

Contextuality and Temporality of Enterprise Architecture Problems: A Comparative Case Study

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Abstract: Many enterprise architecture (EA) projects face severe challenges and risks and may even fail. Although the problems are well-known and identified in the literature, the projects keep struggling. It is thus reasonable to ask why they cannot exploit earlier experiences. In this paper, we try to find reasons for these issues by conducting a comparative case study of twelve public sector EA projects in Finland. By using the earlier identified obstacles, risks, and critical success factors as a lens, we show, through participatory observations of the cases, that the problems emerge very differently in different projects, contexts, and the moments of time. This contextuality and temporality necessitates different coping mechanisms as each case is unique and make learning and the application of earlier experiences and practices difficult. We argue that the problems with contextuality and temporality and their inadequate consideration are the main reasons for often failing EA projects.

Keywords: EA work, problems, architect, qualitative case study

1 Introduction

With digital transformation, the organizations strive toward improvement by implementing radical changes with information, computing, communication, and connectivity technologies (Vial, 2019). They thus significantly change their current practices and processes, and create new business models, services, and products. Enterprise architecture (EA) has potential to support this transformation (Lamanna & Kurnia 2022; Niemi & Pekkola 2020; Korhonen & Halén 2017). Appropriate EA tools help to reach strategic goals and outcomes of digital transformation.

However, implementing and applying EA into digital transformation is not an easy task. Dang and Pekkola (2017), among others (Banaeianjahromi & Smolander 2019; Seppänen 2014; Kaisler et. al 2005) have identified several problems in using EA in public and private sector organizations. The problems range from communication problems to problems with managers, EA work, EA artifacts, assessment, and EA frameworks (Kaisler & Armour 2017). They hinder EA implementation and use, and may even result a failure. For this reason, obstacles, risks, and critical success factors in EA work have been studied almost 20 years (Ylimäki 2006; Banaeianjahromi &

Smolander 2019; Kaisler & Armour 2017) – but still the problems prevail. Thus, despite the studies on EA problems and their root causes (Dang and Pekkola 2017), it is reasonable to ask why the problems constantly emerge despite the organizations have prepared for them?

We argue the EA problems and failures are highly context specific. Consequently, for example knowing that there typically are some communication challenges is not helpful because the challenges appear differently. These dissimilarities, first, make it difficult to identify the challenges and their root causes early enough, and second, they require different coping mechanisms – depending on the context. This evidently hinders the learning from the past EA projects. In this paper we study this argument through an in-depth comparative case study of twelve public sector EA projects in Finland. We first develop an analysis framework from the literature and then use it as a lens to study the EA projects, their documents and the first author's first-hand observations as their chief enterprise architect or consultant.

The paper is organized as follows. First related research and our framework for analysis are presented. This is followed by research settings and methods. Third, our findings are summarized. The paper ends with discussion and concluding sections.

2 Related research

Enterprise architecture aims at providing a holistic view of the organization and its processes, data resources, information systems and information technologies, their current and future states and how to reach the goals, and this way improve organizational decision-making (Simon et al. 2014; Kaisler & Armour 2017). Due to its comprehensiveness, complex EA projects are infamous for their failures (Dang and Pekkola 2017). These failures have been studied in various contexts. For example, in the public sector in general (Lemmetti & Pekkola 2012; Dang & Pekkola 2017), in government offices, municipalities and higher education institutions (Seppänen 2014), and in many other settings (e.g. Ahlemann et al. 2012; Löhe & Legner 2014).

The challenges are identified being largely non-technical (Kaiser et al. 2005). Non-technicality is apparent in the public sector, where Banaeianjahromi (2018) categorized 17 obstacles in EA development in Iranian governmental organizations in four groups: management commitment, infrastructure preparation, personnel engagement, and government and politics. Similarly, Kaisler and Armour (2017) identified “classic” critical problems being related to modelling, managing, and maintaining EA, and new ones being related to security and privacy, new technologies and their applications (e.g., cloud computing, opensource software, sensors), big data, and microservices, all concentrating on issues around technologies, not technologies *per se*.

