestions for BA planning. These suggestions are related to elaboration of a shared vision among the involved organizations through the use of e-government business models, customer-driven requirements engineering, identification and description of processes, and designing implementation strategies and IS support for different types of public processes.

BA planning contains many other important issues we had to exclude. For instance, questions about managing the inter-organizational processes and how to relate legislation and architecture management and planning are vital in BA planning. In our future research we aim to enlarge our analysis to cover also these issues, as well as to reveal the themes of overall EA planning and method adaptation for PA. The lack of a proper theoretical framework for possible e-government business models seems evident. Also a more careful consideration of consequences of applying of an e-government business model is an interesting issue for future research (e.g., the use of different modeling approaches, depth of customer involvement and process implementation strategies) in order to devise a systematic way for enhancing BA at PA.

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IV

GOVERNMENT ENTERPRISE ARCHITECTURE GRID ADAPTATION IN FINLAND

by

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Government Enterprise Architecture Grid Adaptation in Finland

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Abstract

In government, support for strategic political steering, administrative and cross-sectoral development, and integration of processes and systems can be sought out of enterprise architecture (EA) planning. To facilitate this, a proper EA method covering essential government levels is needed. A constructive case study has been carried out to create an adaptation model of Finnish government EA (GEA) grid. The study builds on general principles of method adaptation and observations about GEA method engineering and its pilot adaptations in Finnish State Administration. The model presents systematic guidelines for situational GEA grid adaptation and reuse in Finnish State administration. The model supports GEA grid adoption as a strategic tool for planning and management of organizational change. It facilitates prioritization of government goals, communication and commitment among government actors, and implementation of government interoperability.

1. Introduction

Current trends of public administration (PA) reforms are directed towards electronic services (eServices) and managerial administrative models, such as New Public Management (NPM) [8]. For planning and implementing them, enterprise architecture tools are commonly applied [7]. *Enterprise Architecture* (EA) is a central notion used to align strategies, processes, information, systems and technologies of an enterprise [15]. To structure, organize and guide EA planning, a number of EA frameworks and methods have been suggested (e.g., [28], cf. a review in [15]). An *EA grid* signifies here an EA framework in the matrix form.

PA as the context of EA planning sets specific requirements and constraints on a manner in which an EA method is applied [19]. For government use, EA methods are defined locally or adapted from well-known frameworks [6][7]. An EA grid is in a key position in this adaptation, since it structures the EA descriptions and guides the EA planning process.

In Finland, as part of the Interoperability Development Programme (IDP), a method for government EA (GEA) planning [26] was engineered by adapting some existing EA frameworks [28][5][16] for PA. The method is composed of a large conceptual EA grid, a general-level process model, and normative instructions to apply the grid and description models within it. The GEA method is generic, i.e., it has to be adapted before applying in each development environment. We made observations in the GEA method engineering project and two pilot adaptation projects in Finnish PA. Based on findings from these projects and a review of relevant literature, we designed an adaptation model of the GEA grid deployment in Finnish government organisations.

The aim of the paper is to present (a) a description of EA method adaptation carried out in Finland, (b) an analysis of principles underlying the EA grid adaptation, as well as (c) the GEA grid adaptation model (Geagam) and benefits of using the model.

The remainder of the paper is structured into eight sections. In Section 2, we define basic concepts related to method adaptation and EA frameworks. In Section 3, we introduce the Finnish State administration as the context of applying the GEA method. In Section 4, we describe the GEA method engineering project and findings from its adaptation in two pilot organizations. Section 5 outlines our research methodology. In Section 6, we bring out the principles underlying the GEA grid adaptation and present the GEA grid adaptation model (Geagam). Section 7 discusses the benefits of the GEA grid adaptation. The paper ends with a summary and conclusions.

2. Previous research

No method as such is suitable, but it needs to be adapted for situational needs. *Method adaptation* means the customization or tailoring of a method in a way which makes it more suitable for a domain, an organization, or a project [23]. There are two main approaches to method adaptation. In the first approach, an adapted method is engineered by collecting components from known methods and by integrating them into a customized array of models and techniques (e.g. [4]). In the second approach, a single method, called a base method, is selected and then customized, for instance, by dropping out some of its components, and by enhancing it with new components [21]. Both of these approaches seem to be used in EA method adaptation for PA (see [6] and [7]).

An EA method consists of a framework, a modeling process, techniques, models and roles (cf. [22]). Here, we are particularly interested in the *EA frameworks*. Many of the ideas of modern EA owe to the pioneering work of John Zachman [44] whose EA framework is in the form of a two-dimensional grid. Zachman's framework has got a number of successors and has affected the development of government EA methods too [6].

Through an EA framework, the complex structure of an enterprise can be modeled from different aspects [3]. According to Shah and Kourdi [36], the framework helps to identify the scope of the architecture and structure its elements in architectural layers and dimensions. The framework ensures the consistency of the produced descriptions [22]. It also guides EA planning and development process (e.g., EAG [31][32], Spewak [36]). A suitable specification of a framework is thus of uttermost importance [22]. We use the term EA grid to refer to an EA framework which is in the matrix form. In the EA literature, the dimensions (or columns) of EA grids are more or less fixed, often corresponding to the viewpoints of business architecture (BA), information architecture (IA), systems architecture (SA) and technology architecture (TA) (e.g., [16]). The layers (or levels), however, are still subject to debate.

Layered EA frameworks help in representing various aspects in different models and levels of abstraction [3]. Based on their analysis of work on enterprise architectures, Braun and Winter [3] argue that four design layers have to be differentiated. These include strategy, organizational, application, and software component layers. However, they also note that all the layers need not be found in all approaches, but the layers should be in accordance with the purpose. Malan and Bredemeyer [24] discuss the architectural levels of scope (those of enterprise, domain, application, and component) that help in focusing the architectural decision-making. Agreeing with Bass, Clements and Kazman [2] they conclude that architectural decisions should be deferred to the lower levels in the architectural hierarchy, if it is possible to develop and implement a requirement there [24]. Our focus in the study has been on adapting of architectural levels for different government purposes.

Although there is no agreement, which layers should constitute the essence of EA, it is common to apply an approach where strategic positioning is followed by organizational processes and structures, and finally by information systems [43]. For example, EA Management Grid (EAG, [16]) suggests the description levels of (1) an enterprise, (2) its domains and (3) subsequent systems, in order to support the implementation of strategic goals. An EA planning process based on the EAG framework [31] flows from the strategic enterprise level towards concrete domain and systems levels. At each level, EA descriptions and consequent decisions sharpen towards more focused, concrete and detailed design issues.

The EA frameworks and methods are too generic to be applied as such. According to the survey of national EA work [6], 89% of the governments have defined their EA frameworks locally, mostly based on some of the generic ones. For example, USA's FEA framework (FEAF) [5] has been inspired by Zachman's and Spewak's ones [6]. Further, for FEAF, concepts to be applied using a variety of architectural frameworks and methodologies in federal government are introduced in [10]. However, as far as we know, adaptation models inside the public infrastructure of a country have not been published largely. Therefore, we propose an example of an EA framework adaption model.

3. Finnish State administration

We introduce shortly the Finnish State administration, in order to clarify the context of EA method adaptation. State administration includes about 12 ministries, with ca. a hundred bureaus and agencies in State central administration [27]. Most of the ministries have regional and local offices too operating solely on a regional or local basis (e.g., local register offices) [27].

In Finland, there have been New Public Management related reforms since 1987 [40]. In NPM, the political steering is strategic by nature, which means that ministers are subjects and the administration is the object of steering [40]. Decentralization frees managers to manage, wherefore ministers are free to concentrate on broad, strategic decisions guiding the operational execution [40].

Tiili [40] has analyzed the strategy practices of Finnish State administration between 1995-2006. Government Program (GP, [12]) consists of Government vision, and collections of strategic goals of administrative branches [40]. Since 1995, government strategy specifications have explicated the projects needed to implement GP [40]. Thereafter, program management has been carried on since 2003, to enhance the means for steering and monitoring the implementation of the GP, especially in matters requiring cross-sectoral cooperation [30]. Government strategy specifications have thereafter contained outlined policy programs and their consequent legislative plans [29]. Policy-programs comprise projects with their measures and responsibilities [13].

Although these strategic practices have brought rigor to political decisions, there have been few signs of strategic political steering in Finnish Government since 1995 [40]. Strategy documents are characterized as collections of strategic agendas of each ministry, while there has neither been the will, nor the courage among Government members to prioritize the projects, and to make selections [40]. Projects in strategy specifications lack equal interest politically: GP has either had small issues that are too concrete, or goals that are too general to be strategic [40]. GP was also considered only as a legitimization of what the ministries were already doing [40]. However, new guidelines insist relevant information: 'In the process of promoting and monitoring the GP, the Government shall only be provided with information necessary to make decisions ensuring the materialization of the GP' [29].

To support the strategic political steering, the GEA grid adaptation model (Geagam) aims to promote EA descriptions in such a way that the information and strategic goals presented for ministers shall be relevant and produced in a systematic way. This enhances the prioritization and selection of the most important strategic goals, and outlining of the vision of entire government operation instead of just justifying the current state of administration.

4. CASE: EA method adaptation for PA

In autumn 2006, Interoperability Development Program (IDP) was launched in the Ministry of Finance in Finland to implement a government policy decision on the development of IT management [25]. Its challenging tasks were, par excellence, to engineer a government EA (GEA) method and a GEA governance model. Here, we focus on the GEA method engineering (described also in [41][17]) and its pilot adaptations in two State central agencies.

4.1. GEA method engineering project

The GEA method engineering project (Geamep) group consisted of representatives of Finnish State administration (different ministries and their agencies), a municipality, a university, and the liable consultancy, all bringing their expertise on different fields to the project. The work in the project comprised five tasks: (1) the selection of a suitable EA method or EA methods, (2) the adaptation of the EA methods for Finnish PA, (3) making a user manual for the resulting GEA method, (4) applying the GEA method to a small-scale case and thus producing an exemplar document of the method use, and (5) planning and describing a high level target architecture. The project group worked in 15 workshops from late autumn 2006 until April 2007.

Out of current EA methods, TOGAF [28], FEAF [5], and EAG [16] were found to best meet the requirements set for the new method (cf. [17]). The GEA method was engineered by integrating components of these. The first version was published in June 2007 [26]. The method is composed of a conceptual framework (GEA grid), a process model with stepwise, normative instructions, and an array of description models.

The GEA grid is structured by three description levels and four architectural dimensions (Table 1). The description levels are: PA, domains (e.g., a branch of administration) and sub-domains (e.g., a government agency). For the description of the target state EA, the domain level of the GEA grid was denoted as a cluster [26], i.e., a network of organizations, organized around a common goal. Sub-domains in that case were, respectively, denoted as subareas of the development goal of the cluster [26]. The EA viewpoints correspond to four common sub-architectures: BA, IA, SA and TA (cf. [16][5]). The sub-architectures describe, for instance, organization, services and processes of BA, and strategic data warehouses, information assets and vocabularies of IA. IS portfolios are typical descriptions of SA, whereas technology policies, standards and reference models are typical ones of TA [26].

Generic GEA grid in Finland	BA	IA	SA	TA
PA level				
Domain level				
Sub-domain level				

Table 1: Overview of the GEA grid.

The GEA method is to be applied situationally [26]. This implies, for instance, that a suitable approach to the situation at hand is selected. If the process-driven approach is selected, the first steps are taken to develop BA and IA focusing on services, processes and information. In the system-driven approach, the EA development may start with describing current systems and how they might be harmonized or integrated.

The GEA process model [26] is composed of three phases. In the first phase, the scope of the EA work is to be defined, descriptions of the current state EA collected, needs for the change explored, the vision of the target state outlined, and the development project established. The second phase is to produce primary designs of selected viewpoints and levels concerning the target state EA. Stakeholders are then to be identified, suitable description models selected, issues affecting the EA at hand analyzed, the target state EA modeled, the target state plans reconsidered, and the defect analysis carried out. The last phase is to make a transition plan of the implementation projects, to assess and prioritize them, and to distribute the outcomes to the stakeholders [26].

4.2. GEA grid adaptation in two agencies

The Finnish GEA method has been used in pilot projects in two State administration agencies in 2007 [34][39]. Road Administration (RA) under the Ministry of Transport, plans, maintains, and develops highway networks in cooperation with its regional State offices and authorities of other means of transport. State Treasury (ST), under the Ministry of Finance, produces administrative support services for the entire government. In the projects, the agencies applied the newly established GEA method and the GEA governance model (both produced in IDP). In the following, we shortly describe the GEA grid adaptation in the agencies, and analyze emerged adaptation bottlenecks.

RA has been developing EA for many years, and it has been considered as one of the forerunners in public administration EA work in Finland. Until the pilot project, the work had been conducted without a common method. This had led to a situation where EA products were inconsistent and, in some cases, incompatible among the divisions. The work had also been characteristically driven by IT department with only slight engagement of business managers. Some of the main goals of the project in RA were to collect the dispersed efforts together, to increase the involvement of the business representatives, and to reduce the number of overlapping information systems.

The GEA grid adaptation in RA (Table 2) features the original architectural viewpoints of the GEA grid. The description levels (enterprise, domain and systems levels) correspond, for example, to [24],[16] and [3]. The topmost level describes the organization as a whole from strategic, business-driven, and abstracted point of view. The domain level stands for organizational divisions or other operational units of RA. The systems level features the lowest level of abstraction describing, for example, design patterns and reference architectures of systems. The architectural decisions and principles, demarcated in Ministry of Transport and Communication and Government, were given as boundary values of the RA grid.

In ST, the main goal of the project was to establish and design a common architecture for eServices delivery. A sketch of the current state EA was to be produced as grounds for the requirements specification of the eServices platform. In addition, the GEA grid was to be adapted for further ST use.

GEA grid in RA	BA	IA	SA	TA
Road Administration				
Domains				
Systems of a domain				

Table 2: Overview of the GEA grid in RA.

The GEA grid adaptation process in ST was quite straightforward, due to the fact that the adaptation was not the main goal of the project. The description levels were adopted according to the original GEA grid (see Table 3). The domain level was renamed according to the corresponding ministry, and the sub-domain as ST. In our opinion, this way of adaptation lacks the support of EA process as described in [31]. The resulted grid does not fully facilitate the decomposing of strategic plans as subsequent domain and systems implementation. In their post-project feedback, ST suggested a grid which resembled the grid adapted in RA, though.

GEA grid in ST	BA	IA	SA	TA
State administration				
Ministry of Finance				
State Treasury				

Table 3: Overview of the GEA grid in ST.

As seen, the pilot adaptations produced two different outcomes of the GEA grid (cf. Tables 2 and 3). This is partly due to the fact that ST and RA had different liable consultancies in their projects. One consultancy was the same who was involved in the development of the GEA method, but for another the GEA method was new. The GEA method documentation neither indicated nor instructed the adaptation of the GEA grid. There was no direct communication between the two pilot projects either. Unawareness of expected adaptation practices could be sensed in the project with a consultancy with no previous experience of the newly established GEA method. Thus, the consultancy had to ponder the adoption of the method much more, in order to mentally fix it with their EA concepts. They encountered questions of choosing proper description models and relevant abstraction levels thereof. They arrived at exploiting also descriptions of their own, in addition to the GEA method descriptions. RA and ST grids yielded thus diversified description models compared to each others.

At RA, the chosen description levels support the decomposition EA planning into development domains. The description levels of EAG [31] are taken into use. ST took the given GEA grid more or less for granted, partly since the emphasis of the project was on the eServices platform. An inconsistency with respect to the adaptation of the description levels is remarkable, even more since both of the agencies are in a comparable position in State central administration.

5. Research Methodology

Our research has been made as a constructive case study [20] following the design science approach [14]. The goal was to create a model of the Finnish GEA grid adaptation, based on practical work of GEA method engineering and adaptation as well as current literature on method adaptation, EA, and government reforms. Finnish state administration as a complex adaptive system (GEA as CAS, cf. [19]) provided a challenging environment with approximately 130 organizational actors, and a deep hierarchy of administrative levels.

The first author was acting as a participatory observer at the project workshops of the GEA method engineering. Discussions were written down as field notes, tape recorded at most times, and transcribed and summarized. The second author was observing the pilot adaptations of GEA method in RA and ST. These authors attended several events of IDP. The documents of IDP were also available during the study in a shared workspace of Ministry of Finance.

During 2007, discussions with IDP managers and participants confirmed us of the need of the GEA method adaptation guidelines, thus triggering the work to create the GEA grid adaptation model (Geagam, [42]). The work was commented at meetings of the steering group of the Finnish Enterprise Architecture Research (FEAR) project. In addition, the model was validated through stakeholder reviews by key actors of IDP, the consultancies (TietoEnator Oyj, CapGemini) and the State administration representatives (Ministry of Finance, State Treasury, Road Administration).

6. GEA grid adaptation model (Geagam)

6.1. Underlying principles

The GEA grid adaptation model has been built on five main principles driven from literature and our experience in IDP. In the following, they are expressed as requirements for the GEA grid adaptation.

(1) The GEA grid has to support a totality of organizational actors and service providers whether of public, private, or 3rd sector. A very task of EA methods is to reduce the complexity [22] of PA [19] resulting from numerous actors with various, possibly conflicting or overlapping goals at several administrative levels (central, regional and local). An additional dimension emerges with privatization of public service production (cf. [8][18]). For situations like this, no single, fixed, neither too generic GEA grid can tackle the EA modeling needed.

(2) The GEA grid has to support systematic transformation towards a target state GEA. A current state EA describes existing business practices and ICT infrastructures [35] of PA. A target state EA is a strategic expression of will about a desired future state [35]. Following a trend towards modeling business-lines instead of single organization architectures [9], the target state architecture of Finnish State administration aims at cross-sectoral, seamlessly integrated eServices [25] to avoid sector-driven administrative silos. Policy-programs in Finland present a new strategic, political tool to manage these cross-sectoral development goals [29] as presented in Section 3. However, strategic political tools alone can be seen inadequate to support these kinds of changes. Systematic methodical tools are needed.

(3) The adaptation of description levels has to reflect a rational and centrally advised decomposition into coherent architectural entities. In Section 2 we concluded that architectural dimensions (BA, IA, SA, TA) have established themselves, whereas the description levels of EA frameworks still vary. The adaptation of the description levels is problematic if it is not centrally advised (cf. Section 4.2.). GEA grid adaptation guidelines have to advise decomposing of the totality properly and coherently. The adaptation of the description levels have to reflect these guidelines for each architectural entity subject to EA planning.

(4) Use of the GEA grid has to support EA planning at administrative management level. One of the main objectives stated in the Geamep group was to produce a GEA grid that could be adapted for different operational purposes. Three major purposes were expressed. First, the GEA grid should support planning of common, centralized services (e.g., the centralized financial management of State administration). Second, it should provide help in planning of cross-sectoral processes (CSP) of clusters of organizations. Third, the GEA grid should be adaptable into the use of various organizational actors (e.g. a university, an agency).

(5) The GEA grid has to support analyzing and directing a whole-of-an-administration. Besides EA planning of centralized services, CSPs, and organizational actors at central, regional or local levels (cf. organization-specific adaptation [23]), the GEA grid should support the strategic political steering of an administration. Decision making in PA, occurring at the global level, is quite different from that occurring at the local level [19]. The global level aims at balancing the overall interests of many different local agencies [19]. For example, whole-of-government and

whole-of-ministry EA planning should identify and present relevant strategic issues for ministers.

6.2. Types of use as two grid types

In our adaptation model we divide the use of the GEA grid in two types: for 1) strategic use to enhance political steering, and for 2) operational use to enhance management of an administrative unit.

In strategic use, the GEA grid is to model and direct a whole-of-an-administration (e.g., a whole-of-government, a whole-of-ministry). The parts of a large administrative entity are summed up and analyzed through a strategic grid type. *The strategic grid type* sums parts of a large administrative entity in a relevant way. It consists of the description levels of government levels underneath the administration to be steered. The entire picture of the status quo will be summed up through gathering and analyzing EA descriptions of the parts. The future target architecture will be further outlined to eliminate overlaps, to reorganize the structure, to form new coalitions for cross-sectoral goals, and to share responsibilities for different actors.

In operational use, the GEA grid guides modeling of an administrative unit concerning its operational domains and subsequent information systems. *An operational grid type* presents an EA grid adapted in an administrative unit of the government hierarchy in a communicative and relevant manner.

In the EA literature, there seems not to be an EA artifact suitable for the strategic grid type. For the operational grid type, we propose the EA management grid (EAG) by Hirvonen and Pulkkinen [16][31][32] adapted in the government hierarchy. It was utilized in the pilot adaptation in RA with promising experience. We push this idea further by adapting the EAG in other administrative management purposes.

6.3. GEA grid in State administration

Based on the aforementioned principles and types of use, we have engineered a GEA grid adaptation model (Figure 1). It is composed of four grids illustrating the strategic and operational use. The grids share the established architectural viewpoints of BA, IA, SA, and TA. Each grid contains three description levels for its purpose. Albeit the Geagam seems to result in a bunch of grids in usage, the contents of different grids can be of two main options, that of the strategic or the operational type.

State administration grid exemplifies the strategic use of the GEA grid. The operational use is exemplified with EA grids for a centralized solution, a cluster and an organizational actor. The arrows signify the positioning of the three operational grids in respect to the topmost State administration entity, thus reflecting the decomposition of the totality for EA planning. The contents of the operational grids are explicated in the legend. The patterns in the cells of the State administration grid are not explained, since the grid analyzes and sums more government parts in summary than those that can be illustrated by the three operational grid instances. It should be noted that the number of actual grids depends on the situation at hand. The four grids in Figure 1 have been derived for the needs of Finnish state administration from the Geamep discussions (cf., [41]) and the overall research case setting. In the following, we describe the grids and their use in more detail.

The State administration EA grid illustrates the strategic grid type for the highest purpose. The grid user collects information of branches and agencies thereof, yielding the global picture of the "as is" State administration architecture. This work should be facilitated by a centralized repository of architectural descriptions, as repeatedly argued in the Geamep group. The State administration grid is to support communication between the highest officials and Government, where the latter decides on future directions. Thus, the produced descriptions have to be conceptual and abstract, where excessive details are to be obscured.

The operational grid types present grids with a narrower scope. *The EA grid for centralized solutions* guides the planning and implementation of a common, centralized service (e.g., a central register, a central unit for support services, etc.). *The EA grid for a cluster* is used to develop and implement common goals of a cluster. For example, there is a lack of customer-driven process architectures in child welfare. Different officials of child welfare should consider the continuum of a child's life and plan the service process among different service providers accordingly. The uppermost cluster level of the grid could include strategic descriptions of the cluster (e.g., goals, agreements, and commitments). *The EA grid for an organizational actor* (whether an agency, an enterprise or other organization) guides the strategic planning and management to take into account the organizational environment.

In the State administration grid, the description level of *branches of administration* and the subsequent level of *agencies* present recognized pressures and challenges, conclusive maps of core business functions, information assets, technologies and constraints etc. Architectural pictures of different branches, and parts thereof, are compared with each others, and their shared and specific needs with possible overlaps and conflicts are revealed. Based on this information, essential shortcomings are recognized and presented at the highest level. The *state administration level* contains models and descriptions that bring value for Government.

The optional level of *clusters* in the State administration grid can be utilized in the formulation of the target state EA parallel with capturing of the current branches. New co-operative organizational forms can be designed to by-pass the current state administrative silos. Plans of adding, deleting or adapting a branch, or parts thereof, can be made to establish a more effective form of organization or to define virtual forms of organization (e.g., in [33]). The target state GEA provides, for example, future business-lines, clusters thereof, information assets and ICT strategies with well-grounded transition plans. State administration EA planning yields further requirements to branches, organizations and clusters.

