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Research paper

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Abstract

Enterprise architecture (EA) is used to improve business-IT alignment. In order to achieve this, the organizations need skilled and competent work-force, namely enterprise architects. However, EA is a management approach without a commonly agreed definition or scope. This makes the education and recruitment of enterprise architects ambiguous and elusive. Even though the enterprise architects often operate in IT department, their job description can significantly differ from other IS professionals. Therefore, EA roles or skills and competences cannot be extrapolated solely from IT/IS discipline or literature, but more domain specific understanding is needed. Yet this is not studied comprehensively. Some frameworks exist where enterprise architects are described as jack-of-all-trades but they provide very little understanding about what type of skills should be emphasized and in what type of EA work. In this Delphi study, we elucidate these shortages by identifying different approaches of EA work and by providing a list of most important skills for an enterprise architect. The skill list shows that the enterprise architect position themselves in the intersection of social and technical communities. This indicates that although different EA domains emphasise different skills, the main defining factor of EA skills is the capability to operate in a sociotechnical playground.

Keywords: Delphi, Enterprise architecture, Skills, Sociotechnical perspective

1 Introduction

While digital transformation of organizations has advanced, IT departments and organizations are facing new types of challenges. One of these is the increased complexity of information systems, making the management of organizational information resources difficult (Ylimäki, 2006). As a response to this, many organizations have introduced enterprise architecture (EA) as part of their operations. EA refers to an approach were organizational information resources are mapped and analyzed, and then a new desired to-be state is described with guidelines how organization can achieve it (Ahlemann, Stettiner, Messerchmidt and Legner, 2012).

Enterprise architecture is expected to improve holistic management of organizational information resources by providing a comprehensive view of the organization (Kaisler, Amourm and Valivullah, 2005; Niemi and Pekkola, 2019). However, the definition of what is actually required from EA to provide the benefits remains unclear. Despite the lack of proper definition of EA (Dang and Pekkola, 2017), it is agreed that to yield benefits from EA, a skillful enterprise architect or group of architects is needed (Nikpay, Selamat, Rouhani and Nikfard, 2013).

What makes an enterprise architect skillful and competent has however not been studied extensively. Some rare example include, for example, Ylimäki and Halttunen (2005) who introduce preliminary findings of different types of skills that are necessary, and TOGAF framework, which provides a list of beneficial skills (TOGAF, 2019). However, these studies do not provide understanding what skills should be emphasized when enterprise architects are hired or trained. Instead, they describe enterprise architects as a five-footed-sheep or jacks-of-all-trades, where skills of different areas are not sufficiently compared with each other. The skill sets are also not connected to the enterprise

architects' tasks, which vary from very technical to very business-related social tasks. Consequently, current research does not sufficiently help organizations in improving the holistic management of information resources.

In this paper, we provide a view of a Delphi panel (Okoli and Pawlowski, 2004) of EA experts about what are the skills they think enterprise architects should have and what skills they consider most important. We will thus answer to the following two research questions.

- What kind of skills enterprise architect experts consider important for successful EA work?
- Which of these skills are the most important?

This paper studies the practitioner view of what type of skills are important in actual EA work. Though we acknowledge the need of motivation and other aspects effecting the results of EA work, here we focus on the skills, as current literature provides insufficient answers to the presented question. Moreover, identification of critical skills will also provide relevant practical contributions, including a list of skill requirements for in enterprise architecture hiring. Additionally, findings can provide guidelines on EA training programs, highlighting that model syntax knowledge is only part of the needed skillset.

The paper is organized as follows. First research on EA and related skills are presented. Then our research settings and methods, and the results of the Delphi study are portrayed. Finally, the results are reflected to the literature. The paper ends with concluding section.

2 Related research

2.1 The unclear role and definition of EA

EA can be defined as a holistic management approach (Tamm, Seddon, Shanks and Reynolds, 2011) that enables IT related strategic decision-making by creating a view of organization's information resources, information systems and technologies, and business issues, and related them all to as-is and to-be states (Bernard, 2005; Lucke, Krell and Lechner, 2010). EA is expected to create benefits such as improved business-IT alignment (Gregor, Hart and Martin, 2007), improved ability to manage organizational complexity, as well as better IS integration and decreased IT costs (Ross, Weill and Robertson, 2006). However, how these benefits can be obtained or even what EA actually constitutes in organizations, remains unclear (Dang and Pekkola, 2017; Niemi and Pekkola, 2019). This unclearness seems prevailing with EA: even its terminology is considered to be incoherent. This results in same terms often meaning different things. (Lapalme, 2012) A common nominator of EA research seem to be the absence of commonly and generally agreed definition for EA.

Some studies have tried to clarify the EA field by providing taxonomies of different approaches. For example, Lapalme (2012) presents three schools of thought on Enterprise Architecture according to the scope and purpose of EA. These are IT-focused Enterprise Architecting, system thinking focused Enterprise Integrating, and Enterprise Ecological Adaptation, which focuses on the coevolution with environment and organizational learning (Lapalme, 2012). Saha (2008) presents four EA architecture Design Models which divide EA to be either technology or business focused while the value of EA comes from either standardization or differentiation. Though these classifications are done in very different observation levels, they share some similarities. One of these is the emphasis on the importance of strategy in EA work. In the Design Models framework, the strategy is a key factor behind the model no matter which section is studied. In the Lapalme (2012) classification, a separating feature between different approaches is the way whether the strategy is considered as a "truth" or a plan that can be questioned.