The lack of communication and collaboration seem to be a major problem in many EA projects (Banaeianjahromi & Smolander 2019). The other obstacles include the lack of management support, the lack of knowledge among management, the lack of motivation or knowledge among personnel, resistance to change, EA consultant-related issues and government-related political issues. Niemi (2016) argued that there are potential problems with the stakeholders conflicting views and expectations on EA and

EA benefits, while Dang (2018) stated the root causes origin from organizations, people, strategies, and different institutional pressures. To make the situation even more complex, individual obstacles are tightly interwoven (Banaeianjahromi & Smolander 2019), and the root causes are bound to organization conditions and environments.

In addition to obstacles, also critical success factors (CSFs) have been studied. CSF are, by definition, critical for successful outcomes. If they fail, they become obstacles. In the context of EA, determination, destination, and dexterity have been identified being significant for successful EA work. (Seppänen 2014; Ylimäki 2006).

The third point of view for understanding the EA project problems is the risks. Niemi and Ylimäki (2008) studied generic EA risks and factors that may lead to negative outcomes in the EA projects and negative outcomes resulting from these factors. Their extensive list included: disagreement in the EA product and service requirements and their inadequate implementation, their quality and costs, and difficulties in using them, insufficient organizational security, resources or competencies, lack of management support, information quality and access problems, poorly designed EA processes, incompatibility between various work practices, and inadequate planning, control, and management mechanisms.

Obstacles, critical success factors, and risks form a basis for our analysis framework. Table 1 lists 11 obstacles, Table 2 12 critical success factors and Table 3 13 risks, all that may occur and influence the EA projects. With the framework, critical and challenging issues in EA work can be identified.

Table 1. EA obstacles (Banaeianjahromi 2018 unless otherwise stated).

<i>ID</i>	<i>Obstacle</i>	<i>Description of obstacle</i>
O1	Lack of communication and collaboration	Lack of collaboration between other personnel and architects, between members of a team and between organizations.
O2	Lack of management support	Lack of management support to prioritize the EA development and to assign enough budget and resources
O3	Lack of knowledge among management	Lack of knowledge about the EA method, the importance or role of EA, using EA, or how to manage and steer EA work
O4	Lack of motivation among personnel	The personnel are not motivated to put efforts and use resources to EA work
O5	Lack of knowledge among personnel,	Lack of knowledge about the EA method, the importance or role of EA, using EA, or the objectives of EA
O6	Resistance to change	Personnel resist the change i.e., they do not adapt to the changes that the EA would introduce due to several reasons: lack of knowledge, lack of trust, or fear of losing jobs
O7	EA consultant-related issues	Internal or external consultants lack skills like EA competence, guiding and mentoring competence, motivating competence, or communication competence
O8	Government-related political issues	Inappropriate definition of operations, lack of long-term goals, and political and governmental changes.
O9	Influence of institutional pressure on organizations work life	Institutional pressures make EA to a part of the organization's work life, influencing EA's outcomes. (Brosius et al 2018)

O10	EA Governance framework	An EA governance framework is a critical tool to ensure that the EA can be used appropriately and in long-term. (Aziz et al. 2005)
O11	Enterprise Architecture Management	Enterprise architecture management concerns the establishment and continuous development of EA. This includes the tasks of planning and controlling business change. (Aier et al 2011, 645).

Table 2. EA critical success factors (Ylimäki 2006).