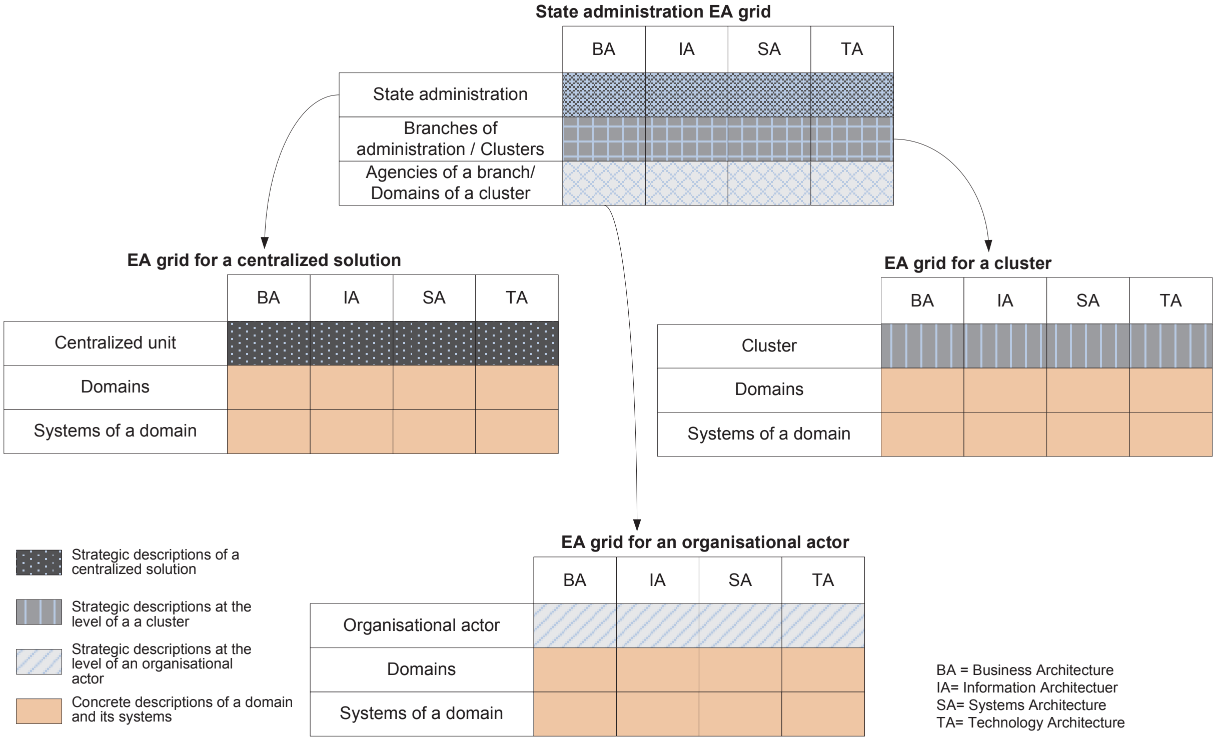

Figure 1. GEA grid adaptation model (Geagam). Examples of strategic and operational use.

In the operational grids for centralized services, clusters or organizations, the description levels of EAG (i.e. enterprise, domain and systems levels, [31]) are adapted. These are equipped with suitable description models. Typically, at the top levels of a *centralized unit,* a *cluster or* an *organization* (Figure 1) future core services are considered in the light of chosen technologies [31]. Examples of suitable descriptions are target state process and services maps, list of central registries, information portfolio, IS portfolio, and current and future technologies [26][34][32]. Moreover, the boundary values (e.g., standards, definitions of policies) of the superior authority must definitely be taken into account [34][26]. Examples of the *domain level* models are various process and stakeholder descriptions, and models on information carried in the processes (e.g., a process-information matrix) [34]. At the level of *systems of a domain,* the models describe, for example, systems requirements, data structures, design structures and platforms of IT systems [34] [32].

To support the application of the Geagam we have constructed a procedure [42] which guides the instantiation of the GEA grid into a concrete EA framework in an agency according to Geagam. It is beyond the space limit of this paper. Geagam has been crafted particularly for the adaptation of the GEA grid wherefore it is an integral part of it. The Geagam exemplifies adaptation of a layered EA grid in a hierarchical set of organisations where the aim is to enhance development of inter-organisational services too. The inherent ideas in the Geagam model can thus be applied with other layered EA grids.

7. Benefits of Geagam

Geagam presents a structure of State administration EA planning descriptions and decisions, offering *(1) a managerial tool to plan and manage adminis-*

trative changes coherently. The purpose of EA planning is to understand the future goals, whereafter their implementation is more straightforward [1]. During the transition, the structure of State administration may be diversiform, since the old and new operational structures may appear simultaneously. Through a coherent method and adaptation, the complexity of the change can be managed.

(2) Geagam helps perceiving State administration as a whole and presenting the "big picture" of it. The current state architecture and the target state architectures need to be captured before organizational change can be implemented. Geagam helps to discern the descriptions of different levels and dependencies between them. When the information about strategic goals and projects is at a comparable level of abstraction, unessential details are obscured. Overlapping or conflicting goals and doubled efforts can thus be recognized more easily. Systematic production and structuring of EA descriptions reveals relevant information and pinpoints the strategic goals of political interest impartially. This enhances the prioritization and selection of the most important strategic goals, and the outlining of the government vision.

To implement the change, *(3) Geagam can help the transformation process* in many ways. During the stakeholder review of the model it appeared that a responsibility of organizing some development efforts (e.g., for a centralized solution) had been delegated to a single agency. Instead of just naming an agency as an implementer, *(3a) an adapted grid can help to recognize the form of organization accordingly to the designed EA plans*. Furthermore, *(3b) communication and commitment among organizational actors is enhanced*. Presenting strategic plans openly based on well-understood whole-of-an-administration architecture promotes discussion and commitment. Moreover, the adaptation model offers a coherent terminology for adaptation. Using the grid types given in Geagam, the adaptation of an EA grid is easier than starting off with a clean slate. The grid types can be applied at different contexts more easily than that of only one original grid in [26]. Thus, *(3c) Geagam relieves the reuse of the GEA method bringing synergy gains*.

(4) By using Geagam the overall interoperability is enhanced through methodical consistency. Without adaptation guidelines there is a risk that different adaptations of the GEA method are not compatible and consistent. This may lead to unnecessary communication problems. The GEA method offers description templates to enhance syntactical comparability [26]. Geagam guides decomposing an entity into architectural sub-entities for EA development. When the decomposition is formed by common guidelines, the comparison of the parts of the architecture is easier. This further facilitates the planning of future goals (e.g., planning of CSPs).

(4a) Geagam supports interoperability across the levels of hierarchy. When national criteria for wide band network implementations were missing, it resulted undesirably in many diversified regional implementations [38]. Alignment of global and local governments is thus to be supported by methodical tools. Vertical interoperability is an ability to exchange information from one level to an upper or a lower level of the hierarchy. The EA planning of an administration and of its underlying units are dependent on each others. Ministries pay attention to the State level boundaries, such as government program, strategy specifications and budget frames, taking them into account in the planning of ministry-wide strategies. Policies on standards, technology usage, and architectural principles are concerns of head officials of ministries. These interests are to be met through EA considerations. For actors underneath the ministries the information of the topmost levels is to be transferred systematically.

(4b) Geagam supports different co-operative forms and interoperability across sectors. Cross-agency architectures and public-private partnerships are encouraged by adapting the GEA grid for clusters. Geagam supports a systematic way to implement cross-sectoral policy programs (cf. Section 3) for which there are no ministries as implementers [29], but which require a virtual organization [33] or other strong means of coordination.

Geagam is a theoretical construct derived from the literature and the practical projects. As far as we know, no such an adaptation model has been explicitly presented. *(5) The model is abstract but advises the practical work at hierarchical domains of PA. It applies to a variety of situations.* In the context of merging several municipalities, for instance, strategic methods are essential. For the planning of the organizational change, EA planning can be organized using respective grid types of the Geagam. They can be applied to support gathering strategic information for the municipal board and administration (strategic grid). The planning of centralized support functions, new cross-sectoral service processes, and merged spheres of authority can be structured by using the three operational grid types respectively.

8. Conclusions

This paper introduced a government EA grid adaptation model (Geagam). The model was built on the knowledge of Finnish government, observations about government EA (GEA) method engineering and its pilot adaptations, and literature. The model is based on strategic and operational grid types used to advise political steering and administrative management, respectively. The previous type was exemplified by a State administration grid to support communication between highest state administration officials and Government. The operational type was suggested for three general purposes, for EA planning of a centralized solution, a cluster or any administrative organizational actor. The Geagam is an inherent part of the GEA grid.

Our model of GEA grid adaptation provides a novel tool for strategic political steering and management of strategy implementation. It supports GEA grid adoption as a strategic tool and facilitates the prioritization of government goals, implementation of government interoperability, and communication and commitment among government actors. The model presents systematic guidelines for situational GEA grid adaptation and reuse thus supporting consistency of adaptation.

Implementation of a common method and its adaptation practices across a large variety of organizations is challenging. Geagam has to be placed in action and applied "in situ" to be subjected to testing. and validation. Moreover, Geagam should be enlarged with guidelines of how to adapt the process, roles and description models of the GEA method. The method offers a large toolkit of possible description models, where situational data of EA development use cases would be of benefit for both research and practice.

New laws on consolidation of municipalities (e.g., [10]) have been passed in Finland, which makes architectural planning important also in municipal administration. The municipalities produce similar statutory services, and deploy information systems in relatively similar processes. Needs for harmonizing emerge. Also strategic political steering in local government is subject to stronger expectations in Finland [40]. In these efforts, a means such as Geagam would be of great benefit to support adaptation of the government EA grid and EA planning. The present job of the first author in a Finnish town which is merging with 5 other municipalities, should enable the applying the Geagam in real situation and gaining of more evidence on the applicability of Geagam.

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EA AS A TOOL IN CHANGE AND COHERENCY MANAGEMENT – A CASE OF A LOCAL GOVERNMENT

by

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EA as a Tool in Change and Coherency Management – a Case of a Local Government

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Abstract

In order to lead a local government towards its politically set strategic objectives, the vision of the overall status quo, as well as of the desired target state of the complex multi-agent system have to be clear. To encounter the challenges of the change management in merging six former local governments into one, in forming a new NPM related operation model, in planning and leading strategic political objectives, and in order to leverage on the information usability produced in everyday governance practices, a Government Enterprise Architecture (GEA) method has been adopted in the city of Kouvola in Finland. The study is a case study by action research adopting the Finnish GEA method in situ by exploiting Gea grid adaptation model (Geagam). The required adaptation of the GEA grid for the case is described and the adoption analyzed.

1. Introduction

Public administration (PA) produces a wide spectrum of services covering almost every aspect of the citizen's life [28]. As such, both central and local administrations are wide entities to manage and guide. Further, there are worldwide challenges to be met, like changing the boundaries and structures of administrations, and building partnerships with the private sector [40]. There has long been a quest for so called New Public Management (NPM) basically heading towards more customer oriented public services, as well as surrendering them to market forces to foster redesign of the organization (cf.[11][22]). Efficiency, accountability, decentralization and marketisation are the main drivers in NPM [11]. E-government has been seen as a next step in the rationalization of government activities along the line of NPM [11]. Using an array of ICTs, governments worldwide aim to redesign dramatically many areas of government activities [11].

PA typically suffers from high complexity of administrative procedures because of many actors and interests, hierarchical and low quality communication, "stovepipe" systems both organizationally and from an information viewpoint, and diverged definitions and terminology [40]. These challenges are evitable in merging of local governments. In the merger, different governance principles and practices, and respective information systems (IS), are to be harmonized according to the strategic objectives set for the new administration. In Finland there is a national state government project [13][3] for the mergers. In our case study, we make an effort to overcome the challenges in a merger of six local municipalities by adopting an enterprise architecture (EA) tool for the change and coherency management to achieve a balanced architecture of the new local government in the future.

The discipline of EA provides a framework to integrate models into one enterprise-wide representation as a valuable asset [40]. In their recent categorization of the EA use, Doucet, Gotze et al. [12] distinctively separate three purposes of EA: 1) for alignment of business and IT to produce a *foundation architecture*, e.g., in [17][36][7], 2) for systematic planning and management of change to produce an *extended architecture*, e.g. in [41], and 3) for coherency management to produce an *embedded architecture*, where the production of EA descriptions is embedded in governance practices to 'leverage on what you already do or produce'[12]. By coherence, [12] is referred to a logical, orderly, and consistent relation of parts to the whole [12]. At its best, EA is used accumulatively for all of these purposes creating a so-called *balanced architecture*, whether in enterprise or public administration domain [12].

In Finland, a government EA (GEA) method [26] was engineered for Finnish PA use [43][45][17] by adapting some existing EA frameworks [27][6][16]. To support the Finnish PA in the adoption of the GEA framework (GEA grid), a special GEA grid adaptation model (Geagam) was constructed [44][45] as a means for the adaptation and adoption among differentiated PA organizations. The adaptation and adoption of

GEA, especially in a government where EA has yet not been adopted, like in the case, is rather complicated. In this study we report first time, how the GEA method is adopted in a real situation by exploiting Geagam. The study is focusing on a Finnish city, Kouvola [7] with ca. 6000 employees and 90 000 citizens, formed by a merger of 6 former local municipalities. In the organization reform, a new Financial and Strategy Management (FSM) unit of the city, including IT Management and Governance team, wished to exploit EA tools, in order to describe and piece together the entirety of the government, to plan, guide and support the change, to lead the strategy objectives, to keep the objectives aligned with the budget and IT, to form a common understanding and objective of the city, and to facilitate the shift towards e-government.

The research forms a constructive case study [19] following action research principles [34]. The aim is to run a practical implementation of GEA adoption with a specific grid adaptation, and to describe and analyze it. The paper is organized into 7 chapters. In Chapter 2 we consider EA, its tools and purposes. In Chapter 3 we describe the Finnish GEA method and its adaptation model. Chapter 4 outlines the research setting and method. In Chapter 5 the GEA grid adaptation in Kouvola is described. In Chapter 6 we analyze the adoption of the GEA. In Chapter 7 we summarize and list needs for further research.

2. Previous research

Traditionally, Enterprise Architecture (EA) has been used to stand for a detailed blueprint of systems, data and technology [39]. Nowadays, it refers to a business vision beginning at the top and resulting in a foundation of IT and business process capabilities [36]. Douce, Gotze et al. [12] add even more on that, by defining EA as 'a young and still evolving management discipline' including all dimensions of an enterprise and uniquely able to serve as the meta approach for designing and re-designing enterprises to compete in highly dynamic public and private sector environments [12]. Also the recent findings of EA practice [29] show, that EA planning projects overlap with management consulting. EA consultants provide not only ICT solutions, but also evaluation and planning of the business for both current and middle term strategies [29]. With *strategy* we refer to 'the plot or the logic of action of the firm for carrying out long-term goals and for creating competitive advantage' [2].

The insight of different EA purposes is not new. Rood [35] divides the uses of EA in two: first in general uses to guide, direct and manage an enterprise, and secondly in information systems development. For her, EA is a conceptual framework that describes how an enterprise is constructed by defining its primary components and the relationships among them [35]. EA in general use is thus a basis for decision making and planning, management of standards, a mechanism for change management, and an enabler of effective communication about the enterprise [35]. Riege and Aier [32] define EA as the structure of an enterprise, where the purpose is to support transformation by offering a holistic perspective on as-is as well as to-be structures and processes. According to [12] 'EA is a large and complex undertaking that allows enterprises to: (1) understand business operations and uncover deeply embedded business rules, (2) elevate the role of information within the organization and treat it as a core asset, (3) understand gaps between information needs of the business and information provided by IT systems, (4) create synergies between available and stable technologies and emerging technologies, and (5) leverage technologies to discover and take advantage of new business opportunities.'

Enterprise Architecture Planning (EAP) is the process of defining architectures for the use of information in support of the business and the plan for implementing those architectures [39]. According to [6], an EAP process concerns modeling for the top-most, strategic level of an enterprise. The typical architectures in the context of the above definition are those of data, applications and technology, whence architectures are like blueprints, drawings or models [39]. EAP is not designing systems, databases or such, though [39]. The EAP process yields a transition plan [29], which defines when the defined architectures will be designed and implemented [39]. EAP as described here can be seen as a convergence of information systems planning (ISP [46]) and strategic information systems planning [29]. It yields the foundation architecture, where business and IT are aligned [12].

For EA planning and development, there are different methods and frameworks (e.g., [6][41][27][16] review in [37]) which are also applied in PA widely (cf. [9][10]). *EA methods* are used for EA planning and implementation, and they consist of a framework, a modeling process, techniques, models and roles [23]. Through an *EA framework*, a complex structure of an enterprise can be modeled from different viewpoints [4]. The framework helps organizing and analyzing the enterprise models and descriptions thus ensuring the consistency of the produced descriptions [23]. The framework also guides EA planning and development process (e.g., [30][31][39]). For example, the framework prior to all, Zachman's Framework, is a comprehensive, logical structure for descriptive representations of any complex objects [7]. EA frameworks are often in the form of a 2-dimensional matrix, (e.g., EAG [30][31], Zachman's framework [47][38], FEAF [6] and TEAF [41]), presenting *architectural viewpoints* as columns and *architectural description levels* as rows. Zachman's framework [38], presents columns, for instance, for functions, data, locations, people and organizations, events which cause things happen, as well as motivations and constraints on the business [15]. The description levels may refer to decision levels of an enterprise [30][31] or other architectural decomposition (cf. [45]) depending on the situation.

Strategic initiatives establish priorities to IT engagement [36]. Strategic planning is typically a starting point in most system development life cycles [15]. Strategy maps [20], corporate goals and policies are often described as a part of the business architecture view of the EA. In Zachman's framework [38], for example, the list of goals and strategies inhabits at the ballpark level of the framework.

Coherency management (CM), as the goal of EA, means that complex enterprises, regardless of the market or government sector, adopt EA as a method for abstracting, analyzing, designing, and re-engineering the enterprise [12]. By coherence, Doucet et al [12] refer to a logical, orderly, and consistent relation of parts to the whole. CM yields an embedded architecture, where everyday governance practices produce EA descriptions systematically [12].

We take a leap to this direction in this study by integrating the EA framework with a strategy framework. Traditionally, in strategic approaches (cf. [21]), the management tracks financial, customer, internal business and process measures, as well as innovation and learning measures, and sets some objectives with respect to each of these viewpoints [14]. The viewpoints, when taken together, permit a complete view of the strategy and tell the story of a strategy in a clearly understandable framework [5]. Strategy modeling in the form of strategy maps depicts the causalities among the goals set across each viewpoint then [20]. Here, a complete view of the vision, strategy and overall enterprise is tried to be captured in the embedded architecture. By integrating the strategy viewpoints with the EA viewpoints we aim at promoting systematic and holistic modeling practices, and transparency in enterprise information management. We adopt EA for enterprise engineering, government and e-government planning, sticking to the wider purpose and definition of EA for the balanced architecture [12] where the foundation architecture, extended architecture and embedded architecture are in use and support each others. In the next section, we describe shortly the Finnish GEA method for an extended architecture in Finnish PA, as well as its GEA grid adaptation model (Geagam) which inherently strives to leverage on the use of the GEA method for an embedded architecture.

3. The GEA method and Geagam model

Finnish Ministry of Finance launched a development programme in 2006 to implement a government policy decision on the development of IT management [25]. It resulted in a government EA method, called GEA method [26], and a GEA grid adaptation model (Geagam) [44][45]. The GEA method, mainly based on TOGAF [27], FEAF [6] and EAG [16] is composed of a conceptual framework (GEA grid), a process model with stepwise, normative instructions, and an array of description models [45].

The GEA grid is structured by three description levels and four architectural dimensions or viewpoints (Table 1). The description levels are: public administration, domains (e.g., in state administration, a branch of administration) and sub-domains (e.g., a government agency, respectively). The EA viewpoints correspond to four common sub-architectures: business architecture (BA), information architecture (IA), systems architecture (SA) and technology architecture (TA) (cf.[45]).

The GEA process model is composed of three phases [26]: 1) defining the scope of the EA work, collecting the descriptions of the current state EA, exploring the needs for the change, outlining the target state vision and establishing a project, 2) designing the target state EA, describing it with appropriate models, and making a defect analysis, (3) making a transition plan of the implementation projects, assessing and prioritizing them and distributing the plan to the stakeholders.

Generic GEA grid in Finland	BA	IA	SA	TA
PA level				
Domain level				
Sub-domain level				

Table 1: Overview of the GEA grid.

The GEA method is to facilitate the planning and implementation of the interoperability of the government services, and the development of eGovernment services [25]. The GEA grid adaptation model (Geagam) supports the choosing and naming of the architectural description levels in a government such that the description levels of EA grid would *(1) support a set of organizational actors and service providers* whether of public, private, or 3rd sector, *(2) guide a systematic transformation towards a target state GEA*, *(3) reflect a rational decomposition into* *coherent architectural entities*, *(4) support EA planning at administrative management level, and (5) help analyzing and directing a whole-of-an-administration* of the organization or the corporate at strategic level [45]. Geagam advices to replicate the generic GEA grid into several co-related grids: into a top-most *strategic grid* for the top-most strategic political and administrative use, and separate, but interconnected *operative grids* for each unit or other centrally advised compositions below the top-most strategic advisory board.

The strategic grid suggested in Geagam strives inherently towards embedded architecture and coherency management, by setting and defining, on one hand, the top-most constraints, objectives, terms and tools for the set of organizations under the highest management, and on the other hand, by gathering the chosen information of the parts, as defined by the set of adapted grids, together to form the holistic picture. The parts of a large administrative entity are summed up and analyzed through the strategic grid type [45]. Architectural pictures of different branches, and parts thereof, can be compared with each others, and their shared and specific needs with possible overlaps and conflicts are revealed. Based on this information, essential shortcomings are recognized and presented at the highest level [45]. Thus the enterprise architecture can be continuously assessed to eliminate overlaps, to recognize new goals, and to share responsibilities for different actors.

4. Research Methodology

Our research forms a constructive case study [19] applying action research [34] principles and practices. Action research (AR) is an interactive inquiry that balances problem solving actions in a collaborative context with data-driven collaborative analysis or research to understand underlying causes enabling future predictions about personal and organizational change [34]. Researchers work as designers and stakeholders with other employees to propose a new course of action in order to help their community improve its work practices [33].

The first three authors have been working in the Financial and Strategy Management (FSM) unit in the new city of Kouvola, as strategy designer, strategy manager and senior officer for the development, in the corresponding order. The first author has taken the role of the researcher, whereas all of them have been designers and stakeholders of the case. The first author has been previously observing the GEA method engineering (e.g., [43]), and also creating the adaptation model for it [45] as a researcher. This study, however, reports first time, how the GEA method is adopted in a real administration by exploiting the created adaptation model. The role of the researcher has focused on defining the research setting, the goals and the approach of the research. After that, the practical and the research work have been intertwined from the recognition of the problem to the implementation. During these phases the role of the researcher has meant continuously reflecting the requirements and constraints of the context with the background knowledge of EA and ISP literature, and the GEA method and Geagam to be applied.

In the autumn 2008, before the merger, the problem of the becoming administration task of the new city was evident, and the adaptation process of the GEA method began. During the AR cycle, beginning in September 2008 until June 2009, different GEA grid purposes with relevant EA viewpoints and architectural levels have been adopted for the new city. The study focuses on the phases of an AR cycle from the recognition of the problem to the implementation.

Planning and constructing of the GEA grid adaptation was conducted by January 2009 when the most relevant purposes for the different grids were recognized, EA viewpoints to be used were identified and description levels outlined. During the autumn 2008 there were 7 workshops to adapt the GEA grid for the new city. The core group of the workshops consisted of the authors, the leader of the Financial and Strategy unit, as well as the controller and the chief information officer (CIO). The work was presented for other stakeholders in ten different presentation or co-development situations. All the products of the adaptation process were recorded along with minutes of the meetings. The documentation made it possible to analytically reflect the needs and requirements of the context with theories.

During the spring 2009, the implementation of the method has taken place. The choices and assumptions made by January have been iteratively elaborated by reflection. The FSM unit has launched many initiatives in the government in order to adopt new governance processes and practices. These have included pilot projects, new ways of modeling, new tools and information systems, four surveys to administrative leaders and politicians, group interviews of the managers about the new governance and GEA principles to be implemented, new administrative bodies for the GEA governance purposes, education, co-development and several presentations. The experiences in the FSM unit, as well as analyzed surveys and interviews, have covered a lot of issues thus bringing valuable feedback and content to the adaptation. The description models identified, developed or adopted during the spring 2009 have been the ones with which the GEA grids adopted have been populated so far.

Here the adaptation of the GEA grid is reported along the AR cycle described above. The adaptation process of the GEA method is still continuing in the future, though, especially concerning the adoption of becoming new GEA descriptions, and the elaboration of GEA planning and management processes.

5. The GEA grid adaptation in Kouvola

5.1. Case Kouvola

The new city of Kouvola, consisting of ca. 90 000 habitants, was formed of the six earlier local municipalities in the beginning of the year 2009. This was facilitated by Finnish Government acts to restructure local municipalities in order to maintain welfare state services also in the future when population ages, the post-war baby boom generation retires, internal migration increases, and economics change in the wake of globalization [3]. In line with the objectives of the national reform, the former six municipalities in Kouvola region were merged to increase the competitiveness, attractiveness and significance of the area, to assure services and to improve the residents' living conditions, to diversify the industrial structure, to balance the municipalities' finances, to develop the administrative structures and to enhance democratic decision-making [7]. As a long term objective Kouvola aims at e-government and efficiency through process automation by open interfaces and SOA architectures.