<i>ID</i>	<i>CSF</i>	<i>Description of CSF</i>
CSF12	Scope and Purpose	Depth and wide of the EA definition in terms of time and content
CSF13	Communication and Common Language	Understandable architecture definitions, legends for diagrams, Communication channels and timing of communication
CSF14	Business Driven Approach	Business Driven Approach to ensure that EA initiatives are traceable to the business strategy (Schekkerman, 2004; Van Eck et al., 2004).
CSF15	Commitment	Commitment (support, leadership, sponsorship, or involvement) of the key stakeholder of project to EA work
CSF16	Development Methodology and Tool	Systematic use of an EA method, frameworks, specifications, and modelling and repository tools
CSF17	EA Models and Artifacts	Usefulness and understandable EA models (e.g., a metamodel) and artifacts (diagrams, tables, matrices, narratives)
CSF18	EA Governance	Well documented EA governance model including roles of stakeholders, period of validity of EA and availability information
CSF19	Project and Program Management	Managing, coordinating, facilitating, and planning the EA projects
CSF20	Assessment and Evaluation	EA evaluation is challenging, because it may take years before the effects and consequences can be measured.
CSF21	IT investment and acquisition strategies	Relationship between architectural and investment decisions
CSF22	Skilled team, training, and education	Defined and documented roles of team members, adequate EA competence based on training, education, or work experience
CSF23	Organizational culture	Attitudes towards architecture approach or changes, trusting environment, open communication, and organizational constraints.

Table 3. EA risks (Ylimäki & Niemi 2008).

<i>ID</i>	<i>Risk</i>	<i>Description of Risk</i>
R24	Lack of use of EA products and services	Lack of use of EA modeling tools, repositories, EA frameworks and EA consultancy
R25	Dissatisfaction of customers	Dissatisfaction with EA services, consultancy, and EA tools
R26	Misuse or misinterpretation of EA products	Difficulty in using EA products or services, insufficient competence for using them correctly, inadequate instructions and training
R27	Insufficient realization of EA objectives	Inadequate implementation of EA, inadequate compliance between EA and its implementations, inadequate planning of implementation, inadequate EA guidance to the implementation project
R28	Inadequate EA process performance	Inadequately designed, described, and realized EA working processes

R29	Insufficient predictability of outcomes	Inadequate planning and control mechanisms, insufficient comprehension of objectives, insufficient work practices, insufficient feedback mechanisms
R30	Insufficient documentation	Insufficient EA artefacts (diagrams, matrices, tables, and narratives)
R31	Personnel problems	Lack of skills and competences, instructions and training, lack of motivation and interest, poor conflict management, incompatibility between characteristics of participants and processes
R32	Participant frustration	Inappropriate EA tools and consultancy, insufficient resources, and guidance
R33	Information loss or theft	Insufficient information quality, accessibility, reliability, integrity, presentation, or security, inadequate amount of information
R34	Diminished EA work system performance – environment	Insufficient management support, resources (time, personnel, money), inconsistencies with organizational culture, partners or legislation, incompatibility between environment and the EA work system, between EA and reality, insufficient flexibility, or competence for understanding EA, high level of turmoil and distractions
R35	Diminished EA work system performance - infrastructure	Inadequate human support, unclear responsibilities, insufficient competences, separate siloes, inadequate information system or technical infrastructure
R36	Ineffective EA work system performance	Poor alignment between organizational strategy and the EA, unclear or missing “big picture” of EA, inadequate control mechanisms for the strategy changes, inadequate EA strategy, incorrect comprehension of strategy

3 Research method and research settings

Earlier listed obstacles, critical success factors and risks have been identified in certain contexts. Although the researchers have discussed their applicability in broader settings, i.e., they have generalized their findings, the problems have been found to be very context dependent (e.g., Seppänen 2014; Ylimäki 2006). Consequently, to understand why the problems constantly emerge despite they are well-known and documented, we analyzed the problems and their causes in 12 public sector EA projects in Finland. From this perspective, this is a comparative case study of twelve cases (Yin 2009).

The first author has been working several years as chief enterprise architect or consultant in those projects. He thus had a unique chance to gain first-hand data about the problems, and how and why they appeared in the projects. We thus rely on the participatory observations (Clark et al. 2009) where the researcher just observes and reflects different actions and situation. This is contrary to action research (Baskerville 1999) where the researcher actively attempts to improve and change the situation. The use of action research thus puts focus on the changes (improvements) and respective actions. Thus, in this paper, our sample is cross-sectional, which we just observe without trying to change it.

Our research material consists of several published and unpublished architectural definitions and artefacts and different plans. The first author retrospectively analyzed them by using our analysis framework and his own experiences as an actor there. Table 4 lists our EA projects and their different details, including our research material.

Table 4. The case EA projects.

<i>ID/ period</i>	<i>Architecture descriptions</i>	<i>Domains (Systems Business, Data, Applications)</i>	<i>Volume</i>	<i>Type of customer</i>	<i>Number of stakeholders</i>	<i>Size of the EA group</i>
RA01 Q3/2019 ->	Baseline and target	S B D A	65 diagrams 13 tables	ministry (national)	4	5
RA02 Q1/2021 ->	Baseline	B D	12 diagrams 8 tables	ministry (national)	6	15
RA03 Q1/2020 ->	Target	S B D A	27 diagrams 16 tables	ministry (national)	3	7
RA04 Q3/2018 - Q3/2019	Target	S B D A	21 diagrams 12 tables	ministry (national)	~ 20	3
RA05 Q4/2020 - Q3/2021	Target	S B	18 diagrams 6 tables	ministry (national)	3	6
RA06 12/2017- 11/2019	Target	S B D A	27 diagrams	EU	11	2
EA07 Q2/2021 - Q4/2021	Target	S B	19 diagrams 1 table	ministries (national)	6	3
RA08 Q1/2020 - Q2/2021	Target	S B	50 pages 40 diagrams 10 tables	ministry (national)	15	5
EA09 Q1/2019 -> cont.	Target	S B D A	56 diagrams 14 tables	agency (national)	4	6
EA10 Q3/2019 -> cont.	Baseline and target	S B D A	41 diagrams 5 tables	agency (national)	4	5
EA11 Q3/2019 - Q4/2021	Baseline	T	14 diagrams 10 tables	vendor (private)	1	4
EA12 Q2/2019 -> cont.	Target	S B	26 diagrams 6 tables	departme nt in a ministry)	2	5

The first author started the data analysis by reviewing all the EA projects. He then analyzed and classified the problems by using our analysis framework to list the obstacles, critical success factors, and risks. We illustrate the analysis process in the next chapter through an example of the Case RA06. The analysis results were regularly discussed and reflected by both authors to ensure correct and consistent interpretations.

4 Observations

We will first present a summary of the cases. Then we will walk through the Case RA06 to show how the problems were spotted and classified, and what effects they had. This is followed by two other cases and their main findings to allow case comparison. Finally, we take a horizontal approach and analyze five problems in all cases to see how they emerged there, and what was the impact of the contexts.

Table 5 summarizes the cases and their problems. They faced several problems, and the same problems emerged in many cases. It is thus relevant to ask whether the problems were actually similar. Capital X refers to critical problems, small (x) in brackets to challenging problems, and a question mark to unknown items. Empty cell refers to a good situation. Shaded columns/rows show the cases and problems that are discussed in detail later.

Table 5. The summary of the cases and the problems they faced. (Success -row: E=exceeded expectations, ok=met the expectations, P=met the expectations partially, fail=failed).

	Cases											
Problems	RA 01	RA 02	RA 03	RA04	RA 05	RA 06	EA 07	RA 08	EA 09	EA 10	EA 11	EA 12
Success	ok	ok	ok	E	E	P	E	ok	E	fail	P	P
O1	X		X						(x)	X		X
O2												
O3							X					
O4						X				X		
O5	(x)		(x)		(x)			(x)	(x)	X		(x)
O6						X						
O7	?	?	?	?	?	X	?	?	?	X	?	?
O8						(x)	X		(x)			
O9										(x)		
O10	(x)		(x)		(x)	X	(x)			X		(x)
O11							(x)			X		
CSF12							X			X	(x)	
CSF13						(x)						
CSF14												
CSF15						(x)	?			X		
CSF16												
CSF17												
CSF18	(x)		(x)		(x)	X	(x)			X		(x)
CSF19												
CSF20	X	X	X		(x)		?	(x)	(x)	X	(x)	X
CSF21												
CSF22											X	
CSF23											X	
R24												
R25										X		
R26										X		
R27	(x)	(x)	(x)		(x)	X		X	?			(x)
R28										X		
R29												
R30												
R31										X		