The organization and governance is changed especially by adopting a New Public Management (NPM) based operation model. NPM is a management theory about how to reform government by replacing rigid hierarchical organizational structures with more dynamic networks of small organizational units, replacing top-down decision and policy-making practices with a consensual, bottom-up approach, adapting a customer–oriented attitude to public services, and applying market principles and practices to public administration [11].

Before the merger, the service production took place in the lowest hierarchical units like at schools, health centre and nurseries. The governance was based on supremacy and management by resources. In the new city, there are four large branches of administration: 1) social services and public health, 2) education and nursery, 3) city planning and infrastructure and 4) branch of industry. Each of these is further divided into two parts, as a service provider organization, and a purchaser, the latter representing policy-makers responsible for the availability and arrangement of the services according to the citizens' needs. The organization model is called 'purchaser – provider model', and is changing but the organization, also operation logic and governance processes. Management by supremacy is replaced by contract management or management by agreement. Service agreements define the attributes of the products and services to be purchased. Providers are coordinated and managed by these agreements. Competition is thus tried to be enhanced by encouraging a future quasi-market with public and private service providers competing of resources from policy-makers (cf. [11]).

Another goal in the new purchaser-provider model is to manage value chains across different providers. This poses a special challenge for service network planning and also for cross-organizational and cross-sectoral process management and planning (cf. [43]). The wished level of standardization and integration should be defined and the processes and systems engaged accordingly (cf. [36]).

5.2. Kouvola GEA grid adaptation

The reasons for and desires of the GEA method have affected the GEA grid adaptation as method requirements. As for the goals of the GEA method, it was hoped *1) to help in managing the change in the merger of the local governments*. It was seen able to facilitate communication, common understanding and will of the target state. It was thought to help clarifying the administrative procedures, enhance standardization and integration, and reduce the "stovepipe" systems. In addition, it was thought *2) to help in leading strategic political objectives* and keeping them continuously aligned with the budget, *3) to offer systematic methodical tools and information for strategic planning of the government* by promoting systematic and holistic modeling practices, transparency, common definitions, terminology, repositories and tools. It was also wished *4) to help in describing and piecing together the holistic picture of the government* for the future agile and proactive reactions, and for planning the new operation model iteratively and *5) to facilitate the specific work of different leaders and experts by systematic governance practices*.

Kouvola city board decided on the EA method adoption for strategic planning in February 2009, with the EA viewpoints taking into account the Balanced Score Card (BSC, [21]) viewpoints, with different grids for the strategic use for the central management, the purchaser, and the provider organizations. In June 2009, further changes to the grid have been presented for the city board yet.

We have engineered a GEA grid adaptation model in Kouvola (Kouvola Geagam). The adaptation principles of Geagam have been applied. Geagam does not advice the adaptation of the viewpoints at all. Thus, for coherency management, we integrated typical strategy viewpoints with EA viewpoints.

Kouvola Geagam (Fig. 1) is composed of four grids, *a strategic grid for the city concern, operational grids for the provider and purchaser organizations and for the centralized support functions*. The arrows signify the positioning of the three operational grids below the concern, due to constraints set by it. The figure depicts the different methodically supported versions: One grid for the city concern, another for the four purchaser organizations, third for the corresponding four provider organizations on each service sector and the 4th for different centralized service providers, e.g., the core IT service provider, the basic financial services (accounting, invoicing, etc.), and the management and renting of constructions.

The grids share the new, *integrated viewpoints* as 1) Service and Customer, 2) Finance, 3) Information and Internal Processes, 4) Personnel, 5) External environment and 6) IT Governance (ITG).

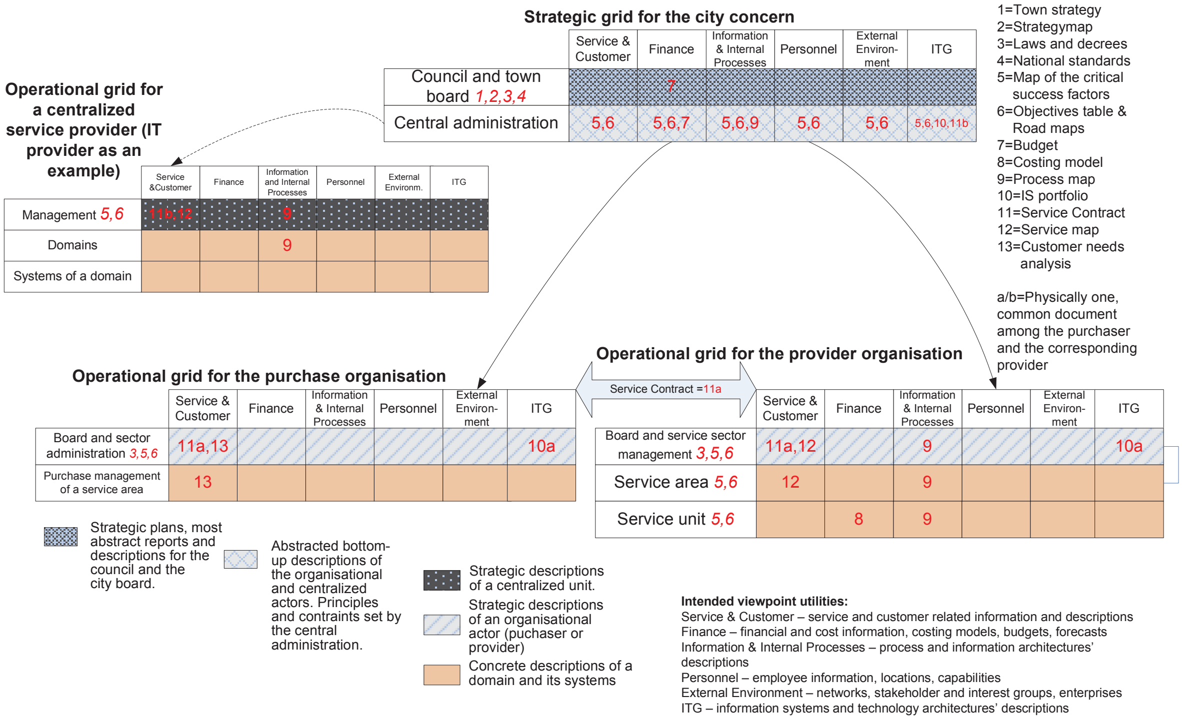

Figure 1. GEA grid adaptation model (Geagam) in local government use at Kouvola city.

In one of the previous cities of the merger, BSC viewpoints had been used for setting strategic objectives. These BSC viewpoints were closely analyzed against the EA viewpoints in the workshop discussions in autumn 2008. During the analysis, the constructed new viewpoints were populated by governance information and descriptions to find out the utility of them. Some of the intended utilities are summarized in the figure (in legend): Service & Customer viewpoint for service architecture and customer descriptions, 2) Finance, for financial and cost information, costing models, budgets, and forecasts, etc., 3) Information & Internal Processes, for process and information architectures' descriptions, 4) Personnel, for employee information, locations, and capabilities, 5) External Environment, for networks, enterprises, stakeholder and interest groups, and 6) ITG for information systems and technology architectures' descriptions. The grid lacks still descriptions for analyzing the information across the different viewpoints. The more traditional GEA descriptions like process maps, IS portfolios, and service maps were divided basically among Service & Customer, Information & Internal Processes and ITG viewpoints.

The number of the *description levels* in each grid varies according to the structure of the organizational actor. The contents of the description levels are noted by colors and symbols, and explicated in the legend.

The strategic grid for the city concern serves at the highest management level. The grid users collect information of the purchasers, providers and centralized service providers, yielding global picture of the "as is" city architecture. The grid is to support communication to the city board and council, where the latter decides on the future directions. Thus, the produced descriptions for them have to be conceptual and abstracted [45]. In the city concern grid, the description level of central administration is for gathering strategic objectives, budgets, services with their cost structures, conclusive maps of core business functions, information assets, capabilities maps, technologies and constraints etc. from the different centralized services, providers, purchasers, and parts thereof, for comparing them with each others, and revealing their shared and specific needs with possible overlaps and conflicts. Based on this information, essential shortcomings are recognized and presented at the highest level of the city council.

The operational grids have a narrower scope. They guide the planning and implementation of individual units, guiding the strategic planning and management of them to also take into account the government environment and constraints set at the upper levels.

So far, Kouvola Geagam has been populated by some of the planned and implemented descriptions, like definitions of policies, regulative constraints, national standards, strategy descriptions, process descriptions and costing models. Information systems portfolios have been gathered with the different actors. The service contracts between the purchaser and the provider are ready to be politically accepted, presenting the service catalogues of each provider. Customer needs analysis to be made by the purchasers of each service sector has been advised. The managers of the central administration (personnel manager etc.) have produced their success factors together, and grouped them according to the GEA viewpoints. Figure 1 shows the situation in late summer 2009.

In the near future, the CIO is interested in populating the relevant cells of the Kouvola Geagam with suitable descriptions for IT governance, and planning of e-government and process automation. The provider–purchaser model has been applied in IT service domain. The CIO sitting in the FSM unit, contracts about the IT services (like hardware etc.) with the centralized IT service provider. The plan is to populate the grid of the IT provider and the ITG columns of the other grids together with the IT provider and the ITG team, to provide most utility for both of them. We have special interests with the ITG team to explore how the original Finnish GEA method descriptions would sit into the Kouvola Geagam to facilitate the information change between the central IT management, the centralized IT provider and other actors. The ITG team has their own "cells" and descriptions in the Kouvola Geagam, and the centralized IT provider has their own grid as well. If the providers maintained life-cycle information of their information systems (ISs) in their grid, for instance, the changes in the intended life-cycles of their ISs could be automatically updated through a 'systems vs. platforms' matrix to the IT provider's descriptions. Thus the IT provider could manage the platform configuration agilely.

As such, the grids are capable of mediating information between the users. The GEA work should be facilitated, however, by a centralized repository of the architectural descriptions [45]. The adoption of the grid in Kouvola has brought forth needs for IS support concerning business graphics, description repositories, description tools, management information systems, data warehouses and their interoperability, etc.

6. Discussion

6.1. Benefits and challenges

In Kouvola, benefits gained from the adaptation so far have been many. Geagam appeared to be useful in the complex local administration by promoting the identification of the needed grids, their purpose and the proper description levels. The adapted viewpoints of the grids reduced the number of frameworks needed in the enterprise communication. For instance, the BSC framework is not needed anymore as a separate strategy method. The adapted Kouvola Geagam with the set of grids, levels and columns has also provided a user interface in the configuration and adoption of a software tool for strategy descriptions.

The GEA adoption in Kouvola has helped to launch a new notion of *holistic consideration* of different strategies, operation models and architectures as a new, common task of the leaders. As is stated in [12] 'EA can provide the context and standards for implementing a number of industry and government best practices including strategic planning, capital planning, service-oriented architecture, information technology infrastructure libraries, knowledge management, program management, security controls, internal controls, quality management and human capital management'. Leaders with these responsibilities in central administration have recognized their interplay more consciously. A new body of these leaders has been launched for the holistic consideration and strategy management purposes.

We would say that EA descriptions have now been embedded in the everyday strategy governance in Kouvola [12]. A systematic way of describing the critical success factors of each actor, with their targets and measurements, has been launched. All the strategy descriptions together are surrendered for the holistic consideration, and will be grouped and prioritized in various ways and by various combinations of actors.

The adapted grids help there to identify the possible ways for abstraction and comparisons. The output will reveal, e.g., the essentials for the long time period, thus helping to overcome obstacles in having short political steering periods.

In the merger, the process descriptions have appeared to be a central tool for the change management. Different service sectors, combined of the organizations of the six former municipalities, get thus help for the harmonizing of their practices. The ITG team has adopted and gathered the information fot eh IS portfolio, which from now on, as a current state architecture, facilitates the procurement of the needed information systems. Thus, the aimed use of GEA as an embedded practice in the holistic consideration, has not excluded the need for the traditional foundation nor extended architectures, as [12] also agree.

However, there have also been several challenges in Kouvola adoption. The GEA viewpoints were produced by integrating the BSC and EA viewpoints, because traditional EA viewpoints (business, information, systems and technology) were not able to cover the products of the common governance practices. Not everybody saw the construct as a coherency management tool, as they did not realize the ITG as a new viewpoint essential. This may be due to the old-fashionable attitudes, where IT is not seen but a support function, and not as a strategic chance, as ‘a central concern’ [29], as inherent in the EA discipline.

Adopting EA for coherency management is a slow process [12]. Also in Kouvola we are still very far from the desired state. The change is going faster than the adoption of GEA as a coherency management tool. In the urge of privatization, many functions are striving for autonomy, without a proper analysis of the shared information needs and without commitment to systematic and transparent information sharing. This hides a risk to slip back to the former situation of many small actors, where partial optimization is common and holistic consideration is not possible.

The biggest challenge met might be the changing of the way of thinking required for coherency management and holistic considerations. Leaders still tend to think ‘in silos’, even old municipalities exist no more. Instead of them, they tend to focus on their new management sites. The common will is still far to reach and should be much more heavily facilitated by added resources into different kind of EA based discussions. In addition to that, the governance information, even though being mostly public, is hard to access. In the organization, there exists an ancient and static practice concerning information management, storing and distribution, where the data is stored into silos. A proper, extensive, easy-to-use IS support for producing and maintaining EA information will be one of the critical success factors of the utility of the method.

6.2. Implications

Based on our study, we would like to conclude that the strategic grid for a complex organization helps to abstract, analyze, design, and re-engineer the enterprise as required of EA in [12]. Thus, we suggest that a complex government or corporate would apply an EA grid as more than one instance, where the set of the grids, organized as strategic and operational grids of the Geagam model, could support the coherency management and change management.

We also suggest the application of the EA method as a framework for strategic planning of an entire enterprise. The IT strategy and management are considered as a part of the larger picture in this view. For this purpose, we suggest integrating EA and strategy viewpoints into an EA framework. Tarabanis et al. [40] also note the overlap of strategic and EA viewpoints in their high level data model for strategic planning in PA, based on business strategy literature.

An organization bases its strategy on certain logic [2], whether aiming to goals concerning customers, resources, products, or growth, just to mention few of the generic strategy models [1]. Ala-Mutka [1] suggests that the strategy of a corporate should be modular, so that the parts of it could be changed agilely [1]. Through systematic modeling practices, a foundational assembly of enterprise models of a complex organization could be provided and maintained in the areas considered important to the organization to provide a holistic model of the business and the strategy. Using EA for an embedded architecture would yield such a repository to be further used as a base library of models for agile, modular strategy planning where a part of a corporate could change its strategy logics independently without slipping to partial optimization.

Based on the single case study, we do not claim any universalities, especially when the adoption of EA is in its initial phase in the case, where only the EA grids, their viewpoints and levels have been identified, adapted and implemented. In the course of further adaptation and adoption, the utility of the GEA method has to be continually estimated. More descriptions are needed to populate the grid, and more experience from the usability of the grids for coherency management needs to be gained. This means more work to find the relevant information and descriptions into the grid, firstly through getting commitment to information sharing and transparency among the actors.

7. Conclusions

This study described and analyzed the Finnish government enterprise architecture (GEA) method adoption in the city of Kouvola, by exploiting the Finnish GEA adaptation model (Geagam). The research formed a constructive case study in situ following action research principles.

We concluded that Geagam for a complex organization may facilitate the coherency management. As a practical implementation, a complex government or corporate would adopt an EA grid as more than one instance, where the set of the grids, organized as strategic and operational grids of the Geagam model, support the holistic consideration of the descriptions. In addition to that, we suggested the application of the EA method as a framework for the strategic planning of an entire enterprise. Practically, we suggested integrating the EA and strategy viewpoints.

The adaptation and adoption of the Finnish GEA method is in progress in the city of Kouvola. The different GEA grids to be used for the city, their viewpoints, architectural levels and some of the EA descriptions have been identified, adapted and implemented. For these, a proper evaluation has to be run after some time of utilization.

For further studies, we suggest conceptualizations of how the division to the embedded, extended and foundation architectures can categorize the EA frameworks and the EA tools. Secondly, traditional EA descriptions support typically the goals of one organization. A local municipality is a multiple-domain and multiple-organisation enterprise, and methodical support for the planning and development of its cross-sectoral goals, processes, and services should be facilitated still more. The IS support of EA information management should also be studied.

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VI

ENTERPRISE ARCHITECTURE DESCRIPTIONS FOR ENHANCING LOCAL GOVERNMENT TRANSFORMATION AND COHERENCY MANAGEMENT

by

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Enterprise Architecture Descriptions for Enhancing Local Government Transformation and Coherency Management

Case study

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***Abstract*—Local governments cover multiple service sectors and are typically organized into diversified, deeply hierarchical organizations. Public services offered are tangible, mostly non-IT-critical, and heavily dependent on human resources. Information management is mainly manual in strategy and management processes. In this case study of a large Finnish local government organization, enterprise architecture (EA) is proposed as a tool for improving the coherency of the local government and its alignment to IT and other resources. We ask, what kind of EA descriptions local government agencies need for coherency management, and how to organize them. We apply action design research principles at the Kouvola City concern by adapting the Finnish Government EA Grid there. The business architecture is unfolded to evaluate the target state for a planned change. The results give new insights into transformation of the local government towards new public management related operation models, government-IT alignment, and further development of EA description tools and repositories for public administration use.**

Keywords - enterprise architecture; business architecture; public administration; local government; change and coherency management; business IT alignment

I. Introduction

Local government is being strongly re-organized, e.g., by fusions and privatization (cf. [12]). Effectiveness and efficiency have become crucial, whence e-government has been set as a critical success factor. Effective changes, however, would presume design activities, e.g., analysis of customer needs, planning service and government structures, human resources, information systems, and costs. All these aspects depend on each other. Designing the target state of a government should be seamlessly supported by blueprinting methods, which can be facilitated by enterprise architecture.

Enterprise architecture (EA) is a systematic, common tool for public administration design [14][15]. EA has proven its power in IT organizations as a tool for strategic IT management [37], where a shift from information systems planning [72] to enterprise architecture planning [62] can be seen. Doucet, Gotze et al. [14][15] state that the purpose of EA reaches beyond business IT alignment into change and general management, which are especially necessary in complex organizations like local government. In addition to being blueprint, EA can be seen as common language, and common decision [61] that enhance consistency, coordination and coherence in an organization [51][14][15].

This study focuses on a Finnish city, Kouvola [11] with ca. 6500 employees and 90 000 citizens, formed by a merger of 6 former local municipalities. We ask what kind of EA descriptions a local government needs for coherency management, and how to organize them for that purpose. Our objective here is to outline some EA models and descriptions in an EA framework to support coherency management in the multi-domain local government.

This study forms a continuation with previous studies concerning Finnish Government EA grid adaptation: A government EA (GEA) method was engineered for Finnish public administration [40]. The method engineering work was reported shedding light on the general GEA method requirements [25]. Secondly, the special method requirements of business architecture development in PA were reported [65]. A special GEA grid adaptation model (Geagam) was constructed [68][69] to support all kinds of PA organizations in the adoption of the GEA framework (GEA grid). This was later adopted and elaborated at the Kouvola City concern for the local government [70]. Here we wish to further refine the Kouvola Geagam.

Our case study is based on action research design principles, adapting the Finnish Government EA Grid at Kouvola. The results are based on the GEA work at Kouvola city from the latter half of 2009 to the end of 2010, on the refinements and recommendations of the Finnish GEA method for Finnish local governments by Ministry of Finance [29], as well as on the latest EA literature, e.g., [1][3][16][26][56][14][15].

In the following we first discuss EA frameworks and their use for different purposes, especially in PA. In Chapter 3 we present the case as a part of Finnish GEA development. Chapter 4 describes the research setting and method. In Chapter 5 the Kouvola GEA grid adaptation model is presented. Chapters 6 and 7 discuss and summarize the results.

II. Related work

Enterprise architecture (EA) has emerged in response to perceived need for more overview of and control with growing systems complexity in large enterprises. The first EA frameworks [17][73] and methodologies [62] were elicited from IS development needs. Later, the focus shifted to information management in federated organizations. Development of EA frameworks was boosted by government initiatives: The US Federal EA [9][10] triggered by legislation in the mid-90s was a milestone followed by GEA work in several countries [35]. The Open Group TOGAF [47] comprises an EA body of knowledge, sourcing especially the large base of governmental EA but also consulting methods. Mature EA methodologies in large organizations cover the ICT planning, management and development.

As the EA is inherently intended for managing complexity, there is a need to structure the whole to confined focus areas, in order to enable separate concerns for efficient decision making on the one hand, and on the other hand, as importantly, to establish the dependencies of the matters and issues in different dimensions. This is essential for collaboration and coordination of ICT management and planning [50][51]. In a meta-level analysis of the existing frameworks and consulting methodologies, a consensus on four EA dimensions has been established: business architecture, information architecture, systems architecture and technology architecture [23].

A study of practical EA work [22][51] reveals that within these dimensions, models and descriptions of EA three levels of abstractions are found: the levels of (1) an enterprise, (2) its domains and (3) subsequently, information systems [23]. The levels reflect three meta-levels of decision making in organizational hierarchies [23] in line with organizational studies, e.g. [13]. EA planning process flows from the strategic enterprise level towards concrete domain and systems levels [49].

Besides managing technology and systems architectures, EA has gained momentum as a business development tool. From business-IT alignment, the EA methodologies are evolving to strategic management approaches with a business–led approach, and further, to coherency management [14][15]. Doucet, Gotze et al. [14][15] separate three purposes of EA: the alignment of business and IT to produce a *foundation architecture*, the systematic planning and management of change to produce an *extended architecture*, and the coherency management to produce an *embedded architecture*. As regards the production of EA descriptions is embedded in governance practices to 'leverage on what you already do or produce' [15]. Coherency refers to a logical, orderly, and consistent relation of parts to the whole [15]. At its best, EA is used for all three purposes whether in a complex enterprise or at a public administration [15]. Modeling has the ability to enforce innovation, quality improvement, new designs, and strategic change decisions e.g., in [4]. The models used to convey EA information are an essential means of collaboration between the different stakeholders in the organization.

EA methods are typically adapted from well-known frameworks, or defined locally both in private [59][60] and public sector [7][8]. Local government covers multiple service sectors [48] and is typically organized in diversified, deeply hierarchical organizations [27]. The services offered are tangible, mostly non-IT critical, and heavily dependent on human resources. Information management is often manual in strategy and management processes [67]. Effects of a strategic change decision are analyzed largely in terms of costs and human resources, not always of IS architecture [26]. PA as a context thus sets specific requirements and constraints on the EA method [27]. An EA framework is in a key position there, having the capability to structure the EA descriptions and to guide the EA planning process [51].

PA in Finland [71], as well as in other Western countries [20][6], has been shifting from a hierarchical structure towards a matrix and process organization. Traditional PA organizations thus become involved, in describing their processes [20]. The shift towards new public management (NPM) [12][32] presumes better performance management [6], as well as better management of operations models (cf. [54]). Privatization and adopting purchaser–provider models bring forth the evident change of the operations logic and governance processes. Purchasing and arranging of services presume different perspectives of the administration, e.g., managing supply chains from various providers to customers. This poses special challenges for cross-organizational and cross-sectoral process management and planning [67].

In our study, we wish to present a case study of a local government, where the EA work towards embedded architecture is to promote the local government capability to encounter these administration challenges in the long run. The case depicts an on-going attempt in adopting EA for a local government coherency management purpose, the latter being a rather new concept in EA literature (cf. [14]).

III. Case Kouvola as part of the National EA

The Finnish Government has proposed to Parliament the so called information management law in late 2010, to enforce interoperability and compatibility of information systems in the public sector [38][39]. The control over the State's information systems architecture is to be shifted to the Ministry of Finance [18]. Local government in Finland, however, is based on municipal self-government, and has been independent concerning the organization of information management and e-government [38][39]. Ministry of Finance guides the co-operation by a national networked organization to promote the compliance to standards and administrative principles of the public sector information management [28]. This poses challenges to the coherency of the local government enterprise architectures. The law, however, will presume enterprise architecture modeling efforts by public organizations including municipalities [38][39]. Municipalities in Finland are also currently planning the centralization of their information management on a voluntary basis, in order to be able to face the challenges of the future law, and to ensure the coherency of their target state systems architectures.

Finnish Government has engineered several design tools for GEA since 2006, including a method for GEA planning and development, *GEA method* [40] and *GEA governance model* [41]. The tools were originally built for the State Administration, but [40] have recently been refined into a national standard for Finnish municipalities [29]. This standard remains still rather general as to the adaptation and adoption guidelines for a diversified multi-domain organization. It considers the architecture as a hierarchy of architectures needed for designing and modeling of a local government at different decision making levels [68][69].