<i>R32</i>												
<i>R33</i>												
<i>R34</i>										X		
<i>R35</i>										X		
<i>R36</i>										X		

4.1 Case RA06: Reference architecture for education sector

The RA06 was a part of a large, two-year-long EU funded project with eleven partners. One of the deliverables was a reference architecture for education domain. This consisted of strategy, business, data, and application architectures. The project and the reference architecture work were steered by the project plan. When the work was completed by the project team, it was elaborated by numerous national and international actors. The EA project got a lot of positive feedback so many of the architecture's building blocks were used in other architectures. In our analysis, RA06 received nine hits: 6 critical and 3 challenging.

All actors **were not motivated to EA** (O4). Some did not understand its role, and because its notation language looked too technical for them, they were afraid that the EA would hamper communication. This was discovered in the meetings where forthcoming seminars were planned, and when people responsible for communication did not want to show the architecture diagrams to other stakeholders. We classified this obstacle as critical because the EA definition was one of the main project deliverables without which the whole project would have failed. Luckily, the architects gradually gained the other project members' trust, so they began to better understand its importance.

Some project members protested the EA and **resisted to change** their practices (O6). The EA was seen as a new tool for managing the service development. Consequently, they did not actively participate in the EA work. This resulted in the EA project missing some domain competences. Although some of this knowledge was compensated by common understanding (about the education domain), the obstacle was not solved entirely. As the distrust towards the EA remained, we considered this obstacle as critical.

When the project begun, the ministry's support was partly missing (O8 **Government-related political issues**). This was observed in the steering group meetings where the project was dictated, without further guidance, to a direction where no EA work is needed. The top management support and its absence were thus critical. Later, the support was gained by demonstrating the importance and benefits of EA work. Currently the ministry reuses the architecture artifacts in other projects. This success means we classify this obstacle as "challenging".

EA Governance framework (O10) is critical obstacle because of a missing EA governance model. Without a governance model the architecture definition is nearly useless – it can neither be used nor further developed in a larger scale. We will discuss this more in the section 4.4.

The project used the Archimate modelling language in its work. Some partners considered it difficult to understand. As the architecture definitions should be easily understandable without any interpretation, **Communication and Common Language**

(CSF13) CSF turned out to be very challenging. The situation alleviated when clear and understandable narrative on the EA diagram descriptions was provided.

The project coordinator and main partners were committed to the project, but not so much to the EA. The **lack of commitment** (CFC15) emerged similarly to the lack of motivation (O4) and personnel's resistance to change (O6) in the steering group meetings and in the daily work. These three challenges are in fact strongly intertwined, making them hard to distinct. During the project, the partners' commitment increased when they learned and understood the meaning and the importance of EA.

The architecture descriptions have not yet led to organizational or system changes although some mock-ups, proofs of concepts, and pilot solutions have been made. **Insufficient realization of EA objectives** (R27) is thus a critical risk that may have its impacts on the future EA activities. This issue will be discussed more in the section 4.4.

The biggest challenge in the project was the partners' attitude against the EA: some were unfamiliar with the EA method, some were dubious about the utility of EA, and some had unrealistic expectations and narrow understanding of the EA work. These challenges resulted from the EA consultant-related issues (O7), which lead to the project participants' low motivation, commitment, and understanding of the role of the EA.

4.2 EA10: Enterprise architecture for a governmental agency

The ministry funded EA10 project designed a first EA definition for a governmental agency. The EA aimed to cover all business services, providing business, data, and application architecture descriptions. Due to lack of commonly missing strategies in the national agencies, the EA work was based on the national reference architecture of that branch of administration. The EA work was about developing a baseline architecture because the business services were deployed simultaneously when they were modelled. The EA project team of twelve persons constitutes chief architects, customers, and ICT provider representatives. The following problems were evident:

O1 Lack of communication and collaboration The EA team had meetings sporadically. Collaboration and communication were thus very weak.

O7 EA consultant-related issues The EA consultant failed in motivating the customer to apply the EA. The customer was suspicious not only towards the EA, but it trusted neither the ICT provider nor the architecture consultant. In fact, the customer blamed the ICT provider if everything did not go smoothly.

O11 Enterprise Architecture Management. The EA management was weak due to the customer's inappropriate information on EA as a method and on its objectives.

CSF12 Scope and Purpose. The scope was adequate, but the customer had not yet realized the purpose of EA work. The customer assumed that the EA is only for technology and application design.

R25 Dissatisfaction of customers. The customer had not realized the importance and meaning of the EA work. They were in a hurry to start to use the EA and felt that it was not promoting the service development quickly enough.

R31 Personnel problems. The customer lacked motivation, interest, and understanding of the purpose of the EA work. This concretized in the project plan in terms of insufficient human and time resources.

R35 Diminished EA work system performance – infrastructure. The customer was not motivated to participate in the EA work, so they postponed pre-arranged meetings. This decreased the architecture descriptions quality and made the roadmap and schedule development for the EA work difficult.

The problems accumulated when the obstacles and risks materialized. The root cause was the unclear understanding of the importance and role of the EA work. This reduced the customer's motivation and commitment.

4.3 EA07: Reference architecture for five agencies

The EA07 is an ongoing governmental project where a reference architecture for two Finnish collaborative administrative branches is created. The architecture consists of strategy, business, data, and application architectures. Currently five government agencies participate the project, although the number is expected to increase. The project was steered by the project plan and governmental funding.

O3 Lack of knowledge. Some stakeholders disliked the idea that the EA work changes and manages their domain. They did not understand its role and meaning. This stopped the project. Now, when the understanding has increased, the project is re-started.

O8 Government-related political issues. The EA project was planned to start during the previous government (before 2019). The project was postponed over the parliamentary elections. After the election, there was a significant change in the governmental policies that steered the project. A reason for the delay was the lack of collaboration capability between two ministries. Such collaboration is not supported by the Finnish administrative structures or traditions.

CSF12 Scope and Purpose. At the beginning, the scope and purpose were not explicitly set. This was assumed to take place during the project when the architects and other stakeholders work together and update them. The definitions are expected to be based on various strategies and other documents.

The Finnish governmental structure does not support inter-administrative collaboration and EA work. Legislation is made in and for silos and siloed organizations, and interoperability in business, data and application levels remains incomplete.

4.4 Horizontal viewpoints on problems

Next, we will look at the problems and how they emerged in different cases.

Lack of communication and collaboration (O1). The lack of communication and collaboration got four critical and one challenging assessments. In the cases RA01 and RA03, initially the EA project teams consisted of only an EA consultant and the ministry representatives. Later both teams were expanded by ICT architects and CIOs. There was no collaboration with education providers or other administrative branches,

i.e. domain experts. In the case EA12, the team was lacking collaboration with other departments. The case EA09 did not succeed in collaborating with the steering ministry, although later some workshops were organized with the architects. The EA10 team had meetings only occasionally.

Poorly understood EA seem to be the main cause for the communication problems. The architecture descriptions are only one of the goals. Equally important is learning by doing the EA since this takes the work into broader use. Wider and deeper collaboration means better learning and better learning means better architecture descriptions and results. There were also practical reasons to not invest in collaboration. The EA work was (and is!) traditionally done in small teams where it is easier and more efficient to work with familiar people, just publish the descriptions, and hope that the other stakeholders adopt and start to use them. The EA teams were not ready to improve their work practices and processes. Collaboration also necessitates coordination and resources. Finally, the EA work was usually perceived as a one-time project, not a continuous process.

EA consultant-related issues (O7). The EA consultant-related issues were critical at least in the cases RA06 and EA10. In all other cases, it was difficult to assess objectively since the first author was the main EA consultant there. However, he has received comments like: “The same enterprise architect is doing all EAs [descriptions]” and “The architecture descriptions look too similar.” This means a good architect can create similar descriptions which are then interoperable, comparable, and consistent.