Kouvola is a new city with ca. 6000 employees and 90 000 citizens, resulting from the merger of six local municipalities in 2009 [11]. The organization structure has been under continuous change. First, there were four branches of administration along with central administration. Each branch was further divided into a service provider organization, and a purchaser, the latter being responsible for the arrangement of the services. Management by supremacy was replaced by contract management [70]. Second, from the beginning of 2011, the four branches were united in two: 1) the town development, incl. city planning, infrastructure and branch of industry, and 2) wealth, incl. public health care, a local hospital, social services, education, and nurseries. The former is a genuine purchaser, since all the providers of the branch have an entrepreneurial form. The latter, to some extent, goes back to management by supremacy, since most producers are part of the city government. Due to continuous changes, also in future, the GEA tools have to be flexible.

Kouvola has been one of the forerunners among the Finnish municipalities in GEA adoption. National GEA tools have been adapted, and some architectural descriptions adopted. The GEA grid was first adapted for the embedded architecture, in order to describe and put together the entirety of the government [70]. Since then many kinds of descriptions have been piloted and some of them have been taken into use. Next, we shall describe more carefully the GEA work in the city of Kouvola.

The GEA tools were first used to support the general management in everyday work as embedded architecture [14][15] and as the traditional foundation architecture [14][15] in IT management. In Finland, EA is wished to be a tool for the general and operative managers as well as in IT management [38]. In Kouvola we have approached this goal by enhancing the foundation architecture and the embedded architecture concurrently: 1) in general management, by proceeding with the strategy and process descriptions, and 2) in the IT team with the government change management and IT alignment goal [54]. This parallel and iterative, 'bit and pieces' approach is a way to introduce a completely new subject to leaders in order to bring in coherency management, where foundation, extended and embedded architectures might be efficiently exploited as multiple modes of EA [15]. Next we describe the efforts done in both general management and in the IT team for GEA implementation.

Main descriptions adopted in general management have been 1) strategy, 2) service, and 3) process blueprints. In late 2009 and early 2010, the town strategy was implemented by depicting the strategies of the various organizational actors as roadmaps. The blueprints across the organizational agencies formed the strategy architecture of the city. Service architecture was described in 2009 and 2010 by service contracts between the purchasers and the providers. The service groups were described for all the services of the city. Process architecture has been described for different purposes, e.g., for productization and to establish new organizational structures. A description tool for process and strategy descriptions has been introduced, process description notations standardized, and main users of the tool educated to act as process consultants.

In Kouvola, CIO leads the IT team of four IT coordinators. The team is responsible for systems specifications, coordination of the IT investments, IT architecture, interoperability, information security etc. The IT team is interested in the foundation architecture descriptions for alignment of government with IT, assuring IS support in any change situation of the organization and supporting strategic service innovations and e-government. The IT team launched several EA initiatives in 2009 and 2010, such as 1) EA capability fostering, 2) GEA governance model development, and 3) SOA platform development. GEA capabilities have been added by educating the IT team on EA theories, national GEA tools and Archimate descriptions. The first version of the GEA governance model was adapted for local government IT use in early 2010, especially for the management of systems and technology architectures. According to the model, the IT team acts in the role of IS/T architect. Governance process yields annual IS roadmaps aligned with implementation resources and ensures coherent IS and IT architectures with locally and nationally interoperable systems. The GEA evaluation of any project against IT criteria has also been embedded in the project portfolio management process recently engineered for the city, e.g., from [41]. The systems solutions are to be estimated in terms of scalability. To enhance the further development and implementation of government IT alignment and e-government, the requirements of Kouvola's technical e-government platform were specified with the GEA method, and implemented with SOA principles and technologies.

IV. RESEARCH METHOD

Our research forms a constructive case study [31] applying principles and practices of action design research (ADR) [57]. ARD is a new approach, combining two commonly used scientific rigors, action research [52] and design research [21]. Action research (AR) 'is an interactive inquiry process that balances problem solving actions implemented in a collaborative context with data-driven collaborative analysis […] enabling future predictions about personal and organizational change' ([52] according to Wikipedia). Researchers work as designers and stakeholders with other employees, to propose a new course of action and to help the community improve its work practices [53]. The first two authors have been working at the city of Kouvola, as strategy designer and as chief information officer (CIO), respectively. They have acted as designers and stakeholders in the organization, responsible for the research setting of the paper and instutionalization of its results.

Both of the methodical rigors are iterative in nature. In design research (DR) the iterations contribute to re-design of technology or an IT artefact [57]. An IT artifact in our case is an EA framework, which is being adapted for a local government [27] for coherency management, through an adaptation model [69]. In AR, the iterations contribute to an organizational intervention [57]. The long-term effect of our artifact is to support the development of a more systematic governance model for the diversified local government in the future. The expected effects are better leadership and organizational consciousness. However, this would presume a far-reaching change process concerning the entire organization culture of the town.

The theoretical aim in DR, is theory abstraction on design principles [57]. Here, we wish to enhance the organizational design and government IT alignment knowledge in PA. In AR, the theory abstraction is done on the effectiveness of change [57]. Knowledge is created through intervention to effect change, and reflecting on this intervention [57]. We urge the utility of systematic EA tools [3] in coherency and change management. So far, we have taken into use descriptions at various organizational levels and functions (cf. Ch.3). The new practices are to, e.g., enforce embedded architecture by facilitating active and participative leadership practices by blueprints. The common interest 'anticipated by the research group' [57] has been the urge to adopt a common GEA framework for the coherency management of the local government, as a means of common understanding, language and blueprint [61], and further, to enhance the interoperability at all levels of the municipality [26]. In this paper, we ask especially, what are the organizational descriptions needed for coherency management at a local government organization.

The research is based on earlier and on-going national GEA efforts. The first version of the Finnish GEA method [40] composed of a large conceptual framework, a general-level process model, a set of description models with templates, and normative instructions for how to apply the framework. It was adapted in pilot projects in State Treasury and Road Administration [69][58]. A general Finnish 'Government enterprise architecture grid adaptation model' (Geagam, [69]) was created as the first guideline for applying the GEA grid to the Finnish public organizations. It included preliminary guidelines for adaptors and adopters [68][69]. The Geagam instructed to recognize the fit between the description levels of a government and the heterogeneous needs of the different administrative roles.

Geagam has consequently been applied at the city of Kouvola in 2009 [70]. The description levels and viewpoints for the new organization were considered with some exemplary descriptions populating the grid. In the current study, we analyze more specifically the description roles and responsibilities of the different types of the organizational actors and the viewpoints for coherency management. The descriptions and models are identified and situated into the set of grids, based on the work done at the city of Kouvola (described in Ch.3), the latest Finnish GEA work [29], and EA literature [1][3][16][26][56][14][15]. Concerning Finnish GEA work, we take into account the set of GEA descriptions included in [29]. Kouvola Geagam is being built iteratively, the second version of which is presented here.

The results reported here have been mainly produced in June and July 2010, by the first two authors. We had ten workshops approximately two and a half hours for each, for the redesign of the framework, and for the depicting the dependencies of the descriptions situated in the grid. The latter illustration will be introduced in our future publication. When populating the grids with the descriptions, we asked ourselves, what descriptions are already in usage, in test use or are still needed. Further, we asked which viewpoint each blueprint is representative of, and at which organization type and decision level the responsibility for the modeling and maintenance of the blueprints exist. We also refined the order, contents and naming of viewpoints and whether they are still appropriate [70]. The choices were made based on our common understanding on Kouvola local government, and the GEA efforts and the needs acknowledged there. In every workshop we produced several iterations of the presented results. Memoranda of the discussions included the used references, comments, and conclusions of the workshops. The role of the first two co-authors was also to reflect on the GEA requirements and constraints of Kouvola context with the background knowledge of EA and ISP literature. The results are described in the next chapter.

The results have been evaluated in a half day workshop with the four IT architects of the town. The evaluation session was organized as a semi-structured group interview by the first two co-authors, emphasizing the utility, content and presentation of the framework. The comments were documented as a memorandum by the first author. The evaluation of the previous version [70] has been made in group interviews of leaders, and in queries concerning the strategy architecture management. The details of these evaluations are to be published later, but have already been taken into account here. In ADR, the phenomenon of interest does not remain static through the research process [57]. Since the Kouvola grid adaptation model was created, a new organization structure emerged in 2011. The reported adaptation model at hand is evaluated against the new organizational structure in use from 2011.

V. GEA GRID ADAPTATION AT KOUVOLA CITY

Here we present the GEA grid adaptation model, called Kouvola Geagam, for the local government at the City of Kouvola, and show how this model is used to organize a large variety of models and descriptions for governance. The model is aimed to support more systematic, transparent and participative management practices and to enhance the coherency management of the city [15]. The goals of the Geagam are as follows: It should 1) provide a common frame of reference for thinking [51], 2) show the necessity of blueprinting of different organizational aspects of a municipality, 3) facilitate the EA work of IT architects, e.g., [16][37], and 4) offer support for all function leaders.

The Kouvola Geagam (Figure 1) is composed of three grids which represent the roles of different organizational actors in the city: a strategic grid for the city concern and two operational grids, one for provider and another for purchaser organizations. The thin arrows signify the positioning of the operational grids below the strategic grid of the concern, due to constraints set by central management and city council on the other organizations. Service agreements between the organization types are depicted by thicker arrows. The number of the description levels in each grid varies according to the decision making levels of the organization types. These levels in the strategic grid are the Council and town board, and the Central administration. In the purchaser organizations they are the Board and sector administration, and Purchase management for each service area. In the provider organizations, there are three levels: Board and service sector management, Service area, and Service unit.

The other dimension of the grids is defined by six viewpoints: Operational Environment, Service & Customer, Information & Data, Personnel, Systems and Technology, and Finance. Operational Environment reflects the external boundary conditions and strategies how to react to these. Service & Customer (S & C) relates to the services provided to customers. Information & Data (I & D) refers to all the data and information collected, processed, stored, and disseminated by the local government. Personnel concerns employees, their capabilities, locations and roles etc. Systems and Technology (S & T) stand for information systems and technology architectures. The viewpoint of Finance is for financial and cost information.

Since we are focusing here on the providers serving town customers, the grid for support function providers in [70] has been omitted here. Centralized support functions, such as rental management, core IT services, and financial services serve the organization of the town. Functional leaders in the central management typically design the organizational service needs in co-operation with other organizational stakeholders, and sign agreements for these support services. For example, CIO buys IS and IT services, and the head of the FSM unit buys financial services. Most centralized providers could utilize the operational grid for providers with slight adaptations.

While making plans and decisions from a certain viewpoint, signified by the column, by a government unit, signified by the row, each number in the corresponding cell signifies the models and descriptions at hand. Models (e.g. strategy roadmaps) are depicted at all relevant decision making levels. The content, however, is specific to different roles and service domains. Table 1 lists the models and documents with the identifying numbers, categorized in the six viewpoints. In the following, we describe them in more detail.

The models and descriptions in Operational Environment relate to the local government dependencies. Finnish local government operations are dependent on a multitude of laws [18], decrees, standards, external organizations, actors and stakeholders as well as external, national or geographical reference strategies and architectures (models 1-3). Strategic choices [43] are formed typically through the analysis of the strengths and weaknesses of the current state, and the threats and opportunities of the future state of the organization (SWOT analysis [30], models 4). Strategic actions and goals are planned and modeled as roadmaps (models 5). Centralized strategy modeling notations and tools yield the so called Kouvola's strategy architecture with comparable descriptions among different organizations. Strategic choices and goals constrain and direct also the architectural principles and the strategic business requirements (models 6-7). In order to evolve towards coherency management, (1-5) are to guide the design of other viewpoints, e.g., service design [4], systems planning and acquisition, human resource (HR) design, cost analysis and budgeting.

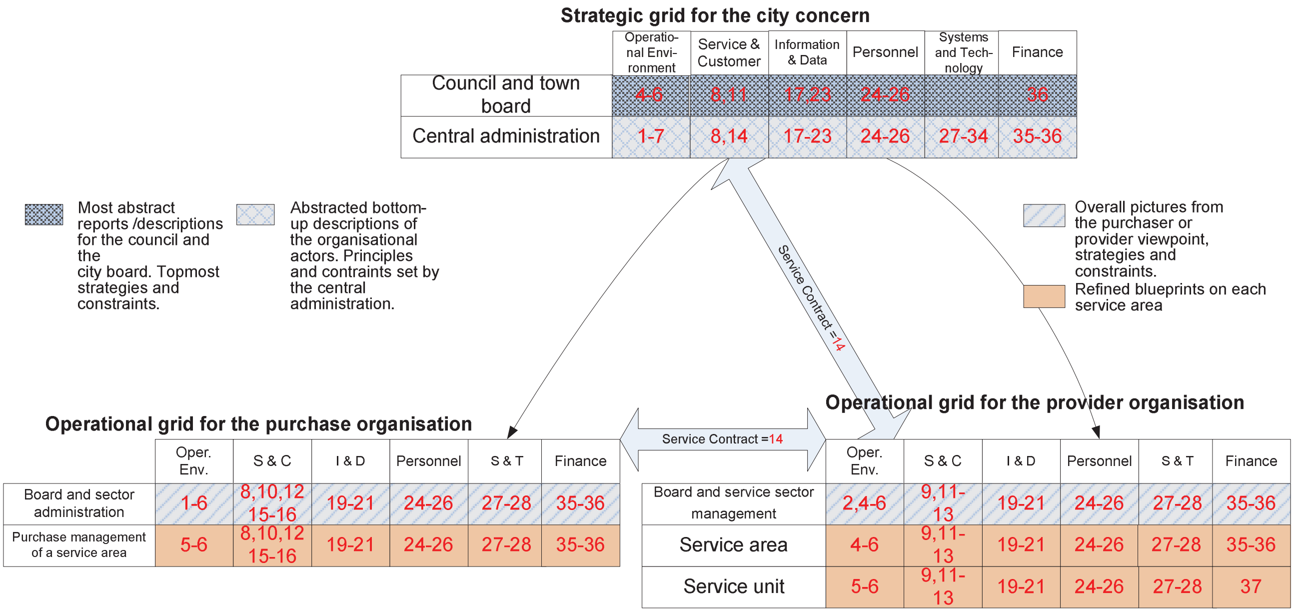

Figure 1. Kouvola Geagam.

TABLE I. GEA DESCRIPTIONS POPULATING KOUVOLA GEAGAM (* = IN USE / TEST USE)

Operational Environment	Service & Customer	Information & Data	Personnel	Systems & Technology	Finance
1 Laws, decrees and (national) standards 2 Organisational actors and stakeholders 3 Reference architecture and strategies 4 SWOT factors/trends * 5 Strategy goals and roadmaps * 6 Business requirements * 7 Architectural principles *	8 Government operations model * 9 Business model * 10 Client segmentation and structure 11 Service map and catalogue * 12 Process map and descriptions * 13 Services vs. production processes * 14 Service contract * 15 Customer needs analysis * 16 Client or Life even process vs. used services mapping *	17 Strategic and management processes map and descriptions * 18 Information flow * 19 Processes – information 20 Organisational actors - information 21 Information portfolio and information structures 22 Logical information assets 23 Semantic concepts * (definitions and bywords)	24 Organisation diagram * 25 Job descriptions * 26 Processes – Job descriptions' roles *	27 Systems – information – 28 Process-systems – 29 Systems requirements * 30 System services specification 31 Constrains 32 IS portfolio and IS map * 33 Data dictionary 34 Logical systems	35 Cost-benefit analysis 36 Budget * 37 Costing model *

The goals and availability of the provided services are planned by the purchaser. The purchaser has to plan, what services and of what quality level, are provided for the customers of the local government. It also has to control the quality and fulfillment of 'ipso jure' requirements. The purchaser should be interested in customer needs, experience [4], feed-back, and seamless cross-organizational client and life-event processes [67], in order to invest in the services consequently, and produce the seamless client experience. The strategic arrangement of the services is also planned by the purchaser. Government operations model depicts the chosen providers and services thereof, preferably against the life event process of a customer. The provider would depict the business goals for effective, innovative and transparent provision, the due provider processes and the information capital formed in them. Service experience of the clients [4] should interest them for quality assurance. In Kouvola, the largest service area has ca. 2000 employees in ca. one hundred schools and kindergartens. The client is met in these locations where the execution of the services takes place, and the client information is created. Service & Customer viewpoint is thus populated with government operations model (8) and customer needs analyses (15) for purchasers. Business models (9), service maps and catalogues (11), services–processes matrix serve the providers. Client segmentation and structures (10), service contracts (14), and process descriptions (12) are for the both. Concerning process descriptions, the purchaser and provider roles differ with the contents of the descriptions: The purchaser, as a policy-maker and responsible for the availability and arrangement of the services, should rather focus on life-event processes (ref) versus services to-be-purchased (16), whereas the service provider might to wish associate its service map with its provision processes (13), the so called 'coal face processes'[46].

Information & Data viewpoint refers to the information and data architecture [3][23]. Beyond the client processes, identifying and modeling of the abstract management and strategy processes [46] has been lacking in PA in Finland [67]. Management and strategy processes (17) were therefore clearly separated from the client and provision processes, and considered parallel with information flow descriptions (18), and thus situated in the I & D viewpoint. By this separation, we wish to emphasis the urgent need of the development and automation of the governance processes and practices, currently lacking enough resources to evolve. Nursing or teaching, e.g., cannot be highly automated. Only the information flow automation can help to get rid of the unnecessary and overlapping governance work to integrate governance processes among functional management processes. Other descriptions in this viewpoint are more traditional (19-22). Logical information assets (23) range from Excel-sheets to databases and data warehouses [42].

The Personnel viewpoint involves employee information, the locations and capabilities thereof, as well as roles (24-26). The Systems & Technology viewpoint refers rather traditionally [47][23] to the information systems and technology architectures from the ICT management viewpoint (27-34). For example, the systems are analyzed against their information or processes. The Finance viewpoint collects the financial and cost information produced in the organization, whether annual (such as budgets) or costing models (35-37).

The order and titles of the description viewpoints have been refined slightly from the previous Geagam version [70] in order to better support the design process in various organizational change situations [15]. The goal of the changes may focus on aligning resources, whether human, systems or rooms.

The description levels serve different roles of the organizational decision levels. Top management, council and board members wish to have summaries of the current states and goals of the branches and service areas. Central management is the most responsible for producing such analytic *bottom-up descriptions*. At the moment, these kinds of descriptions are either manual or lacking. Secondly, the central management is presumed to produce the vertical management practices transparently, and to provide functional policies to follow. This yields management and strategic processes (13) as well as functional management strategies and goals (5) at the central management. Some descriptions form *top-down hierarchies* providing a kind of boundary conditions to other organizations for alignment, such as top decisions, strategies, goals, and principles.

However, an iteration should be applied both in top-down and bottom-up descriptions. The dependencies between the descriptions of different viewpoints [1][16] follow the principles in EAP processes [62][50]. In our research workshops in summer 2010, beyond the hereby reported Geagam framework, we concurrently built a layered meta-model depicting the descriptions as entities with their relations (in the style of [1][16]). How all the different descriptions in Kouvola relate to each other will be reported in our next publication.

In the Finnish local government, systems are seldom designed and built by the government itself. Instead, solutions are bought from private markets [39]. The IT team is basically responsible for systems requirements and acquisition in co-operation with the branches. The systems description level, typically at the bottom of hierarchical EA grids [23], is left out in our construct so far. Also most technology architecture descriptions, such as technical services, hardware architecture, network diagram, deployment diagram, integration map, technology components catalogue [29] are left out in the current version of the grid. IT services (cf. ITIL [45]) are outsourced at Kouvola to be provided by a centralized IT support function that became a town-owned corporation in 2011. This IT service provider manages the IT services delivery and the company business, owning the technology architecture descriptions of the town. However, to maintain S & T architectures, the IT team needs descriptions provided by IS providers, as well as by the corporate IT. The descriptions presumed by IS providers could be situated in Kouvola Geagam S & T viewpoint at the relevant description levels.

VI. DISCUSSION

The presented EA framework provides several advantages for the local government transformation and coherency management. At the same time, there remain many kinds of challenges in the adoption of the framework. Here we first end up with some advantages to be gained, as well as perceived challenges for EA in PA use, next give some practical suggestions for GEA deployment implementation in a local government.

A. NPM quests for the efficient coherency management

Enterprises can be seen as service systems [36], as 'value co-production configurations of people, technology, other internal and external service systems, and shared information' [63]. When adopting the definition for public administration, the value looked for has to mean more than currency. The local management brings value in wealth, using common currency for that, as wisely and largely as it can. Therefore, in NPM, a local municipality needs to continuously evaluate the services and the ways of arranging them. When investing in several service providers, there should also be systematic practices to manage the service system thus produced. By Geagam, we wish to offer a systematic tool for coherency management of different organizational actors and roles thereof. Re-organizing of purchasers and providers is a continuous process, which seems to change organizations towards the centralization of the former ones and the de-centralization of the latter ones at Kouvola.

Both in outsourcing and contract management, the information-flow between the stakeholders may halt, if it is not agreed upon in the service contracts. There is a need to define an operations model, with the desired levels of process standardization and integration [54]. This is essential for the set of organizations in a government that are in continuous change concerning enterprise forms, structures and processes. An EA grid as a tool for coherency management can be considered a meta-model of all the descriptive information (descriptions) about production, development, and management. Outsourcing practices, at least at Kouvola, quest for more systematic and thorough practices concerning the integration of the information. There are risks of losing important information in privatizations. We might conclude more generally, that a shared GEA grid among different management and organizational roles, as a means of coherency management, would bring stability and systematicity to public administrations service system re-engineering, through a common meta-level categorization of the enterprise information, models and descriptions. Geagam could act as a check list for the purchaser, in ensuring the coherency of a set of providers concerning transparent information flows, and further, in digitization of the information interfaces between them. If even common description methods were insisted from the chosen providers, that would also enhance comparability.

Evaluation of the target state in and its change effects, has to capture also the dependencies, and consequences to the personnel and the costs, especially where the services are human resource dependent. EA for coherency management could be used to align all kinds of resources with strategic demands, whether human, information systems, rooms or money, by analogy to business IT alignment. In Geagam we have anticipated this kind of use, and do wish to discuss it more widely in the future.

B. Embedding architecture in government practice

At Kouvola we have embedded the depiction of strategic action plans in management tasks at all the organization levels. By embedded architecture, the managers have better capabilities to recognize their own spheres of responsibility, and the relationships with each other (cf. [15]). Process architecture is depicted within the same modeling tool, and saved in the same repository, as strategic plans. EA blueprints from the ICT perspective will be forced by the new information management law. So far they have been facilitated by the IT team and Archimate tools. However, the value of all the descriptions and the information in them, is added only if all this information is used in communication, adding new meanings [66] and enhancing innovation [4]. EA provides a unifying alignment mechanism towards a common vision for the organization [15]. We consider our EA grids as a support for such an alignment mechanism, and a meta-level tool, as they provide a common framework of analysis. By adopting a shared categorization of organizational descriptions, a meta-level organizational awareness can be enhanced, and is instantiated by descriptions and common description repositories.

Kouvola was merged from smaller municipalities, where almost everybody knew each other, and information management was easier to manage without meta-models. However, since the merger, information about existing information bases has often been lacking. Consciousness, availability, transparency and reusability of information would be the practical benefits from the realization of the Geagam. Blueprinting itself makes things transparent, although often tables, lists and matrices are enough as EA descriptions (cf. in [29][73]). If all managers can access relevant information easily with equal principles, it will make managing a lot more efficient, eliminating also human based 'hair ball' connections [19] in the information flow, and enables more holistic considerations in a specific decision situation.

Challenges in adopting a common framework for common understanding of the shared information are multiple. The idea of embedded EA is rather new and not many practical cases have been presented in the literature (see a collection of EA in its different modes in [14]). The adoption of EA practices by general managers in Kouvola has been slow and tedious, requiring education and change agents. Common learning presumes meta-level capabilities to guide organizational development [66]. Blueprints open up an organizational actor for the others, which can been seen risky by leaders who wish to keep everything in-doors. Lack of trust can thus prevent the adoption and use of modeling tools. Authorization policies should support socio-organizational requirements [55] of the blueprint exploitation, such as suitable access rights and trust, bridging thus the gap between security and usability.

C. Government EA tool development

As mentioned above, the evaluation group analyzed all the descriptions situated in Geagam. Most descriptions are used by all management roles, independent of their decision making level or organization type. However, some functional management roles are responsible for the development, instruction and maintenance of some descriptions practices, e.g., the IT team for the IS portfolio, and the strategy team for the strategy roadmaps. A shared repository and meta-engineering tool for development of the notations and maintenance of descriptions would stop the central management from parallel development and hinder from the silos of blueprints.