Nevertheless, these comments underline the importance of the consultants. Especially the EA consultants have a big influence on the architecture deliverables. Besides architectural competences, the consultants are expected to have other skills like communicating, collaborating, motivating, or social skills (c.f. Ylinen & Pekkola 2020). Consequently, the EA-consultant related issues emerged because the consultants did not have all necessary skills *in those projects*. For example, they may have missed communication or social skills which may have been adequate elsewhere.

EA Governance framework (O10) and EA Governance (CSF18). The EA governance and governance framework (O10 & CSF18) was critical in two cases and challenging in five. In the case RA06, the architecture descriptions were planned to be used as input to other EA projects. This was very difficult. In case EA10, the absence of the governance framework almost suspended the EA project and hampered the service development. Although in five cases the EA governance management model was missing, they are projected to develop it later when their EA descriptions are mature enough.

The absence of the EA governance models and frameworks results from their low priority. The customer organizations were keen on utilizing the architectural descriptions without understanding what it requires in a long run. They were not familiar with making governance models or seeing the EA as a holistic tool for managing, steering, and developing operations.

Assessment and Evaluation (CSF20). This CSF got five critical and four challenging assessments. Evaluating architecture descriptions is challenging because it may take years before the effects and consequences emerge and can be measured (Ylimäki 2006). In fact, only two of our projects got good credits in the assessment.

The case RA06 was evaluated by an external evaluation agency and the case RA04 in several real-life use cases and seminars and events. In general, the customers seem not to value assessment and evaluation. They are satisfied already when the EA is in use.

Insufficient realization of EA objectives (R27). An insufficient realization of the EA objectives refers to the ultimate EA goals: new services, applications, and processes. Architecture descriptions and learning are means to reach these goals. This risk got two critical and five challenging hits. All the projects which got “challenging” assessments are under construction, meaning the risk will most probably not occur. The original objectives of the case RA06 (a reference architecture) was not realized but many of its ideas and architecture descriptions have been reused in other projects. In the case RA08, instructions for implementing the reference architecture were not made. This makes it difficult to realize the objectives.

The EA objectives are usually not realized because of inadequate architecture implementation instructions. The actors seem to believe that architectural descriptions are sufficient for reaching the goals, so no separate EA implementation guidance is needed.

5 DISCUSSIONS

There seem to be many reasons for successes and failures in the EA work. Three core factors in our public sector EA context are 1) limited collaboration, 2) administrative structure of the Finnish government, and 3) the role of EA consultancy. By managing these root causes, we can eliminate many other problems. However, as we will discuss next, they may not necessarily be the causes in other settings, or can be managed similarly.

Earlier studies have identified that the lack of communication and collaboration is the core obstacle that could explain many other problems (Banaeianjahromi & Smolander 2019). This is not surprising since EA development is mostly about communicating and collaborating with different stakeholders. The problem is also apparent in our EA projects. Eight projects have identified collaboration as essential strategic capability while four ignored it. However, collaboration problems occurred differently and because of dissimilar reasons. The cases RA01 and RA03 had internal problems and misunderstandings, the case EA12 had horizontal communication problems with other departments that were unwilling to collaborate, and the case EA09 vertical problems with its steering actors. The case EA10 had pragmatic problems of setting up meetings. Consequently, communication and collaboration problems emerged very differently, requiring different coping mechanisms.

Organizational structures, legislation, politics, and top-down guidance and governance have been identified as root causes in the public sector (Dang & Pekkola 2017). In our cases, the missing collaboration capability between administrative branches was due to the governmental structure. The Finnish public sector administration follows expertise-based, sectional responsibilities where different ministries and agencies mind their own businesses without interfering the others. Similarly, legislation is made in silos. Interoperability in semantic issues and vocabularies is incomplete. Financial structure does not support interoperability.

Under the circumstances inter-administrative collaboration becomes very difficult so Finnish public sector EA projects are usually not bridging administrative boundaries. For example, the means to manage interoperability challenges between different administrative branches are very limited. Here the case EA07 is a rare positive exception. It is a collaboration project between two ministries, aiming to deliver a new collaboration model to bridge inter-administrative branches. Its utilization remains to be seen as elections and changes in the government or its ministers, or a new government program influence the EA projects and may even terminate them (Banaeianjahromi & Smolander 2019).

The complexity of the EA concept (e.g., Haki & Legner 2021; Lemmetti & Pekkola 2012) often necessitates external interpreters to facilitate the EA work. This emphasizes the role of EA consultants. They can be seen as influential factors, both positively and negatively, behind many problems and how they are coped. An architect plays a major role in the EA development, its maintenance, establishing communication, and providing coordination between the business and the IT teams (Banaeianjahromi & Smolander 2019). Yet this work is difficult since the problems materialize differently in different contexts. This exacerbates the architect's work since his/her earlier experiences, competences, skills, or the social eye, that may have provided successful outcomes in the earlier occasions, may not be appropriate in a new context.

The core factors: collaboration, administrative structure, and consultancy, can thus be considered as root causes in the cases. However, at the same time, they are very contextual. For example, in the case EA10, the problems had accumulated up to the extent that replacing the consultant or investing in collaboration to get a fresh start would not have helped. The window of opportunity (Tyre & Orlikowski 1994) to advance EA in the agency was closed for the time-being. This means the other problems have become more significant root causes. Consequently, the problems are not only contextual, but their importance varies over time. This means that our currently unrealized problems may be realized and hit the fan in different circumstances.

The contextual and temporal characteristic of the problems makes their coping mechanisms challenging. Once a successful strategy and approach may not be successful in other occasion. In this sense, when different internal or external incidents alter the EA project environment, the problems' coping mechanisms need to change respectively (c.f. Smolander et al. 2021). Monitoring and then acting on these incidents can be the responsibility of the EA project, EA architect, or the whole team, depending on the organization and the scope of the project.

Contextuality and temporality also make the learning from previous projects and from the others difficult. Like the problems with transferring the EA practices and tools from one context to another (c.f. Dang & Pekkola 2017), also transferring the experiences and practices how to cope with different challenges is difficult. This means that in every new project and situation, one must learn the context, the stakeholders, the problems, and how they emerge there to be able to handle them appropriately. Learning from previous experiences is difficult.

6 Conclusion and contributions

In this paper, we have studied EA-related problems and how they appear in EA projects. Although the problems have been studied earlier, their manifestations in individual projects have gained much less interest. Our analysis of twelve EA projects demonstrates that the problems are highly contextual and temporal, their relative importance varying between the projects and over time. This variation puts pressures to EA work which need to be responsive to the changes in the EA project contexts. Once successful preventative actions may be unsuccessful in other times and other contexts. We argue that this contextuality and temporality and their inadequate consideration are the main reasons for often failing EA projects.

This notion of the contextuality and temporality of EA problems is our main contribution. Although it has been implicitly acknowledged earlier, the varying appearances of the communication problems, for instance, demonstrate the need for profound understanding of this variation, and for practical mechanisms to analyze the problems and to acting accordingly. Simple suggestions for coping with certain challenges are too generic claims without significant practical value. For the same reason, we, the authors of this paper, abstain ourselves from making suggestions how to solve various problems.

This notion is useful for researchers as an encouragement for further research on the instantaneous of the problems and their evolution and changes over time, and for practitioners to pay attention to smaller details when trying to survive in the turbulent world of EA work.

The study has some limitations. First, the chosen research method, participative observations, is subjective as the first author was living the daily life of the projects. Although we have minimized the problems of accidental misanalyses by constantly reflecting the findings among the authors, subjectivity is still there. However, as our purpose was not to analyze all problems and their prevalence but to see how they emerged in different situations, subjective bias is minimal. Second, the context, Finnish public sector EA projects, some national, some EU wide, may emphasize some problems. The Finnish administrative structure as a root cause for inter-administrative problems is a good example of such local problems. Again, we were not interested in individual problems but their emergence. In this light, Scandinavian context does not limit the findings.

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