At Kouvola, blueprints had been in use rather little before the merger. They are also quite a new management tool altogether in PA [6][20] presuming abstraction of organizational contents at a higher level. Gaining the benefits from the blueprints is related to the capabilities in utilizing the models. In Finnish governmental organizations, information is mostly retained in traditional data bases, and even in datasheets and word documents (cf. [42]). Producing blueprints has been considered troublesome at Kouvola, even though the available description tools being improved all the time. Tools that can automate visualizations of relational data would enhance blueprinting a lot.

Models and blueprints can be developed independent of a categorizing framework. However, a framework like Geagam, may enhance the innovation and development of the descriptions of dependencies among different viewpoints. In many meta-modeling tools, a change in one blueprint can be automatically replicated into another [65]. The KuntaIT descriptions that were analyzed, included various cross analyses among two of the viewpoints. These were mostly in a matrix format, however. New kinds of dependence descriptions between the EA viewpoints should be added to the embedded architecture description repertoire, and be supported by engineering tools.

D. Practical suggestions

We conclude with some practical suggestions for GEA deployment and implementation in a local government:

1) Implement architectural terminology and modeling practices step by step in the organization, e.g. one dimension at a time. In Kouvola, EA maturity was quite low at the time of the merger. Different modeling practices have been deployed and developed separately step by step. Strategy architecture, for instance, has been established separately, as a new concept including strategic action roadmaps. The long term goal is to have common descriptions of all the dimensions of the organization where all architectural dimensions are utilized by the general management. Then it will be easier to develop and present new kinds of description models, even with crossing viewpoints and among different functional management roles. However, in the beginning, the whole framework might be too much for leaders.

2) Proclaim the GEA as library. By modeling and blueprinting, we are adding to a shared information asset. Considering the EA grid as a common information repository scheme might enhance the use of it. The benefits of EA become real only once the descriptions are reusable and reused by individuals other than those who 'authored' them. Awareness of information is important and should be facilitated by efficient communication.

3*) Adapt your EA grid gradually* in analogy to evolving library categorization. The grid is not the first thing to be presented for the end-users of the blueprints at the organization, but the blueprints are. The evaluation group concluded, that the current Kouvola Geagam for coherency management is needed, since the Finnish GEA grid (see in [69][29]) as such does not assume the embedded architecture approach, lacking e.g., the personnel descriptions that have been added in Kouvola Geagam. However, for the implementation of the grid, it is better to proceed 'hands on' and to experience practical success stories through organizational innovations, rather than present many versions of the adaptations of the grid.

VII. CONCLUSIONS

We presented a refined government EA grid adaptation model for Kouvola city (the Kouvola Geagam), populated with a set of enterprise architecture descriptions. The adaptation process of the GEA method is on-going. We presented and reflected on the building of the second version of the Kouvola Geagam. The model was built using the action design research principles, and was based on the organizational work done at the City of Kouvola, within the process of the Finnish Government Enterprise Architecture (GEA) development, and is based on most recent EA literature. The organizational interventions emerged especially from urging GEA by the strategy management and the information management functions, as well as for process descriptions. The new practices were to enforce an embedded architecture, to leverage on active and participative leadership, and to ensure government-IT alignment, and foster e-government.

In our reflection, we suggest Kouvola Geagam as a useful tool for systematic management of new service operation models emerging in NPM, by noticing the unchangeable description roles represented by our grid types, even in continuous change of the organization structure.

There are still challenges in the adoption and use of the framework. Our subject about the GEA framework is quite theoretical, concerning framing and categorizing descriptions for government embedded enterprise architecture. For us, the GEA framework is a way to create a mental structure for coordination and collaboration. However, it is difficult to evaluate the value and utility of such a mental frame. The focus of the evaluation could be on interventions concerning blueprinting practices, dimensional architectures (business, strategy architecture, information architecture etc.), and the dimensional dependencies (the relations and consistent maintenance of the various artifacts), and organizational awareness and consciousness through the common framework thereafter.

Much is to be done to provide an embedded architecture for general management, including a wider range of models and repositories, easier blueprinting techniques, and elaboration of GEA planning and management processes. The last involves the development of new governance practices capturing all management roles beyond IM.

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VII

MANAGEMENT STRUCTURE BASED GOVERNMENT ENTERPRISE ARCHITECTURE FRAMEWORK ADAPTION IN SITU

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Management Structure Based Government Enterprise Architecture Framework Adaption in Situ

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Abstract. The fragmentation of the public sector makes it difficult to manage strategically and architecturally as a whole. Enterprise Architecture (EA) is considered as an improvement to that. Architectural modeling and visualization of the general management strategy plans along with parallel database development in a local government forms the primary data in the longitudinal case study using Action Design Research Method. To find a proper organizational fit for the EA framework in public sector, we reflect on how the current state architectural descriptions got organized in situ in a deep corporate hierarchy, and what were the emerging management needs in re-organizing the content of the descriptions. We suggest the EA framework in public sector as a strategic corporate management tool. As for the current state EA descriptions, we propose implementing the framework not as a static, but as a dynamic data model of the current management structures.

Keywords: Government enterprise architecture - Framework adaption - Strategy architecture - Action Design Research

1 Introduction

Public sector changes are trending toward privatizations, cost savings, e-government, and private sector management practices [1]. Today's challenges like mergers, corporate governance, and new business models are due [2]. Public sector is formed of organizations of high complexity. When silo-thinking among public organizations is added [3], consequences follow, e.g., e-government efforts end up sparsely structured and basing on ad hoc cooperation [4].

Enterprise architecture (EA) emerges as a promising tool for change and coherency management in public sector [5-7]. We refer to the public sector use of the EA tool as *Government Enterprise Architecture, GEA* [5]. EA is defined as 'analysis and documentation of an enterprise in its current and future states from an integrated strategy, business, and technology perspective' [8]. It provides people at all organizational levels a meaningful frame that allows understanding of the enterprise [9]. Any conscious change of a complex entity requires descriptions as a starting point to shed light on its components and their relationships [10]. The description models for architecting an enterprise are typically organized in an *EA framework*, e.g., in

[10,11]. *EA method* comprises the EA framework, models, developing process and roles, etc. [12]. The present study focuses on the EA framework adaption in situ.

An organization who starts using the EA tool usually adopts a particular EA framework, either an existing or a customized one [13]. No method is suitable as such but rather needs adaption to the situational need [14]. *Method adaption* means customization of a method for a certain use, e.g., for an industry, organization or a project [15]. To select an EA method for the customization is not straightforward [16] due to the difference in approaches, scope and purpose [17], see different approaches e.g., in [18-20]. Some organizations adapt a known framework, whereas others develop their own, possibly based on others [6]. In public sector, all these approaches seem to be used [21]. A framework is not necessary, since EA is adopted without a framework, too [6]. Some approaches are even listed as 'ontology frameworks' in [22], not displaying the categories of EA models but rather focusing on the relationships of the EA descriptions and their contents, e.g., in [23,24].

Assuming that no GEA framework is fit to adopt as such in the complex public sector, we are concerned, how to adapt GEA framework for the current state descriptions in a public corporation. Coherency of an organization means that the parts of it have logical, orderly and consistent relations to the whole [7]. We assume that the up-to-date current state GEA descriptions could support achieving the coherency of the public organization. We aim at the adaption principles of the GEA framework for the current state GEA management. This is done by analyzing, how the current state architectural descriptions got organized in a deep corporate hierarchy, and what management requirements emerged in re-organizing the content of the descriptions. Architectural modeling and visualization of the strategic plans along with the parallel database development yield the primary data of the study. The report is part of a longitudinal case study in Finnish local government using *action design research*, ADR [25] from 2008 to 2015. It presents the reflection and learning of the ADR cycles in the city. The case study composes an abductive evaluation of former findings in Finnish state government [26]. Previously resulted propositions are reconsidered based on the artifact building and organizational intervention.

The results suggest the current state GEA framework as a dynamic data model of the management structures of the adopting corporation. The limitations, as to generalizability of the results are due to one case organization and one architectural viewpoint. As a longitudinal study with several artifact iterations and levels of data collection, we wish to present preliminary suggestions for the current state GEA framework adaption. Related literature is described in Ch. 2, the case organization in Ch. 3, the propositions for the evaluation and the research methodology, in Ch. 4., along with the strategy architecture development. Ch. 5 describes findings, Ch. 6 discusses the implications and limitations, and Ch. 7 concludes.

2 Related works: Enterprise Architecture Frameworks

Enterprise Architecture, EA, as the analysis and documentation of the enterprise [8], is dependent on the architectural representations, i.e., *EA descriptions,* that display the enterprise structures and functions in the current or target state as pictures, diagrams, lists, etc., [11,27]. Each type of EA description - *EA model* - is preferably based on a commonly agreed modeling notation and practice. EA models are traditionally enlisted in an EA framework*,* e.g., [8,11,28]. A framework signifies a skeletal structure, a frame containing something, or a set of frames [29]. We denote *EA framework* as a container of EA models and connected information, typically including classifications. In 'traditional EA approach' [30] EA frameworks are typically 2- or 3-dimensional matrices or cubes, e.g., in [10,31] or [8,28,32]. We use the term *EA grid* synonymous to EA framework, and *GEA grid* to governmental one.

The dimensions of the EA grid vary in the suggested frameworks and other comprehensive works [11,28,32,33]. There seems not to be a general opinion on how many dimensions the EA grid should include and what these dimensions should signify. Convergence seems clear of the dimension called *EA layers* [34] or *EA viewpoints* [35]. We use these terms synonymously. EA models are typically categorized in the EA layers of Business, Information, Systems, and Technology Architectures, (BA, IA, SA, TA), e.g., in [11,31]. Simon et el. [34] have categorized a vast amount of EA studies based on their focus on one or more of the four aforementioned layers. These four EA layers seem to be identifiable in most EA grids one way or another. In some frameworks, strategy descriptions are included in the BA layer [11], some grids explicate *Strategy* as a separate layer [8,28,33], and some call it *Business motivation,* including the strategy concepts such as mission, vision, goals and objectives [36]. When any of these layers is documented in an organization, it may alone produce a set of co-dependent descriptions. For example, the *strategy architecture* in a hierarchical organization comprises institutionalized strategy goals as hierarchies of descriptions [33]. That is as laborious job per se to produce [37].

Beyond the EA layers, suggestions of the following dimensions vary. Typical options for the second and third dimensions are the organization structure or lines of business [8], the abstractions level of the models [8,38] or the system life-cycle [32]. By using the word *EA grid dimension* it is emphasized here that the conception of the EA framework dimensions is not settled. In addition to the aforementioned 2-3 dimensions as 'x-, y-, and z-axes', we shall suggest that there might be more dimensions for the current state GEA management in situ.

Many authors signify the EA evolvement for new purposes [6,17,39]. In [6], EA is seen as an advanced development tool for information systems engineering from 80's, an enhanced information management tool by 2000, and a promising future tool for strategic business management by 2020. It is titled as a tool for solving business questions as 'only abstract representation of the entire enterprise' [39]. Lapalme [17] shares EA evolvement in three purposes 1. the business-IT alignment, 2. the organizational integration for enterprise coherency, and 3. the adaptive co-evolution of the organization with its environment. The EA grid scope seem to appear in different variations differentiated by the EA purpose. In [17], for enterprise IT architecting, e.g. [40], for enterprise integration, e.g., [19], and for co-evolution [20]. In the last example [20], the EA grid's scope may evolve when the EA maturity of the deploying organization grows. Hoogervorst and Dietz [41] emphasize the importance of identifying the future system that is to be architected, and then defining the EA grid accordingly. However, achieving the coherent fit of the EA grid with the future system to be architected is seen meager by them [41]. Beyond the aforementioned traditional grids, there are other types of frameworks which are not literally frameworks in the sense of a 2- to 3-dimensional grid [22]. Instead of an explicitly defined grid, they offer EA principles, modeling rules and standardizations, e.g., [23,24]. When standardized diagrams become 'data with well-defined structures and meanings' and represent the facts and concepts behind the picture [24], the descriptions form more structural dataset than traditional figures, enabling searches and reconstructions, e.g., in [24,42].

There is a challenge in the EA literature for more case studies to bridge the theoretical foundations and practical work [30,34]. A mature theory to tie-in the variety of EA frameworks is called for [8]. There is 'no generally accepted theory, recommendations or standard of the EA framework, even though such one is included in numerous EA works of governmental institutions, standards bodies, academia, and practitioners' [34]. Partly this may be, because the EA concept has evolved in purpose and scope. However, this raises up the question, whether the EA framework as the classification of the EA models has anything to do with the practical EA description in situ. In the case study, we are drilling in the development of the current state GEA descriptions for the strategy architecture. Certain organizational classifications for the current state GEA description contents arise, and propound to reformulate the GEA grid adaption propositions.

3 The Case Organization

The study connects to GEA adoption in Finnish public sector, where state government and local government co-exist [43]. *State government* comprises 12 ministries that draft legislation and steer their branches with the help of around fifty specialized central agencies. The regional and local state services are governed by approx. two hundred regional state agencies. *Local government* consists of circa 300 municipalities. Municipalities are self-governing units by Constitution, with the right to tax the residents. The services are further dispersed locally in the town areas. State and local government develop the public services together. Similar organizational trends can be perceived in both, e.g., corporatizations.

The case organization in the study is a municipality corporation in Finland, the city of Kouvola. The city was formed in 2009 in a merger of six municipalities and three municipal joint organizations. By 2015, the city had more than 90,000 citizens on the area of 3,000 km^2, 6,500 city employees, and annual expenditure of 0.5G€. The provided services were education from nursery to secondary school, health care up to a district hospital, business support services for entrepreneurs and farmers, social and legal services of citizens, water supply and sewerage, as well as the planning, building and maintenance of land, city infrastructure and town buildings. This resulted in deep hierarchies in *administrative organization* with multiple *organizational actors* such as the sectoral domains, central management (CM), and in-house enterprises. CM tasks were shared to corporate executives (CxO) and their units. The *political organization* comprised city council, board and 19 sub-boards in 2009. Since beginning, the new city was in continuous change. After starting as a 'purchaser-provider organization' in 2009, it was changed gradually to process organization. Some management levels appeared purely administrative due to vast service catalogues, service groupings, as well as both geographical and governmental oversight tasks. Accordincly, the administrative levels were diminished. Gradual outsourcing of prominent business areas was apparent as they were exposed to market competition. These drivers resulted in three major organizational changes in 2011, 2013, and 2015.

4 Application of the Action Design Research

Finland has been launching GEA since 2006, and after that it has established its role by Information Management Act 2011. The effort has yielded a common GEA method [38], where the GEA grid forms a central part, cf. [16,26,44].

The report presents a reflection and learning phase of the *Action Design Research ADR* [25] as part of a longitudinal case study in City of Kouvola in 2008-2015. The city needed novel management tools in the merger. Case study results from the state government were deployed, i.e., the GEA grid adaption model*, Geagam* [26]. Geagam was subdued to abductive evaluation in the City of Kouvola. *Abductive logic of reasoning* forms a ‘process of discovery’, where inferences are drawn to the best explanation when the phenomenon under study is investigated with wider sets of data [45]. This is particularly effective for evaluating the findings of new phenomena [45]. The research setting is figured in Fig. 1. With the insight of the CxOs, a city specific GEA grid adaption model was constructed and applied in two ADR research cycles as *Kouvola Geagam*. These *alpha* and *beta versions* included GEA method objectives and inherent adaption principles [46,47]. Kouvola Geagam was included in GEA governance model of the town, and admitted as strategy framework by city board. Propositions under evaluation are explicated in 4.1. The ADR reflection techniques are described in 4.2, and the development of the strategy architecture artifacts in 4.3.

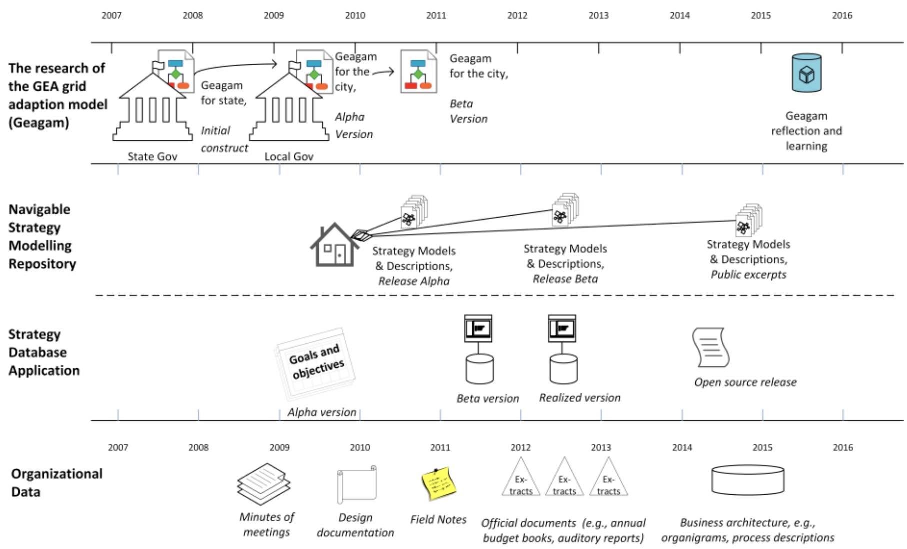

Fig. 1. The research setting for GEA framework adaption

4.1 Geagam Propositions

GEA grid adaption model, *Geagam*, presents of a set of typified EA grids for the public sector organization types in Finland. The model was initially constructed using state government as the unit of analysis [26]. Kouvola Geagam followed presenting the set of GEA grids in the local government context [46,47]. The new context provided new findings of the GEA grid adaption especially for the required EA layers [46,47]. For the ADR learning and reflection phase at hand, the inherent adaption principles in [26,46,47] were subjected to textual analysis to explicate the propositions for evaluation. By excerption and categorizing, the suggested principles in-between the Geagam constructs were triangulated and enforced. For the study, we chose the most significant propositions enforced by the traditional assumptions of the 2- and 3- dimensional EA frameworks. Administrative organization hierarchy was suggested to display as the description levels (rows) of the adopted GEA grids. The political decision levels were mapped to these administrative levels. GEA grid viewpoints as columns of the GEA grids were suggested to cover the concern areas of the CxOs as *expanded EA layers*.

Propositions: GEA descriptions of a complex public corporation are to be organized in static GEA grids with two dimensions, those being
1. the administrative levels as the description levels of the GEA grids, and
2. the central management concern areas as the expanded EA viewpoints of the GEA grids.

4.2 ADR Reflection and Learning by Recursive Artifact Development

As the responsible for the process and strategy architecture modeling of the town and the related artifact development, the author used *Kouvola Geagam* and its inherent principles to realization and maintenance of the strategy architecture for evaluation data. Kouvola Geagam instructed the design and implementation of the navigation structures of a *strategy modeling repository*, and the iterative development of a *strategy database*. The artifacts evolved through development cycles, which were considered as recursive ADR cycles to the GEA grid adaption cycles, Fig. 1. We are not reporting the design principles of these recursive artifacts, analysis focuses to them only in the extent where they reflect on the GEA grid adaption.

Both organizational intervention and utility of the artifacts were pursued in the development as ADR method insists [25]. Artifact development and maintenance produced data, such as requirements, documentation, perceived design principles etc. Organizational intervention was traced to town documentation. Such data sources are summarized as organizational data in Fig. 1 with figurative illustrations. As ADR method suggests [25], the *building* of the artifacts, *intervening* in situ, and *evaluation* of the innovations were interlinked and mutual. Central and sectoral management insights were continuously perceived in regular meetings during the development. CxOs were keen on the applicability of the tools in their management role. The annual city audit process took official stance on the prevailing strategy planning principles. User experiences and feedback were gained from the sectoral management. The author acted as principal designer and researcher in the design of the Kouvola Geagam, and the recursive strategy artifacts.

We reflected on the Geagam propositions based on the artifact building and organizational intervention in situ. The propositions were submitted to the evaluation by analyzing the *recursive artifacts* as 'wider set of data', as abduction logic presumes [45]. This was done by analyzing, how the current state strategy architecture descriptions got organized in a deep corporate hierarchy during organizational changes, and what were the emerging management needs in re-organizing the content of these descriptions. Based on the analyses, a revised explanation of GEA grid adaption is proposed for current state GEA management.

4.3 Strategy Architecture Development

Next, the strategy artifacts, their premises and development are described along with the data analysis. Town strategy was institutionalized by strategic planning [48], as instantiations of the town strategy goals by each organizational actor and relevant administrative levels. The strategic planning was updated annually as a part of the budgeting process. In 2009, no systematic long term expressions could be perceived in strategic planning. Strategy visualization and modeling were unknown. There was no information systems support for strategic planning beyond text editing. No adequately specific solution was found in the market either. Goal and objectives, as well as follow-up information were given point-like by actors. This yielded unstructured institutionalization and incoherent implementation of the town strategy.

Strategy discourse was facilitated by GEA practices and tools. Strategy modeling practices were developed along the *strategy-modeling repository*. Secondly, the strategy information management was developed as an in-house *strategy database*. The artifacts were introduced to the central and sectoral managers. The first yielded the visualized long term objectives and operations as road maps (Fig. 2), the latter, the structural data for the same (Fig. 3). The development of the strategy artifacts was parallel for practical reasons, carrying a vision of a united system though.

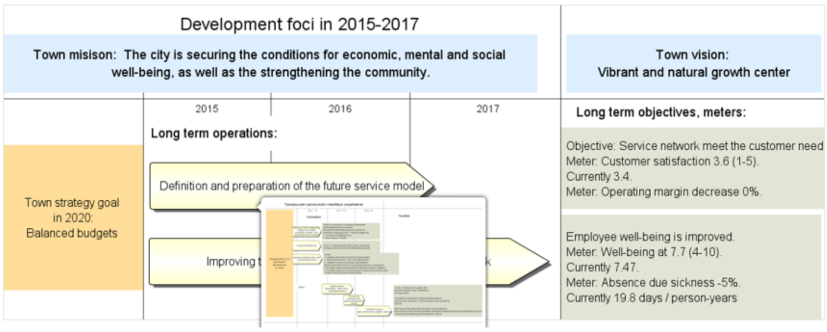

Fig. 2. *Strategy modeling repository*: Road map for mayor, in budget book in 2015

Strategy modeling repository. A process modeling tool was deployed for the strategy modeling in a cyclic manner. The town strategy goals were institutionalized as objectives, measures, and related operations as *strategy road map*, of the description owner, Fig. 2. Optional actions maps were further navigable from this picture, as (not clear) in Fig. 2. By 2015, the repository consisted sets of road maps along administrative hierarchy, yielding 'a hierarchical set of descriptions', as *strategy architecture* [33]. The navigation structures of the different repository versions were at the focus of our data analysis, and they were compared to organigrams, process architectures, and suggested GEA grid dimensions.

Strategy database application. The development of the strategy database aimed at automatic visualization of the road maps, cf. Fig.2. By 2014, the development yielded Ratsu Information System as open source publication [49]. The application was iteratively introduced in annual strategic planning process, Fig. 1. It offered a platform to test the strategy information in structural format, facilitating database queries and excerpts to official reports. The resulting database schema reflects the management requirements as emerged during the research period for reporting, filtering, and re-categorizing the description contents. The implemented database schema was analyzed by re-categorizing and generalizing the entities and relationships, to achieve a reconsidered vision of the database at conceptual level.

5 Findings about GEA Grid Dimensions in Situ

During the development of the strategy modeling repository, we discovered that the tabular data given by managers could be automatically visualized as road maps, and thus leverage on everyday governance as suggested in [7]. This launched the design and implementation of the strategy database with a normalized database schema [49].

The database covered the basic entities that are depicted in Fig. 3 as business motivation elements, such goals, long-term objectives and operations, measures and actions as the refinements of the operations. Business motivation (BM) is used from [36] as one of the 'building blocks' of EA [8]. The conceptual diagram inside the rectangle is figurative, since the BM model was not at the focus of our analysis. Instead, based on the reverse engineering and database schema abstractions, *categorizing dimensions* of the BM elements were identified. Fig. 3 illustrates the results as a conceptual diagram of a data-warehouse. BM is related to the categorizing dimensions via a fact table that can be instantiated for any BM element.

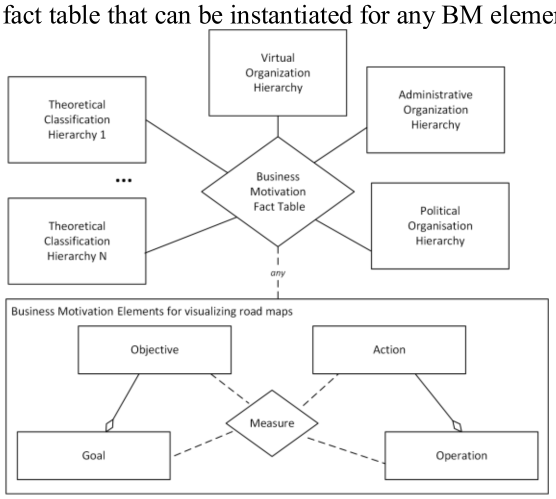

Fig. 3. *Analysis results:* Business motivation elements classified by management structures

The conceptual model in Fig. 3 illustrates the management structures that dictated the management information needs. They are signified as a star-model dimensions for organization hierarchies and a theoretical classification. In our data, all the categorizing dimensions could be hierarchical, and most were. The dimensions also could have relations to each other [49]. There were three types of organization hierarchies. *Administrative organization* refers to line hierarchy of the corporation and its organizational actors. *Political organization* denotes the hierarchical structure of the city council, board, and subordinate boards. *Virtual organization* comprised strategic and political development efforts, e.g., cross-sectoral or cross-agency policy programs, e.g., enforced by the state government or law. In the municipality, these were typically governed by a virtual organization. As one example, the environmental program was one of our pilots when introducing the strategy artifacts. *Theoretical classification hierarchy* refers to the theoretical management classification in use, with possible sub-classes. The number is not limited, some examples are the strategy viewpoints, the EA layers, quality management viewpoints, and various other classifications for various purposes, either district or nation wide. Next, the Geagam propositions (from 4.1) are reflected based on the strategy architecture data.

5.1 From Classifying GEA Models to Classifying the GEA Model Elements

EA models are typically enlisted in EA grid. Our propositions in 4.1 suggested *static GEA grid* with two dimensions as 'GEA model container'. The proposed GEA grid dimensions were the administrative levels, and the expanded EA viewpoints achieved by expanding the business architecture layer to its subparts with the stakeholders.

The assumption in 2009 was that it would be enough to classify the business motivation elements firstly according to the administrative organization, and secondly according to the expanded EA viewpoints. The expanded Kouvola Geagam viewpoints were 1. Operational Environment, including strategies, 2. Service & Customer, 3. Information & Data, 4. Personnel, 5. Systems & Technology, and 6. Finance [47]. In the first development cycle of the strategy modeling repository, CxOs corporately produced the road maps for each of these Kouvola Geagam viewpoints. The road maps for the six partial architectures composed kind of crystallized sub-strategies to town strategy. As for the sectoral management, they depicted their road maps for each of the administrative levels without including this classification to Kouvola Geagam viewpoints. However, the sectoral outputs were of interest to CxOs and virtual organizations' managers, because both had a synthetizing role to the whole. The interests focused on particular objectives, e.g., the chief human resource officer (CHRO) was keen to report the objectives and operations of the human resource (HR) development from the road maps of other managers. Thus, very soon the need to re-organize the road map contents emerged.

During the development cycles, instead of one organization hierarchy, three of them emerged. Also organizational classifications were multiple, even though two of them, the EA and the strategy viewpoints had already been converged as one. Consequently, we provided in the strategy database the three organization structures, and a dimension table for any management classification. The ability to select the description contents dynamically by user was provided.

Based on the strategy artifact development for strategy architecture management, the classification of the strategy descriptions into static grids with 2 dimensions showed inadequate at least for their contents. The strategy model elements were classified in the relational database, to enable the re-organization of the description contents by different areas of concern. As a generalization, this could be done to EA descriptions of the other partial architectures too (such as BA, IA, SA, TA). Why CHRO should not be interested in HR related process phases, objects, etc.? We contemplate it inadequate to classify the current state GEA model elements in 2-dimensional frameworks. A similar kind of argument is presented for the GEA models as an implication and a 'best explanation' [45], in Ch. 6.

5.2 From Description Levels to Multiple Management Hierarchies

We proposed the administrative levels of a public corporation as one GEA grid dimension in 4.1. This was implemented in both of the strategy artifacts. Strategy descriptions hierarchy followed the administrative hierarchy. Notification of the line organization seemed an essential management requirement. The organizational rules may have had effect on that, since the objectives and measures were required at the top administrative levels in the annual budgeting and strategic planning process.

Strategy architecture modeling supported dependencies between the administrative levels in the deep line hierarchy. The administrative managers insisted strategic representations of the subunits under them. E.g., the team of the mayor prioritized and picked the most important objectives of the sectoral and central management road maps into the budget book, as illustrated in Fig. 2. It seemed that a description becomes strategic only after strategic way of processing. Two road maps seemed similar by notation, but the other had been processed strategically and the other not. Strategic descriptions sprang up by prioritizing, synthesis, summing, mean values, or iterating in top-down and bottom-up workshops between administrative levels.

5.3 From GEA Layers to Multiple Theoretical Classifications

Very typically EA grids refer to conventional BA, IA, SA, and TA layers. We proposed in 4.1, that the CM concern areas should be supported by expanding EA viewpoints in the adapted GEA grid. Fig 3 shows one theoretical classification entity for the *expanded GEA layers* of Kouvola Geagam (listed in 5.1).

To support the CM concerns, we made an attempt to combine the EA and strategy viewpoints by converging them into one classification. This classification was used for both GEA management and strategy planning purposes. CxO were in the practitioner role both while creating Kouvola Geagam, and in strategy modeling. The first strategy descriptions in 2009 were corporately produced by CxO's. They followed the expanded GEA layers, and were close to the CM units' division as a result but not enough. They could not serve as corporate 'sub-strategies', because CxOs had difficulties to differentiate their 'own' objectives from others'. Accordingly, the next strategy modeling repository version was organized along the CxO roles. In different ADR cycles of the strategy artifacts, no one-to-one relationship between the extended GEA viewpoints (EA + strategy) to prevailing CM functions were reached. This would have required organizational changes, which were not due. This is not necessarily to be aimed either, since theoretical classification is not same as management functions. If CxO roles cannot be mapped to an existing classification, CM functions could be implemented as another one for reporting needs.

As a generalization, we suggest, that any theoretical classification used in the adopting public organization could be presented as a dataware dimension. EA and strategy viewpoints integration could in principal work, since both are theoretical classifications. However, this presumes agreement in the adopting corporation, and in the research society. Next, the findings are discussed and generalizations propounded.

6 Discussion

We suggested in the results that classification of the current state GEA model elements should situationally reflect the prevailing real-world management structures of an adopting public organization. This is illustrated in Fig. 4a) as a conceptual data-warehouse model. The management structures refer to prevailing organization structures or theoretical classifications as described in Ch. 5. Their amount is situational as indicated in Fig. 4a) by 1…N. The possible practical implications are discussed in 6.1, and the theoretical ones, the validity and reliability in 6.2.

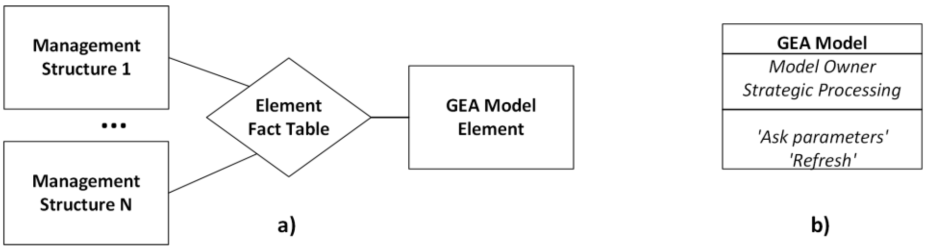

Fig. 4. a) Generalization of the results as a conceptual model b) GEA Model Class

6.1. Practical Implications: Dynamic Hypercube for As-is GEA Management

The as-is, or the current state GEA management of a public corporation could benefit of a dynamic hypercube implementation, based on the proposed generalizations in Fig. 4. *The GEA Model* Class in Fig. 4b) comprises the attributes 'model owner' and 'strategic processing' manner. It relates to many GEA Model Elements (not drawn into Fig. 4). *Model owner* refers to the unit of the adopting organization, which is responsible for the development and maintenance of the model notation and instantiation in situ. For example in our case, the responsible unit was sought and officially named for the process modeling. *Strategic processing* of the strategy road map was described in 5.3, e.g., as the synthesis and prioritization of the descriptions. Both of the exemplary attributes of the GEA model are dependent on the organizational hierarchies. GEA model entity could thus also benefit from a similar fact table as we proposed for the GEA Model Element in Fig. 4a). GEA model associations to management structures could also be further added and differentiated. For example in the strategy database, the strategy model elements were associated to management structures via association types *owner*, and *report*.

Relating the GEA models and model elements situationally to management structures would presume hypercube data-warehouse implementation. This type of development of the current state GEA management would open chances to almost unlimited implications. Here we are restricted to mention just few. Any GEA model contents could be refreshed according to user preferences (e.g., categorized by the chosen management structures), as suggested in Fig. 4b) by the class functions 'ask parameters' and 'refresh'. Organization types in a public corporation could be implemented as a categorizing dimension with associations to any GEA model as a recommended on for that organization type. The static 2-dimensional grids for any organizational actor could be excerpted in real-time by chosen dimensions. Even if the hypercube implementation was not on tap, for an enterprise architect entering in a public organization to implement the current state descriptions, he could anticipate the interests of the various stakeholders by identifying the situational management structures of the organization as *enterprise* (architecture) *dimensions*.

If GEA information followed the prevailing management structures real-time, the prevailing management structures would appear transparent, and the understanding of organization could be enhanced. This is essential among organizational actors that should be interoperable. Kotusev [30] points out, that in [23] the EA is defined as a tool also for developing the organization structure, however, without any means for it. Transparency of the prevailing management structures would help to develop the consistency of the organization. GEA would evolve as a tool for general management for supporting the rationalization of the organization structures and dimensions.

6.2. Theoretical Implication: Differentiating Current and Target State GEA Fit

Typically, in the EA theory, no specific difference is made between the current or target state use of an EA framework. The results here incline to differentiate the GEA methodology for current state and target state GEA management. The current state grid would 'fade out' to become dimensions in a data-warehouse. If the current state GEA management evolved into this direction, it might shift the GEA grid notion towards adaptive EA frameworks [23,24], and closer to practice of using 'no grid'[6]. According to Buckl et al. [42], the EA grids are often too abstract for real use as such, or too massive and large for practical deployment. They [42] present paths and dependencies of EA models for rearranging them according to management requirements. Our results have resemblances also to model driven architecture [24], which also presumes presenting model and model element dependencies.

Discussing the target state EA grid adaption is beyond the paper. However, the situational EA grid adaption by Hoogervorst and Dietz [41] might suit for the target state GEA development. Kotusev [30] classifies EA management methods as traditional, rigid ones, e.g., in [8,10,11,28], and to more flexible ones concentrating more on the target state EA development, e.g., in [18]. Even though his literature analysis concerns basically IT architecture management methods, the results might be considered indicative to our suggested theoretical implication about separating the adaption principles for GEA grid in the current and target states.

Reliability and validity. The generalization in Fig. 4 is presented with the humble notion, that it is restricted to primary data concerning the strategy architecture development. A municipality is an extraordinary case organization for public administration studies. It has a wide geographical service outlet, multiple service domains, deep hierarchies at least in a dual organization, various enterprise forms, and typically a separate corporate management. As such, it shares structural analogies with the state government. However, one case, principally one researcher, and a single partial architecture set limitations to the generalizability. Consequently, the results cannot be validated based on this study, even though according to the observations, the management requirements for re-organizing the descriptions contents seemed to hold for other architectural viewpoints too. The construction of the artifacts is also never subject independent. Their interpretation as the primary data source is therefore challenging. In the study, the use of recursive artifacts exponentiates the challenge. The development of the artifacts and minutes of the workshops and meetings were submitted to participants. The arguments are also based on conceptual models to make the inferences transparent and arguable. The strategy artifacts and excerpts were published for reliability in [49], and in annual budget and audit books. The results can still be considered initial, typically abductive logic.

7 Conclusions

We described the reflection and learning of an action design research case study in a Finnish city corporation. Government enterprise architecture (GEA) framework adaption guided the development of the strategy architecture. GEA framework adaption principles were evaluated and reconsidered based on that work. As a generalization of the results, we proposed implementing GEA framework as a dynamic data model of the prevailing management structures for the current state GEA. This would facilitate deeper understanding of organization structures, and enhance the GEA method use as a strategic general management tool in public sector.

We reflected on traditional EA framework assumptions, critically questioning the concepts of a given framework and its dimensions. The results imply the current state GEA implementation as a dynamic hypercube along management structures in situ. The suggested approach comes close to model and content driven EA approaches. We acknowledged the restrictions of the study, as for the generalizability of results. Accordingly, we call for further constructive case studies on the GEA framework adaption, differentiated for current state GEA management and situational target state GEA development. GEA tool development as data-warehouses seems a fruitful area to study. Many more research areas can be perceived, e.g., how to automatically visualize the GEA descriptions for each model type, and how to gather the needed tabular information, and classify it according to management structures.

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VIII

ENVISIONING INFORMATION SYSTEMS SUPPORT FOR BUSINESS ECOSYSTEM ARCHITECTURE MANAGEMENT IN PUBLIC SECTOR

by

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Envisioning Information Systems Support for Business Ecosystem Architecture Management in Public Sector

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Abstract. Based on our research concerning Finnish national enterprise architecture (EA) adoption in long run, we discuss here how EA concept and tool are to be developed to support business ecosystem and organization design. Our research context indicates, beyond a federal government or a state one, that even a single municipality, like a city concern, can be perceived as an ecosystem of its sectoral domains, subsidiaries etc. We outline a vision of an overall ontology-based, shared EA repository for the-whole-of-government current state descriptions. We specify the central design principles and functional requirements for such a system and illustrate some potential use cases of it. The study suggests further abductive studies on the best design for such a system. Consequentially, we propose EA as a concept for organizational design of a government entirety.

Keywords: business ecosystem, enterprise architecture, ontology, public sector.

1 Introduction

The world has become interconnected so that the organizations are intertwined with business partners and integrate into networked business models. This enhances efficiency by focusing on company's core competencies while leveraging capabilities of their partners. The concept of a business ecosystem is suggested as an economic community of interacting organizations and individuals [28, p. 9] to create value through the increased information, services, and products for the customer [18, p. 28]. Ecosystems have attracted interest also in the public sector, and inspired new models of public services delivery, where the ecosystems-enabled co-creation is suggested as key innovation [5]. Recent examples include Nordic Smart Government project aiming at the data driven Nordic region, based on the interoperable digital ecosystem for data exchange between systems and authorized parties. Prevailing reform in Finnish Social and Health services aims at a shared business ecosystem that will include shared IT services as the common platform for currently siloed and fragmented data resources. The ecosystem model is believed to improve the quality of social and health services, and create new opportunities for business, research, and societal growth [39].

Enterprise architecture (EA) is commonly considered as a valuable approach to coherently manage and align the organizations' key assets, such as business processes and services, information systems, and data. EA has been applied in large and complex organizational change endeavors, business mergers (e.g. [9, [34]), electronic government (e.g., [6, 15]), and building business ecosystems platforms [39]. However, EA methodologies fall short in bridging internal and external environments, and in involving customers, supplier, business partners and other various stakeholders for building successful ecosystems [37]. Drews and Schirmer [12] propose a plausible idea of how intra-organizational EA should evolve to respond the organizations' interconnectedness.

For the interconnectedness of the *public administration (PA) as a business ecosystem*, (later *government ecosystem*), the paper proposes a vision of the real-time information system support. We ask, what kind of information system (IS) is needed in a complex socio-technical government ecosystem for real-time current state analysis. We outline basic functional requirements of an ontology-based, shared EA repository. The work is constructed as a design research, based on our observations in Finnish public administration EA adoption, e.g., [41, 24], as well as the literature anticipations of the future EA in business ecosystems, e.g., [12]. We recognize the far-reaching nature of the vision. However, the rapid development of the enterprise modeling and meta-modeling methodologies (e.g., [10, 38]), should anticipate that no long will take to the vision to be implementable. Artificial intelligence, neuro technologies etc., are the future options for creating and maintaining the as-is *business ecosystem EA* (BEA). We use Finnish National PA as an example to illustrate the given vision. The aim of the study is to encourage evolutionary studies, and pilots, especially constructive ones, to reach out to more specific specifications and design principles for the BEAM solution.

The remainder of this paper is structured as follows. In Chapter 2, the EA management is presented as a tool in collaborative networked environments. In Ch. 3, the research setting of the constructive study is described. In Ch. 4, the Finnish PA is illustrated as an example of the government ecosystem. We shortly outline the previous exploratory research of the EA adoption in Finland, that inspired the vision at the paper. In Ch. 5, the vision of the public sector EA management IS and its foreseen usage is described, with some core requirements and illustrations. In Discussion (Ch. 6) we answer the challenges presented for the execution of the business ecosystem EA management in [12]. Chapter 7 presents conclusions and suggests further studies of the subject.

2 EA Management in Networked Environments

Visnjic et al. [42] present cities as "ecosystems of ecosystems". Business ecosystems (later, *ecosystem*) have been much studied and defined in a variety of ways (e.g. [20, 31]). Similar ideas have been discussed in other fields under different terminology [1, 17]. Governments and the economy are perceived as complex social systems by several authors [3, 30]. As the world alters towards networked and complex structures, the changes within the organizations and in the environments are becoming more frequent, yet more difficult to perceive and foresee. This creates the demand for organizations to evolve constantly, to move out of the traditional, possibly stagnant structures and operating models. Public organizations have been struggling with the agile ideology [35], as means to the frequently changing environments.

The research of social architectures that are embodied in organizational design thinking, are concerned by social sciences [27], whereas technical architectures are discussed by engineering sciences, such as enterprise engineering and EA. The need to integrate technological and social perspectives in the design and engineering of organizations, is urgent [27]. Social nature of systems seems to be necessary to be taken into account in design of the ecosystem of organizations. Poli [33] distinguishes complex and complicated systems: a complicated one can be understood through structural decomposition, whereas complex ones can be understood via functional analysis. This suggests, that complicated systems can be modelled fully (in theory), while complex systems remain heuristic in nature, and cannot be fully captured. Therefore, disciplines (e.g. EA) which concern the analysis and design of an organization should possess a dualistic nature - concerning both complex and complicated problems.

The current EA methodology is lacking in the capabilities of business ecosystems analysis and design [13, 32]. Recently, a systemic stance on an organization in an ecosystemic environment has been supported, e.g., in [12, 19]. EA might need a reconceptualization on methods and tools, to provide requisite coherence and adaptability in reacting internal and external change demands [19, p. 278]. In the paper, we suggest the current state EA modeling to follow the engineerable path as the complicated problem, by semi-automated models of the as-is, whereas the target state design of BEA is left with situational, heuristic practices, however benefiting of the as-is repository.

3 Research Setting

The research follows the principles of the design research (DR) [16], where the theoretical knowledge base and the real-life environment are married for the researchers to create an artefact that is needed in the environment. In the study, we envision an IS solution for EA descriptions' accessibility, and automated update in government ecosystem. The IS vision stands for the design artifact in terms of [16]. The IS vision also proposes the hypothesis that is to be evaluated in future studies in government ecosystems, e.g., in a municipal corporate, or a national government. Beyond the EA research endeavors of the Finnish EA adoption, the authors hold EA development or EA education roles in Finnish PA. We build on the personal research and development endeavors, as well as the latest enterprise modeling and architecture knowledge base, where the most influential for the work have been the EA frameworks and methodologies [29, 14, 8, 10]; EA conceptual foundations [7, 21, 23]; EA studies from the business ecosystem perspective [4, 12]; and enterprise modeling and engineering [38, 22, 11, 36].

The proposed IS vision forms a continuum in abductive DR cycles concerning EA framework adaption in Finnish PA [39, 40, 41], that suggested two things. First, the current state EA descriptions of a government ecosystem were to be modeled as structural, re-arrangeable descriptions e.g., like in [29]. Secondly, the current state descriptions elements were to be represented in relation to the prevailing management structures in real-time. This requires a common meta level representation of PA management structures – i.e., a contextual ontology. Finally, as for the current state EA descriptions, the EA framework for public sector was proposed to be implemented as a dynamic data model of the current management structures [41]. In this paper, the described previous results are further enlarged by abductive logic reasoning to present the hypothesis for future iterative and constructive case studies. Abductive logic forms a 'process of discovery' where inferences are drawn to the next best explanation in each cycle, with wider set of data [25]. Consequentially, the paper presents the IS vision for government ecosystem EA based on the ontology of the government management context.

4 Challenges of the Finnish PA as Ecosystem

Finnish national PA, as a 'whole-of-government' forms a complex ecosystem of actors. The actors are organizations of high complexity, e.g., with variety of products, services, official responsibilities, and complex administration structures. The political organization comprises a parallel hierarchy with the administration. Further, various cross-organizational management forms, such as policy programs are typical. According to our observations, these management structures are not always documented transparently.

Re-organization of the administrative structures has become an established practice in Finnish PA. The trends to centralize and decentralize are simultaneous. New Public Management related reforms have taken place since 1987. Gradual outsourcing of prominent business areas can be perceived in both state and local sectors. Simultaneously, the mergers have been encouraged by the State government especially in the municipal sector. The municipalities have conglomerated in many ways, e.g., via forms of collaborative networks, joint ownerships or by strict mergers. A conglomerate form of management is typical to public sector organizations, creating a complex system per se with various corporate governance functions, deep administrative hierarchies, and multiple types of actors, like sectoral domains, in-house enterprises, subsidiaries etc.

Re-organization and re-structuring are not typically based on profound systematic analysis and design. The current state organizational structures form a hindrance to the recurring transformation efforts. In a network of organizations, the management structures and classifies should be transparent at high usability levels, to enable the comparative analysis of the as-is corporate structures of the ecosystem, before the design of the common goals implementations. Finnish Information Management Act 2011 necessitates PA actors to publicly model their EA. However, despite of the serious endeavors in launching the shared EA modeling tools among PA actors, the open sharing of the EA descriptions is not at adequate level. Innovations and best practice sharing has to be based on mutual agreement on personal level first. The search algorithms and comparisons are neither profoundly supported at model element level. Furthermore, as Finnish administrations are trending towards citizens-as-partners type practices in service development, the customers and citizens might form a remarkable resource in innovating public services and structures, based on an open source EA description.

5 Vision of The Ontology-based Real-time EA Repository

We outline the vision for the IS support of the government ecosystem EA at conceptual level, 1) to enable the comparative analysis across 'whole-of-government', and 2) to provide the real-time as-is information of the ecosystem for target state design. Sect. 5.1 describes the vision, and 5.2. outlines the tentative target state BEA design process.

5.1 IS support for the Ontology-based Real-time EA (OREA)

We suggest co-creating the public sector ontology of the different level government ecosystems (local, national, federal), and mapping the EA descriptions and metamodels to them. We would like to see the output as the contextual ontology of government ecosystem EA modeling and enterprise engineering, on which you could build the corresponding shared digital IS ecosystem for EA management and development. We yield below the design principles and some central functionals requirements for this IS vision, illustrated by exemplary use cases. The envisioned system provides kind of a semantic web, enabling many types of data mining and comparative analyses.

For the design principles of as-is BEA realization we suggest following: 1) *Dynamic as-is contents* - automated updates or suggestions for updates. 2) *Scalability*, from the local ecosystems to the national, and the federal ones. 3) *Open access EA information* for citizens, and partners. 4) *Plug-in architecture* options - external organizations outside of the ecosystem are facilitated to plug into the government ecosystem EA. The plug-in architecture enables co-creation, and co-evolution of the ecosystem also with the private actors. Plug-in option offers the option to the new actors to join the ecosystems, thus supporting spontaneous evolution of the BEA. Next, we present three functional requirements (R1, R2, R3) for the as-is BEA realization:

R1. Basic modeling and meta-modeling functionalities, that are readily available in many modeling tools, (e.g., [38, 36]**)**. Modeling techniques have still to be innovated more for the organizational coherency and co-evolution purposes. In our development work, e.g., the strategy architecture models of the city were iteratively designed for the best fit to the purpose. The model notations and templates are to be designed situationally, where the model elements and attributes may associate to each other. The real-time as-is descriptions can be automatically visualized via metamodel rules, based on the structural information yielded regularly in everyday-work of the civil servants.

R2. Agile analyses and comparisons tools, that necessitates interdependent, commonly agreed ontologies, e.g., for business catalogues, and organigrams. For example, the as-is management structures can be made transparent in real-time and used to categorize the EA descriptions and their elements. Each description model and element are associated to relevant management structures. Also, different types of organizations, different types of management structures, and different types of management classifications are represented in the shared ontology. They facilitate the management needs for re-structuring the model instances according to their needs. Leaders and enterprise analyst may search descriptions and their elements according to shared ontologies, into which the metamodels of different description types are associated. For example, the Minister of Commerce may browse for the different organizational options of the municipalities entrepreneurial services, to decide whether each municipality has organized them as a subsidiary, in-house-enterprise, via joint ownership, or other. Along the organigrams, he might get the visualized volumes of the actors. The citizen can compare, e.g., the service catalogues between the municipalities.

R3. Situational EA frameworks of the as–is description can be pulled out of the system according to given parameters. The system might offer different EA frameworks templates to different organization types, too. Each organization may instantiate their framework and choose the EA models they prefer in their EA. EA frameworks are sketched as printed outlines as functionally. For instance, the CEO of a water supply subsidiary may request the outline of the EA descriptions realized in his organization, and in those of the neighboring cities.

5.2 Target State Design in the Government Ecosystem.

Figure 1 suggests a tentative management model for the government ecosystem architecture. The stages 1 to 5 illustrate the tentative target state design process for co-creating new services in the ecosystem (Fig. 1): In the phase 1 (Idea), an initiative appears, e.g., from citizens, government actor, or private companies (cf. [24]). To support the innovation, the phase should be as open as possible. This creates a socio-technical dimension to the idea co-creation. In Phase 2 the idea evaluation is done by a variety of stakeholders. Agencies might have a special interest in the financial analysis, whereas local citizens might appreciate the geographical locations of the services. The balance between financial and functional performance must be achieved [24]. This is followed by Phases 3a Current state analysis, 3b Target state design, and 3c Gap analysis. In (3a), the participating actors are identified, resulting in the subset of necessary distinct EA's, covering concerns such as customers, partners and suppliers [12], i.e., *EEA* (see below). In Phase 4, Project implementation starts with suitable project organization, involving the configuration of internal and external ecosystem actors, and IT-service providers. The as-is BEA updates semi-automatically by increments in the project implementation, finally fully reflecting the previous target state. The deployment may be also ceased at any time based on the feasibility checks, too.

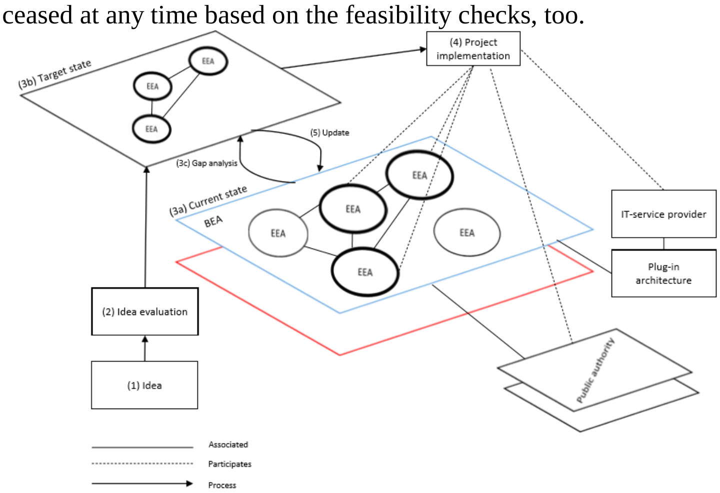

Fig. 1. BEA management: the blue and red layers illustrate as-is BEA repositories for a couple of government ecosystems. The phases 1-5 indicate the target state design of the ecosystem.

6 Discussion

The domain of EA methodologies has evolved towards the holistic organizational design and development [23]. Al-Kharusi et al. [2] note in their study of EA at dynamic environments that the human and organizational aspects is neglected in target state design. While [37] acknowledge the EA as a way to cope with organizations' ever-increasing complexity, they argue that the EA methodologies do not efficiently advocate the cross-organizational interactions between business entities. They call for business ecosystem architecture models to allow filling the gaps between internal and external operating environments, such as customers, suppliers, and business partners. Drews et al. [12] discuss the stages from the traditional EA to *Extended Enterprise Architecture* (EEA), and finally to the *Business Ecosystem Architecture* (BEA). While they suggest EEA to already extend to cover concerns such as customers, partners and suppliers, they argue that that for BEA, a central actor must have an overview of the whole ecosystem, i.e. the infrastructure and interfaces to all connected EEA's.

Drews and Schirmer [12] also present challenges of extending EA towards a value-producing instrument in complex and networked environments. Based on their four cases, 16 challenges for business ecosystem architecture management are displayed. and classified into four groups: (1) challenges regarding the (meta-)modelling of EEA and BEA; (2) challenges regarding the tool support; (3) challenges regarding the management of EEA and BEA; (4) challenges regarding the socio-technical dimension. We divide the challenges into the two categories: the complicated problems, i.e., those that can be dealt with by using engineering practices; and the complex problems, i.e., those that mandate the use of heuristic practices. Next, these problems, along with our proposed answers them are further discussed. The answers are derived from the afore-envisioned IS support of the OREA management of the government ecosystem. The answers can be seen as the anticipated benefits of the envisioned digital system.

6.1 As –Is BEAM as Complicated Problems

Our proposed solution to complicated problems is an ontology-based, shared EA repository for the-whole-of-government real-time updating descriptions.

Challenges concerning modelling include inter-organizational interfaces on all layers, finding the right level of abstraction and identifying shared business objects [12]. The shared ontology would support associating intra-organizational EA models inter-organizationally. The shared ontology might also help mapping the abstraction levels of the EA descriptions and their elements, whereby comparative cross-agency analysis were enabled. It would provide a common search index for comparative analyses and data mining, which would further enable the recognition of shared architecture objects, overlaps and bottlenecks.

The challenges [12] include those associated with ultra-large-scale architectures with a large number of actors in BEA. As a solution, the envisioned BEAM IS support semi-automatically would provide the ultra-scale current state descriptions. Updates would be based on the content changes in structural documents and automatically visualized as EA models in all EA layers. Therefore, the ultra-large-scale BEA descriptions would remain continuously updated. In future times, artificial intelligence might even make inferences based on less structured input or even graphic contents.

Challenges concerning tools include tool support for ontologies as well as those concerning open standards for data exchange (import/export). Here, we propose envisioned IS support per-se as described in the paper. Common modelling standards such as ArchiMate, UML, and BPMN could be mapped to the (core) concepts of the shared ontology to enable search and comparison regardless of the modelling language.

6.2 To – Be BEAM as Complex Problems

Concerning the complex problems, our proposed solution is the proposed target state analysis and design process.

Challenges concerning management**,** such as inter-organizational tasks and roles can be approached with more transparency both in inter- and intra-organizational levels via ontologies that apply to management structures [41]. Managing the aspects concerning BEA service provision can be solved with open network structure of actors and service providers. Also, our 'plug-in architecture' enables new (and temporary) actors to attach and contribute towards the development of ecosystems and services.

Challenges concerning socio-technical aspects, e.g. citizens and consumers as actors, and the lifeworld of customers and partners [12]. Our solution provides an open channel for citizens and consumers to suggest and peer-evaluate ideas for the development of the ecosystem.

The modelling and tool in Drews and Schirmer's challenges, is the part which our vision of ontology-based hits best, as the shared EA repository for the-whole-of-government, updating in real-time. It encounters with EEA and BEA modelling and tool challenges, since they can be seen as "complicated", engineerable ones. The management and socio-technical aspects are more related to the complex issues, where solutions can be considered mostly heuristic and situational in nature. Therefore, the tentative practice of the target state BEAM design given in Ch. 5, tentatively answers these complex challenges.

7 Conclusions

We presented the design principles and central functional requirements of the ontology-based as-is government ecosystem architecture repository, that is meant to be applicable to any chosen whole-of-government entirety. The proposed solution has several anticipated benefits. The system might maintain transparency and comparability across the entirety of the government, eliminate duplicate work, enhance the sharing of the best practices, and most importantly, support the co-evolution of PA structures towards higher coherency and synergies. Shared EA descriptions would support also co-creation and co-evolution of the ecosystem. However, the implementable solutions require further studies. Especially it requires the design of a future common, wider ontology of the public administration sector and concepts. This implies application of ontology engineering knowledgebase in further development and research of the subject (cf. [24]).

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IX

ECOSYSTEM ARCHITECTURE MANAGEMENT IN THE PUBLIC SECTOR – FROM PROBLEMS TO SOLUTIONS

by

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Ecosystem Architecture Management in the Public Sector – From Problems to Solutions

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Abstract. Based on our research concerning enterprise architecture (EA) in the Finnish public sector, we discuss how EA concept and tool need to be developed to support government business ecosystem and organization design. Our research context indicates, beyond a federal government or a state one, that even a single municipality, like a city concern, can be perceived as an ecosystem of its sectoral domains, subsidiaries and such. We outline a vision of an overall ontology-based, shared EA repository for the-whole-of-government current state descriptions and specify the central design principles and functional requirements for such a system, illustrating some potential use cases of it. Based on interview data from four smart city cases in Finland, we suggest a management model for the government ecosystem architecture target state design, specifically a design process for co-creating new services in the ecosystem. Further, we outline some principles for government ecosystem architecture management.
Keywords: Enterprise Architecture, Ecosystem, Public Sector, Ontology.

1 Introduction

The world has become interconnected so that the organizations are intertwined with business partners and integrate into networked business models. This enhances efficiency by allowing companies to focus on their core competencies while leveraging capabilities of their partners. The concept of a business ecosystem is suggested as an economic community of interacting organizations and individuals [1] to create value through the increased information, services, and products for the customer [2]. While the underlying complexity of the public administration is prone to increase, governments struggle to achieve public-policy endeavours by dividing complex issues into smaller pieces [3]. Contrariwise, embracing holism and the interconnections among organisations might be a key to solve some of the problems occurring. Ecosystems have

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attracted interest also in the public sector, and inspired new models of public services delivery, where the ecosystems-enabled co-creation is suggested as key innovation [4]. Recent examples include Nordic Smart Government project aiming at the data driven Nordic region, based on the interoperable digital ecosystem for data exchange between systems and authorized parties. Prevailing reform in Finnish Social and Health services aims at an ecosystem that will include shared IT services as the common platform for currently siloed and fragmented data resources. The ecosystem model is believed to improve the quality of social and health services, and create new opportunities for business, research, and societal growth [5].

While offering possibilities, operating in an ecosystemic environment might prove to be challenging, and the change from traditional government structures might be difficult to manage, requiring holistic yet detailed view. Enterprise architecture (EA) is commonly considered as a valuable approach to coherently manage and align the organizations' key assets, such as business processes and services, information systems, and data. EA has been applied in large and complex organizational change endeavours, business mergers [6], [7], electronic government (e.g. [8], [9]), and building business ecosystems platforms [5]. However, EA methodologies fall short in bridging internal and external environments, and in involving customers, supplier, business partners and other various stakeholders for building successful ecosystems. Prior studies (e.g. [10]) for a thorough review, see [11]) have discussed Extended Enterprise Architecture. Further, Drews and Schirmer [12] propose a plausible idea of how intra-organizational EA should evolve to respond the organizations' interconnectedness. Still, the means of extending the focus of enterprise architecting from intra-organizational to the ecosystems level is an area not yet sufficiently studied. Although previous research (e.g. [13], [14], [15]) has discussed EA in a smart city context, we differentiate from these valuable contributions by focusing to government ecosystem architecture per se, and only use smart city as an example of public administration (PA) ecosystem.

This study is constructed as a design science research, based on our observations in Finnish public administration EA adoption, (e.g. [16], [17]), as well as the anticipations of the future EA in business ecosystems, (e.g. [12]). Based on these explorations, our objectives are the following. For the interconnectedness of the PA as a business ecosystem (later, government ecosystem):

I. We aim to outline some basic functional requirements of an ontology-based, shared EA repository for government ecosystem and to propose a vision of a real-time information system support for such a repository.
II. Based on our latest generate/test cycle, we use interview data from four smart city cases, and further develop previously introduced [18] management model for the government ecosystem architecture target state design, as well as outline some principles for government ecosystem architecture management.

The usage of ontologies for EA integration and analysis [19] and combining EA modeling and enterprise ontology [7], [20], [21], [22] are not unheard of. Further, Fischer, Aier and Winter [23] and Hansen and Hacks [24] have discussed federated repository approaches for the maintenance of EA models. The rapid development of the enterprise modeling and metamodeling methodologies [25], [26] should anticipate the vision to be implementable in the near future. Artificial intelligence, among other solutions, could be the future option for creating and maintaining the as-is *business ecosystem EA* (BEA). Automatic data collection for EA models [27] modeling [28] and documenting EA [29] have already been discussed. As an example, Gladden [30, p. 1] discusses enterprise mega-architecture, which "*disengages human enterprise architects from the fine-grained details of architectural analysis, design, and implementation, which are handled by artificially intelligent systems functioning as active agents rather than passive tools*."

We use Finnish National PA as an example to illustrate the given vision. This research aims to make a contribution to the discussion concerning the evolving discipline of enterprise architecture, and its usage in ecosystemic environments as well as enhancing the interconnectedness of the public administration as an ecosystem. First, we aim to contribute by advancing the work of EA usage on PA by envisioning requirements for information system (IS) for real-time current state analysis in PA ecosystem. Second, we outline the basic functional requirements of an ontology-based, shared EA repository. Third, we suggest a management model for the government ecosystem architecture target state design, specifically a design process for co-creating new services in the ecosystem, and outline some principles for government ecosystem architecture management.

The remainder of this article is structured as follows. In Section 2, the EA management is presented as a tool in collaborative networked environments. In Section 3, the research setting of the constructive study is described. In Section 4, the Finnish PA is illustrated as an example of the government ecosystem. We shortly outline the previous exploratory research of the EA adoption in Finland that inspired the vision at the article. In Section 5, we discuss the challenges presented for the execution of the business ecosystem EA management in [12], and present some solutions for these challenges. We discuss the vision of the public sector EA management IS, and describe its foreseen usage with some core requirements and illustrations. Further, the government ecosystem target state design process is illustrated along with the results of our latest research cycle. Section 6 presents conclusions and suggests further studies of the subject.

2 EA Management in Ecosystemic Environments

As the world moves towards networked and complex structures, the changes within the organizations and in the environments are becoming more frequent, yet more difficult to perceive and foresee. This creates the demand for organizations to evolve constantly, to move out of the traditional, possibly stagnant structures and operating models.

Organizations of different kinds are increasingly perceived as systems operating in ecosystems. For instance, Visnjic et al. [31] present cities as "ecosystems of ecosystems". Further, governments and even the society are perceived as complex social systems by several authors [32]. As noted by Caputo et al. [3], "*the society could be defined as a complex set of relationships based on the continuous sharing of resources and on the combination of several expectations culminating in the building of new value*", thus making society a domain which "*cannot be analysed in the light of a mechanistic approach; it requires the adoption of a holistic perspective*". The idea emerged from the field of biology, different types of ecosystems have been widely discussed in academic disciplines, such as marketing, strategy, social sciences, innovation management, engineering and information technology, gaining popularity especially in recent years. Ecosystems have been defined in a variety of ways, and different kinds of ecosystems include business-, innovation-, service-, and platform ecosystems as well as various others. Adner [33] sees ecosystems as "*the alignment structure of the multilateral set of partners that need to interact in order for a focal value proposition to materialize*", and makes a separation between ecosystems-as-affiliation ("*ecosystems as communities of associated actors defined by their networks and platform affiliations*") and ecosystem-as-structure ("*ecosystems as configurations of activity defined by a value proposition*"). In line with Adner, we see the latter as a suitable metaphor for government ecosystem, where diverse actors come together to meet a shared value proposition. Han, Lowik and de Weerd-Nederhof [34] have recognized common elements of different ecosystems, including focal roles, co-specialization, co-evolution and co-opetition, pooled and loosely coupled interdependence, hierarchical structure, shared vision, system-level business model, and modularity. Further, ecosystems can be interpreted as nested in layers, ranging from micro-level (service exchange between actors) to interdependencies between co-existing ecosystems at mega-level [35]. Ecosystems have been used as a conceptual paradigm in the public sector, as seen, as an example, in the case study of a national health information system, where public and private health care organizations act in meso-level, and the whole ecosystem represents macro-level [36].

Enterprise architecture (EA) has been defined as a discipline focused on the alignment between business and information technology (IT). With EA organizations can define their current and future states, as well as a roadmap between them, taking into consideration aspects such as processes, capabilities, applications, systems, data and IT infrastructure [37], [38], [39]. However, as argued by Lankhorst [40, p. 205], *"In practice these domains are not approached in an integrated way. Every domain speaks its own language, draws its own models, and uses its own techniques and tools. Communication and decision making across domains are seriously impaired"*. Kloeckner and Birkmeier [41] in their article about enterprise architecture from a systems perspective, state that *"A comprehensive enterprise architecture therefore specifies, amongst others, the goals and strategies of an enterprise, its business processes as well as the associated resources like production systems, information systems and humans. While the former aspects are often included in current concepts of EA, especially humans, as integral parts of enterprises, are often not taken into consideration. But only such a complete picture would essentially support necessary transformations of organizations in a flexible and agile way*". Current EA methodologies fall short in bridging internal and external environments, and in involving customers, suppliers, business partners and other various stakeholders for building successful ecosystems.

According to Magalhães and Proper [42], the research of social architectures – embodied in organizational design thinking – is concerned by social sciences. Contrary, technical architectures are discussed by engineering sciences, such as EA (ibid). In the same vein, Pennock and Rouse [32] state, that there are at least two broad perspectives viewing enterprises as systems – architecting enterprises (i.e. analyzing and designing the functions, structures and processes) and managing the enterprise. Bernus et al., [43, p. 96], note that *"EA must encompass both soft* [e.g. related to organizational of social phenomena] *and hard systems* [e.g. engineering problems]*, model complex systems behavior through self-design, and add the human interpretive behavior and cognition to organizations as living systems."*. Interestingly, Poli [44] distinguishes between systems that are complex and those that are complicated: a complicated system can be understood through structural decomposition, whereas complex systems can be understood via functional analysis. This means, that while complicated systems can (in theory) be modelled fully, modeling complex systems is always incomplete. Regardless of the view, concerning the nature of social systems seems to be necessary when the emphasis is on an ecosystem of organizations.

Therefore, disciplines (e.g. enterprise architecture) which concern the analysis and design of an organization should possess a dualistic nature – concerning both complex and complicated systems [44], soft and hard systems [43], social and engineering problems [42] and architecting and management problems [32]. In practice, this means combining two perspectives: modeling the state of, e.g. the infrastructure and data of the organization (complicated problem) as well as managing social phenomena in the midst of ecosystemic environment (complex problem). Two kinds of requirements of architectural development are apparent in said environments. First, the practices of enterprise architecture management (EAM) must allow flexible and responding designs to make it possible to answer the unexpected changes in environment, and to grasp the newly emerged requirements and possibilities that often ensue. On the other hand, operating in complex networked environments necessitates carefully planned EAM that considers various interconnected yet independent parties as well as able command of various concurrent contingencies. The development activities in complex business ecosystems call for possibility for emergent design at the same time as they necessitate strictly coordinated architecture planning and management. The former must extend to interfacing networked organizations operating in a same ecosystem and to acknowledge their individual business strategies and processes as well as software and technology landscapes.

To conclude, although a systemic stance has recently received notable interest in the EA field on research (e.g. [43], [45]–[50]), and EA has been studied as a means of understanding networked and ecosystemic settings (e.g. [13]–[15], [51]–[57]), the current EA methodology is still lacking in the capabilities of business ecosystems analysis and design (see, e.g. [10], [57],

[58]). EA might need a reconceptualization on methods and tools, to provide requisite coherence and adaptability in reacting to internal and external change demands [59].

In the article, we suggest the current state EA modeling to follow the engineerable path as the complicated problem, by semi-automated models of the as-is, whereas the target state design of BEA is left with situational, heuristic practices, however, benefiting of the as-is repository.

3 Research Setting

This research follows the principles of the design science research (DSR) [60], where the theoretical knowledge base and the real-life environment are married for the researchers to create an artifact that is needed in the environment. DSR as discussed by Hevner et al. [60] is frequently used in studies concerning the modeling of ecosystems, such as smart cities (e.g. [61]), as well as in discussing EA in ecosystems [62]. In this study, we envision an IS solution for EA descriptions' accessibility, and automated update in government ecosystem. Also, previously introduced [18] management model for the government ecosystem architecture target state design is further developed, and some principles for government ecosystem architecture management are outlined. These stand as design artifacts in terms of [60], forming hypothesis that is to be evaluated in future studies in government ecosystems, e.g. in a municipal corporate, or a national government. Beyond the EA research endeavors of the Finnish EA adoption, the authors hold EA development or EA education roles in Finnish PA. We build on the personal research and development endeavors, as well as the latest enterprise modeling and architecture knowledge base, where the most influential for the work have been the EA frameworks and methodologies [25], [63], [64], [65]; EA conceptual foundations [43], [48], [66]; EA studies from the business ecosystem perspective [12], [51] and enterprise modeling and engineering [26], [67], [68], [69]. The described previous results are further enlarged by abductive logic reasoning to present the hypothesis for future iterative and constructive case studies. Abductive logic forms a 'process of discovery' where inferences are drawn to the next best explanation in each cycle, with wider set of data [70].

To elucidate our vision, we present excerpts from our most recent research cycle, a multiple case study of four smart cities in Finland. The interview data is used in a generate/test cycle [60] to further enhance our previously introduced [18] model for PA ecosystem target state design process. We conducted a total of eight interviews with seasoned enterprise architecture professionals as well as a diverse range of managers from Jyväskylä, Helsinki, Espoo and Turku. Of these, the latter three are part of a 6Aika – a collaborative smart city ecosystem of six of the largest Finnish cities [71], while Jyväskylä is a frontrunner of Finnish smart city endeavors with its smart city districts such as Hippos and Kangas [72]. The interviewees were selected with the purposeful sampling.

We conducted semi-structured interviews between November 2018 and January 2019. The interviews were audio recorded, transcribed and analyzed using conventional content analysis, according to Hsieh and Shannon [73]. The interviews lasted between 43 and 56 minutes, the average being 50 minutes. As discussed by Hsieh and Shannon (ibid), conventional content analysis can lead to concept development and model building. The excerpts presented in the following sections were translated into English and edited for brevity, thus removing hesitations, words and such, which were not essential for overall understanding of the data.

The proposed IS vision and the tentative government ecosystem architecture target state design process form a continuum in abductive DSR cycles concerning EA framework adaption in Finnish PA [5], [16], [74], that suggested two things. First, the current state EA descriptions of a government ecosystem were to be modeled as structural, rearrangeable descriptions, e.g. like in [63]. Secondly, the current state descriptions elements were to be represented in relation to the prevailing management structures in real-time. This requires a common meta level representation of PA management structures – i.e. a contextual ontology. Finally, as for the current state EA descriptions, the EA framework for public sector was proposed to be implemented as a dynamic data model of the current management structures [16].

4 Challenges of the Finnish PA as an Ecosystem

Finnish national PA, as a 'whole-of-government' forms a complex ecosystem of actors. The actors are organizations of high complexity, e.g. with variety of products, services, official responsibilities, and complex administration structures. The political organization comprises a parallel hierarchy with the administration. Further, various cross-organizational management forms, such as policy programs are typical. According to our observations, these management structures are not always documented transparently.

Re-organization of the administrative structures has become an established practice in Finnish PA. The trends to centralize and decentralize are simultaneous. New Public Management related reforms have taken place since 1987. Gradual outsourcing of prominent business areas can be perceived in both state and local sectors. Simultaneously, the mergers have been encouraged by the State government especially in the municipal sector. The municipalities have conglomerated in many ways, e.g. via forms of collaborative networks, joint ownerships or by strict mergers. A conglomerate form of management is typical to public sector organizations, creating a complex system per se with various corporate governance functions, deep administrative hierarchies, and multiple types of actors, like sectoral domains, in-house enterprises, subsidiaries etc.

Re-organization and re-structuring are not typically based on profound systematic analysis and design. The current state organizational structures form a hindrance to the recurring transformation efforts. In a network of organizations, the management structures should be transparent at high usability levels, to enable the comparative analysis of the as-is corporate structures of the ecosystem, before the design of the common goals implementations. Finnish Information Management Act 2011 necessitates PA actors to publicly model their EA. However, despite of the serious endeavors in launching the shared EA modeling tools among PA actors, the open sharing of the EA descriptions is not at adequate level, and the implementation and use of the method have been challenging [75]. Innovations and best practice sharing has to be based on mutual agreement on personal level first. The search algorithms and comparisons are not profoundly supported at model element level. Furthermore, as Finnish administrations are trending towards citizens-as-partners type practices in service development, the customers and citizens might form a remarkable resource in innovating public services and structures, based on an open source EA description.

5 EAM in Ecosystems – From Problems to Solutions

The domain of EA methodologies has evolved towards the holistic organizational design and development [48]. Al-Kharusi et al. [76] note in their study of EA at dynamic environments that the human and organizational aspects are neglected in target state design. While [77] acknowledge the EA as a way to cope with organizations' ever-increasing complexity, they argue that the EA methodologies do not efficiently advocate the cross-organizational interactions between business entities. They call for business ecosystem architecture models to allow filling the gaps between internal and external operating environments, such as customers, suppliers, and business partners. Drews and Schirmer [12] discuss the stages from the traditional EA to Extended Enterprise Architecture (EEA), and finally to the Business Ecosystem Architecture (BEA).

Drews and Schirmer [12] also present challenges of extending EA towards a value-producing instrument in complex and networked environments. Based on four cases, 16 challenges for business ecosystem architecture management are displayed (ibid). The presented challenges are classified into four groups: (1) challenges regarding the (meta-)modeling of EEA and BEA; (2) challenges regarding the tool support; (3) challenges regarding the management of EEA and

BEA; and (4) challenges regarding the socio-technical dimension. We divide the challenges into the two categories: the complicated problems, i.e. those that can be dealt with by using engineering practices; and the complex problems, i.e. those that mandate the use of heuristic practices. Next, these problems, along with our proposed answers for EEAM and BEAM for the PA as an ecosystem, are further discussed.

5.1 As-Is BEAM as a Complicated Problem

We outline a vision for the IS support of the government ecosystem EA at conceptual level, 1) to enable the comparative analysis across 'whole-of-government', and 2) to provide the real-time as-is information of the ecosystem for target state design. Our proposed solution to complicated problems is an ontology-based, shared EA repository for the-whole-of-government real time updating descriptions.

As discussed by Bakhshandeh [78], ontologies can be used for identifying and disambiguating concepts with formal semantics, facilitating knowledge transfer and computational inference, thus allowing the analysis and detection of logical inconsistencies. The use of logic-based ontologies as the representational basis of EA models makes the use of computational inference and mappings between elements of different domains possible, enriching the overall architecture description [78]. Hinkelmann et al. [21] note that "*because of the complexity of enterprise architecture, machine intelligibility of enterprise architecture descriptions is considered essential for agile enterprises"*. Further, as noted by [21], prior research shows, that an ontology could be a solution to the above mentioned problems. We suggest co-creating the public sector ontology of the different level government ecosystems (local, national, federal), and mapping the EA descriptions and metamodels to them. We would like to see the output as the contextual ontology of government ecosystem EA modeling and enterprise engineering, on which we could build the corresponding shared digital IS ecosystem for EA management and development. We yield below the design principles and some central functional requirements for this IS vision, illustrated by exemplary use cases. The envisioned system provides kind of a semantic web, enabling many types of data mining and comparative analyses.

For the design principles of as-is BEA realization we suggest the following: 1) *Dynamic as-is contents* – automated updates or suggestions for updates. 2) *Scalability*, from the local ecosystems to the national, and the federal ones. 3) *Open access EA information* for citizens, and partners. 4) *Plug-in architecture* options – external organizations outside of the ecosystem are facilitated to plug into the government ecosystem EA. The plug-in architecture enables co-creation, and co-evolution of the ecosystem, offering the option to the new actors to join the ecosystems, thus supporting spontaneous evolution of the BEA. Next, we present three functional requirements (R1, R2, R3) for the as-is BEA realization:

R1. Basic modeling and metamodeling functionalities, that are readily available in many modeling tools, (e.g. [26], [69]). Modeling techniques have still to be innovated more for the organizational coherency and co-evolution purposes. In our development work, e.g. the strategy architecture models of the city were iteratively designed for the best fit to the purpose. The model notations and templates are to be designed situationally, where the model elements and attributes may associate to each other. The real-time as-is descriptions can be automatically visualized via metamodel rules, based on the structural information yielded regularly in everyday-work of the civil servants.

R2. Agile analyses and comparisons tools, that necessitates interdependent, commonly agreed ontologies, e.g. for business catalogues, and organigrams. For instance, the as-is management structures can be made transparent in real-time and used to categorize the EA descriptions and their elements. Each description model and element are associated to relevant management structures. Also, different types of organizations, different types of management structures, and different types of management classifications are represented in the shared ontology. They facilitate the management needs for re-structuring the model instances according to their needs. Leaders and enterprise analysts may search descriptions and their elements according to shared ontologies, into which the metamodels of different description types are associated. For instance, the Minister of Commerce may browse for the different organizational options of the municipalities entrepreneurial services, to decide whether each municipality has organized them as a subsidiary, in-house-enterprise, via joint ownership, or other. Along the organigrams, he might get the visualized volumes of the actors. The citizen can compare, e.g. the service catalogues between the municipalities.

R3. Situational EA frameworks of the as–is description can be pulled out of the system according to given parameters. The system might offer different EA frameworks templates to different organization types, too. Each organization may instantiate their framework and choose the EA models they prefer in their EA. For instance, the CEO of a water supply subsidiary may request the outline of the EA descriptions realized in his organization, and in those of the neighboring cities.

Next, concerning the as-is BEAM, we discuss the challenges by Drews and Schirmer [12], as well as our proposed solutions to the complicated problems, i.e. an ontology-based, shared EA repository for the-whole-of-government real time updating descriptions.

Challenges concerning modeling include inter-organizational interfaces on all layers, finding the right level of abstraction and identifying shared business objects. As a solution, we propose a shared ontology, which supports associating intra-organizational EA models inter-organizationally. This shared ontology may represent the abstraction levels of the EA description and their elements, whereby comparative analysis is enabled inter-organizationally. Also, it provides a common search index for comparative analyses, which enables the recognition of shared architecture objects.

Further, challenges include those associated with ultra-large-scale architectures with a large number of actors in BEA. As a solution, the envisioned BEAM IS support semi-automatically provides the ultra-scale current state descriptions. Updates are based on content changes in structural documents and automatically visualized in all EA layers. Therefore, the ultra-large-scale BEA descriptions remain continuously updated.

Challenges concerning tools include tool support for ontologies as well as those concerning open standards for data exchange (import/export). Here, we propose envisioned IS support per-se as described in the article. Common modeling standards such as ArchiMate, UML, and BPMN could be mapped to the (core) concepts of the shared ontology to enable search and comparison regardless of the modeling language.

The modeling and tool aspects in Drews and Schirmer's [12] challenges, is the part which our vision of ontology-based hits best, as the shared EA repository for the-whole-of-government, updating in real-time. It encounters with EEA and BEA modeling and tool challenges, since they can be seen as "complicated", engineerable ones. The management and socio-technical aspects are more related to the complex issues, where solutions can be considered mostly heuristic and situational in nature. Therefore, the practice of the target state BEAM design, given in the next section, tentatively answers these complex challenges.

5.2 To-Be BEAM as a Complex Problem

Concerning the complex problems, our proposed solution is the government EA target state analysis and design process outlined below. As stated by one of our interviewees, enterprise architecture still seems to be a solid option for the government ecosystem design and governance: *"We have a development-model, and there, architecture has a distinct role. Architecture has a very tense role in everything before the implementation, where we model operations, data and business-architecture, stakeholders and actors and their dependencies, in order to get an understanding of the whole ecosystem. What we are developing and how it relates to everything else. And there we use enterprise architecture. When the project starts, it's more of making sure that everything matches the architecture."* Another interviewee, an enterprise architect, stated that EA is even more important in ecosystemic environments than before, noting that the current and target states should be updated in an agile manner: *"I think that it is even more important that we apply enterprise architecture ... but that does not mean that EA should not adapt to the change, when we are making it. We have the target state, to which we take some kind of agile transitions. But in this developing world, it does not mean that we would necessarily reach that target state. Also, the target state has to be developed from time to time. In my mind, the idea of enterprise architecture is that we have an idea of our operations, where we are making strategic change, a clear target state. And we take small steps towards it."*

Next, we discuss some relevant problems of broadening the focus of EA to BEA as discussed by [12], before proposing an ecosystem architecture target state design management model and principles.

Challenges concerning management, such as inter-organizational tasks and roles can be approached with more transparency both in inter– and intra-organizational levels via ontologies that apply to management structures [16]. Managing the aspects concerning BEA service provision can be solved with open network structure of actors and service providers. Also, our Plug-In architecture enables new (and temporary) actors to attach and contribute towards the development of ecosystems and services. As noted by one of the interviewees, another enterprise architect, the modeling functionalities should be easy to use and agile enough so that each organization can develop fit for purpose descriptions, as well as enable co-creation between the actors in the ecosystem: *"Modeling each organization's own architectures is something that different organizations could do themselves, because of the differing needs. But future scenarios, the big picture, – it is something where cocreation in the ecosystem could enhance the understanding of the realm."*

Challenges concerning socio-technical aspects, e.g. citizens and consumers as actors, and the lifeworld of customers and partners [12]. Our solution provides an open channel for citizens and consumers to suggest and peer-evaluate ideas for the development of the ecosystem. It seems, as noted by one interviewed manager, that in a public smart city ecosystem, the public administration needs to function as a central actor, though not necessarily as a leading actor: *"The city could act as an operator, matching organizations. Ecosystems are grounded on voluntary participation. ... I don't see the city as a leading actor, more like being a coordinator, ... but if the city can influence on the way things work out and bring other actors to the same table ... in that way, yes."* This viewpoint of public administration acting as a facilitator rather than leading actor in idea co-creation and idea evaluation was a recurring theme in our interviews: *"We have also another goal, which is enabling services outside of those produced by the public administration. Co-creating and co-innovating with, e.g. enterprises, so trying to find a role as a facilitator, where ideas and open data could develop business activity to the area"*, stated one manager. In prior research [79], roles within ecosystems are discussed. These include (1) niche provides, who form the majority of most ecosystems, (2) physical dominators, controllers of the bulk of the innovations occurring, (3) value dominators, who extract value from the ecosystem, and (4) keystone organisations, i.e. leaders. Further, ecosystems governance, i.e. decision-making covers two modes of governance: integrator and a platform hub (ibid). Drews and Schirmer [12] also discuss about the roles in BEA. While they suggest EEA to already extend to cover concerns such as customers, partners and suppliers, they argue that that for BEA, a central actor must have an overview of the whole ecosystem, i.e. the infrastructure and interfaces to all connected EEA's. Our results indicate that in smart city ecosystem, public administration sees itself as a facilitator, not a leader. In line, [31] presents cities as "platform hubs", which facilitate the interaction of third-party service providers with customers, citizens and companies.

Figure 1 suggests a management model for the government ecosystem architecture. The stages 1 to 4 illustrate the tentative target state design process for co-creating new services in the ecosystem.

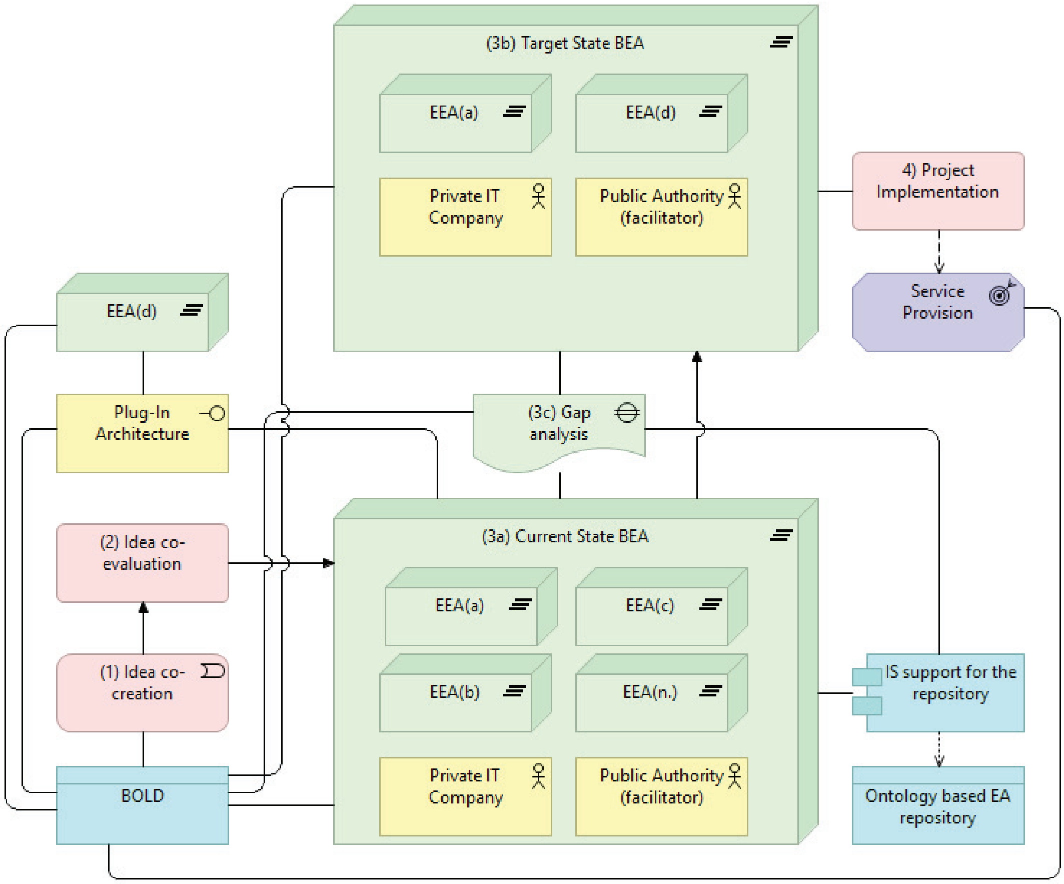

Figure 1. BEA management model in ArchiMate

In the phase 1, idea co-creation, an initiative appears, e.g. from citizens, government actor, or private companies (cf. [17]). To support the innovation, the phase should be as open as possible. Idea evaluation in the ecosystem seemed to be both a challenge as well as richness of the ecosystem approach. One interviewee, who acted both as a manager and a business architect, noted the following: *"It is a challenge… what kind on platform would enable the participation of citizens ..., and maybe some enterprise or an organization could seize those ideas."* This creates a socio-technical dimension to the idea co-creation, which was noted also by the interviewees: *"We have created models for co-creation, meaning a way to operate with enterprises and research institutes, when we are developing or helping enterprises to develop services."* A challenge frequently mentioned was the storing of data and the creation of shared data models. As an example, one interviewee mentioned, that majority of the interviewed cities belong to Helsinki Region Environmental Services, a municipal body, which produces waste management and water services. Although waste management is a vital theme in smart city and PA endeavours, no shared repository or data models exist. Caputo et al. [3] further discuss the vital themes of linking smart technology and big data in a smart city ecosystem from a systems thinking perspective. They conclude, that efforts should be made to make the data freely available, as value is generated from the usage of the data, not the data itself, although noting that smart technologies and big data are as key levers able to produce effects only as a consequence of actors' participation and collaboration. Fostering Big and Open Linked Data (BOLD) [62] seems to be a key to successful EA usage in the ecosystemic environments.

In Phase 2, the idea co-evaluation is done by a variety of stakeholders. For instance, public agencies might have a special interest in the financial analysis, whereas local citizens might appreciate the geographical locations of the services, and private enterprises can have goals of their own. The balance between financial and functional performance must be achieved [17], and those ideas recognized, which benefit the ecosystem as a whole. As stated by one of our interviewees, a manager: *"We have this challenge with new services and ideas from the citizens. If we get a good idea somewhere, from citizens, it does not mean that we as a public actor can manage that. But maybe some enterprise or other community could do it with us."*

This is followed by Phases 3a Current state analysis, 3b Target state design, and 3c Gap analysis. In 3a, the participating actors are identified, resulting in the subset of necessary distinct EA's, covering concerns such as customers, partners and suppliers [12], i.e. *EEA* (see below). The as-is BEA updates semi-automatically by increments in the project implementation, finally fully reflecting the previous target state. The deployment may be ceased at any time based on the feasibility checks, too. Also, the architectures of each individual EEA participating can be updated alongside. Here, as well as in prior phases, the ontology discussed above is necessary to ensure consistent and coherent data content between different actors of the ecosystem. For instance, if different actors in the ecosystem would not have mutual naming conventions for their information architecture elements and data content, co-creation would not be realized optimally.

Phase 4, Project implementation starts with suitable project organization, involving the configuration of internal and external ecosystem actors, and IT-service providers. Almost all of the interviewees mentioned the usage of (open/public) data as well as sharing data between the actors of the ecosystem as a crucial aspect in service co-creation. The usage of data seems to cover the whole design process, from idea creation to implementation. As noted by one of our interviewees, an enterprise architect, *"Data is the thing. We should understand the citizen-data and the essence of whole, so that we can use that data and implement services where needed ... with data we should provide services across the ecosystem, not just public services, but services provided by that area."* This view was shared by a manager of another city: *"In my mind the key is to gather data about the environment and use that data in design and management".* The data can be used to create a sense of the whole ecosystem, as well as to decide which projects to implement: *"Big enough picture is needed, but the experiments need to be small. Our idea is, that we take one segment, cluster some data ... and then begin the concrete project".*

As discussed in Section 3, in DSR [60], the theoretical knowledge base and real-life environment are married for the researchers to create an artifact that is needed in the environment. In line with that thought, we refer to prior research, alongside our interview data, and propose principles (P1 – P6) for government ecosystem architecture management. Hedges and Furda [79] discuss architectural principles based on earlier research, offering three perspectives: decomposition, modularity and design rules, which cover four rules: simplicity, resiliency, maintainability and evolvability. Janssen and Kuk [46], examine the use of EAs in the Dutch public administration from a complex adaptive systems perspective, and based on analysis of 11 cases, derive eight architectural design principles, including development of modular architectures, stimulation of sharing and formation of coalitions. Further examples include the study by Lnenicka and Komarkova [62] who discuss developing a government enterprise architecture framework to support the requirements of big and open linked data with the use of cloud computing. Carter [53] discusses Systems Theory based architecture framework for complex system governance, and introduces a method, along with some principles. Jacobides, Cennamo & Gawer discuss ecosystems more generally. These valuable contributions offer a baseline for our pondering:

P1. Dual nature and nestedness: government ecosystem architecture should, at its highest level of abstraction (to-be complex level), be simple; yet thrive to capture as-is complicated architecture accurately and unambiguously, harnessing latest technological achievements (see Section 6.1, cf. [79]). The ecosystem forms of different systems, such as participating actors. Although the ecosystem is emergent, systems-wide design and planning can be achieved at various levels.

P2. Openness: ecosystem should strive to openness, where new actors could join the ecosystem (ibid). Openness does not only mean the lack of restricting new actors to join, but also actively promoting the ecosystem. This is done with Plug-In architecture (see Figure 1), (cf. [79]).

P3. Evolvability, Needs-based utilization and Modularity: to foster the evolution of the ecosystem, not only should openness be fostered, new services should be designed in modular and agile way. [80] note, that while not regularly noted, an important characteristic of ecosystems is that they help coordinate interrelated organizations that have significant autonomy via modular architectures, which allow for coordination of independent yet interdependent firms through ecosystems In Figure 1, a particular project is implemented in means of modularity: participants include existing ecosystem members, as well as a new member, joining through the Plug-In architecture. The ecosystem evolves through projects, where participants are decided on demand. (cf. [46])

P4. Co-operability: much like in natural ecosystems, government ecosystem is based on co-operability, such as co-creation of services. In Figure 1, project implementation is achieved by a variety of voluntary participants. Although participating to any given project is voluntary for the ecosystem actors, public administration actors frequently act as facilitators (cf. [46], [80]).

P5. BOLDness: from idea co-creation to new service provision, to automated As-Is BEAM, actions in the ecosystem are based on fostering Big and Open Linked Data (BOLD) [62].

P6. Holism and Circular Causality: to foster the benefits of the ecosystem, a systemic stance is needed, embracing holism, e.g. interactions among actors, as well indirect causality among actors. Holism also includes notion of complementary viewpoints, where different actors have varying perspectives about the actions in the ecosystem (cf. [53]).

These principles, along with the management model and the IS-supported, ontology-based EA repository form the tentative basis for the government ecosystem architecture design and management. As discussed prior (see Section 2), disciplines such as EA possess a dualistic nature – concerning both complex and complicated systems [44]. We argue, that this is to be achieved by combining two perspectives: modeling the state of, e.g. the infrastructure and data of the organization (complicated problem) as well as managing social phenomena in the midst of ecosystemic environment (complex problem). We suggest the current state EA modeling to follow the engineerable path as the complicated problem, by semi-automated models of the as-is, whereas the target state design of BEA is left with situational, heuristic practices, however benefiting of the as-is repository.

6 Conclusions

Based on our research concerning Finnish national enterprise architecture (EA) adoption in long run, this study discussed the development of EA in order to support business ecosystem and organization design. We discussed, what kind of information system (IS) is needed in a complex socio-technical government ecosystem for real-time current state analysis, and what kind of management model is needed for the government ecosystem architecture target state design. Our research context indicates, beyond a federal government or a state one, that even a single municipality, like a city concern, can be perceived as an ecosystem of its sectoral domains, subsidiaries etc. The objectives of the study were, to:

I. Outline some basic functional requirements of an ontology-based, shared EA repository for PA ecosystem and to propose a vision of the real-time information system support for such a repository.
II. Further develop previously introduced [18] management model for the government ecosystem architecture target state design.

In this study, we outlined a vision of an overall ontology-based, shared EA repository for the-whole-of-government current state descriptions. Further, the central design principles and functional requirements for such a system were specified, and some potential use cases were illustrated. A tentative management model for future state ecosystem architecture was discussed via a model of design process for co-creating new services in the ecosystem, and government ecosystem architecture management principles were outlined. We envision an IS solution for EA descriptions' accessibility, and automated update in government ecosystem. The IS vision and presented tentative model stand for design artifacts in terms of [60]. As discussed prior, we used abductive logic reasoning to enhance our vision, which forms a 'process of discovery' where inferences are drawn to the next best explanation in each cycle, with wider set of data. As for our latest research cycle, we used interview data from four smart city cases in Finland, serving as representations of PA ecosystems. Thus, we propose EA as a concept for organizational design of a government entirety.

There are some limitations to our study, and, in the following reliability and validity are discussed in relation to our last interview round. Reliability is seen as to what degree the results are consistent. Validity concerns the accuracy of the measure, which means the degree to which measurements are what they should be. Concerning validity, there are at least few notions to consider. Interviewees interpret the questions in a way that is in concordance with their rendition of the reality in that particular time and place. We as scholars have made our own interpretations about the study material in the analysis phase, and therefore, some preconceptions may have affected the analysis. Therefore, although this research could be repeated with the exactly same layout, with same circumstances and with the same interviewees, different sentiments could occur. According to Hsieh and Shannon [73] threats to validity regarding content analysis further include the risk that the researchers fail to understand the whole context, and thus missing key categories. We tried to minimize this risk with analysis triangulation, where two authors both analysed the data. To enhance repeatability of the interviews (i.e. reliability), example questions of a manager interview are offered in the Appendix. The case studies reported were based on only a single country, its public sector, and four cities, and different aspects might be emphasized elsewhere. Therefore, more research is definitely needed, for instance, on other countries.

This article is based on a working paper, presented at the Workshop on Resilient Enterprise Architecture, in liaison with the International Conference on Perspectives in Business Informatics Research. Prior to the conference, the paper was reviewed by two blind reviewers. This could be seen as some form of cross evaluation, adding the soundness of the results and analysis. After the conference, the paper was further revised based on the discussion and additional data. Several pages were added, and the original management model was further enhanced, and design principles were outlined.

We presented the design principles and central functional requirements of the ontology-based as-is government ecosystem architecture repository, that is meant to be applicable to any chosen whole-of-government entirety. The proposed solution has several anticipated benefits. The system might maintain transparency and comparability across the entirety of the government, eliminate duplicate work, enhance the sharing of the best practices, and most importantly, support the co-evolution of PA structures towards higher coherency and synergies. Shared EA descriptions would support also co-creation and co-evolution of the ecosystem. However, the implementable solutions require further studies. The aim of the study is to encourage evolutionary studies, and pilots, especially constructive ones, to reach out to more specific specifications and design principles for the BEAM solution. Especially it requires the design of a future common, wider ontology of the public administration sector and concepts. This implies application of ontology engineering knowledgebase in further development and research of the subject (cf. [17]). Secondly, the tentative target state design process should be both tested at a real environment, and further enhanced based on the results.

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Appendix: Example questions of a manager interview

- Name?
- Occupation and job description?
- What projects are going on in your city?
- What in your opinion is the “nature” of a smart city? What about an ecosystem?
- What elements constitute the above mentioned?
- Do you see smart city/ecosystems endeavors as project work?
- Do you see smart city/ecosystems endeavors as a whole or as several individual projects?
- Who are the participants of the above mentioned?
- How the participants are “decided” or how the whole is composed?
- What is the motivation or goal in your endeavor?
- Who/what are the target of your endeavors?
- What kind of problems you are trying to solve?
- How the smart city/ecosystems-thinking helps you to solve these problems?
- What kind of changes there has been from the beginning of the project?
- How do you manage the design and development of your smart city/ecosystem?
- What kind of methods do you use in different phases?
- What positives and negatives have you had in your endeavors?
- Have you identified some best practices?