Despite the emphasis on strategy and business, it still seems that the primary purpose for EA is to build better IT systems and applications (Doucet, Saha and Bernard, 2009, p. 54). Although EA is supposed to consider business architecture, information architecture, application architecture, and technology architecture with the organizational strategy (Doucet et al., 2009, p. 53), there are no many examples of EA actually being used to build better enterprises (Doucet et al., 2009, p. 54). Moreover, often EA tends to focus on describing interrelated components, instead of focusing enterprise level objectives such as business outcomes (Lapalme, 2012). It seems that EA is in principle strongly connected to the strategy and enterprise development, but its practical execution is often missing, making it difficult to define, what EA or EA work actually constitute for.

Consequently, the combination of technical and social components of the organization should thus be emphasized (Luna-Reyes, Zhang, Gil-García and Cresswell, 2005). However, sociotechnical approach is rarely explicitly

articulated in the IS or EA studies (Sarker, Chatterjee, Xiao and Elbanna, 2019). For EA, the sociotechnical focus could mean that instead of approaching organizational transformation from the technical perspective, attention is moved to the imbrications of social actors and technologies tools. This would result in new affordances, constraints and routines, and enable the transformation of the organization (Leonardi, 2011) However, how this kind of change of foci has occurred in practice, remains unclear.

EA in practice is rarely based on a self-created EA approach for the organization (Urbaczewski and Mrdalj, 2006). Instead, organizations tend to implement existing EA frameworks. These frameworks are typically designed either for very general level or for a very specific purpose, which might not be fully comprehended in the implementing organization. For example, depending on the framework EA can be defined as a tool for developing large and complex systems (FEAF), a tool for creating different organizational views (DoDAF), a tool for supporting organizational decision-making (TOGAF) (Urbaczewski and Mrdalj, 2006) or a tool providing a shared language among different operators (Zachman, 1999). When these frameworks are utilized without a proper understanding of their purpose and without a clear vision of the purpose of EA in general, it is no surprising that EA practitioners do not have a coherent understanding of EA or what it is intended for (Doucet et al., 2009). Moreover, as Kotusev (2016) points out, general ideas or specific details of well-known EA frameworks can rarely be found in organizations successfully practicing EA (Kotusev, 2016).

Making matters even more confusing, enterprise architects can have many different roles in organization (Strano and Rehmani, 2007; Gøtze, 2013). For example, enterprise architects can work as modelers of the IS or the enterprise. They can also be seen as change agents or strategic developers supporting the strategic decision-making. (Strano and Rehmani, 2007) Additionally, they can act as communicators, leaders, or managers, depending on the role of EA in the organization (Gøtze, 2013).

2.2   The critical skills of enterprise architects

Due to the complex nature of EA and quite often appearing challenges, such as difficulties of EA implementation (Löhe and Legner, 2014) and benefit realization (Tamm et al., 2011; Niemi and Pekkola, 2017), it is essential that EA work is conducted by a skillful enterprise architect (Banaeianjahromi and Smolander, 2016; Dang and Pekkola, 2017). The lack of sufficient EA related skills can result in both insufficient performance and inability to obtain the full potential of EA (Iyamu, 2009). The enterprise architects' skills are critical for EA to yield benefits (Ylimäki, 2006).

However, as the roles and tasks of the enterprise architects vary, their skills and competences are difficult to define. In some cases, the enterprise architects are IT professionals who have got the task of enterprise architecting when EA was implemented in the organization and located in the IT department. In this type of cases, one could easily presume that the skill-needs are similar to other IT professionals. This assumption is easily made as the role of IT departments has started to evolve from a service organization to a strategically significant solution organization (Morneau and Talley, 2007). With this evolution also the IT professionals' skills and competences have changed (Byrd and Turner, 2001). Although technical skills are still sometimes emphasized, the importance of social aspects has increased. In addition to the increased focus to social aspects in the skill needs of IT professionals, also business have become emphasized (Bassellier and Benbasat, 2004; Estevez and Janowski, 2013). This difference can be explained, at least to some degree, by the role of the IT department in the organization (Morneau and Talley, 2007). For example If all the technical aspects have been outsourced, then it is logical to emphasize outsourcing management skills (McFarlan and Nolan, 1995). The general transformation has resulted in creation of different competence frameworks and educational curriculums (Noll and Wilkins, 2002). Simultaneously the need for different skills have expanded from mere technical skills (Todd, McKeen and Gallupe, 1995) to include business skills and interpersonal skills (Feeny and Willcocks, 1998) such as collaboration, communication and innovation (Noll and Wilkins, 2002). In this context, EA has just been another new responsibility, and the skills of enterprise architects have not been sufficiently differentiated from other IT professionals.

EA however is not about extensive comprehension of technical knowledge or third party collaboration (Besker, Olsson and Pessi, 2015). Therefore assuming that these studies and presented frameworks would provide holistic view of the enterprise architects' skill needs is misleading. For example, modelling, as a critical skill for enterprise architects, is rarely mentioned in general IT skill classifications (Potts, 2013). This urges for an enterprise architect specific skill and competence definitions.

As the enterprise architects can be seen as managers, developers, and modelers, for instance, it can be assumed that architects need skills in all of these areas. According to the management literature, managers and leaders should have

skills such as persuasiveness, administrative ability, fluency in speaking, knowledge about group tasks, diplomacy and tact, social skills, creativity, conceptual skills, and cleverness (Carmeli and Tishler, 2006). On the other hand, from the development point of view, enterprise architects should be skillful for example in project management where the skills such as technical skills, conceptual skills and softer skills are required (Pant and Baroudi, 2008). In the modelling work, more technical knowledge is obviously required (Potts, 2013). Altogether management literature provides long listings of necessary skills in different areas of operations (Whetten and Cameron, 2001; Yukl, 2002; Katz, 2009). These lists, however, do not combine management skills with technical aspects, which are critical part of the work the enterprise architects are doing. Consequently, it is very difficult to define what skills should be emphasized when searching for a jack-of-all-trades, i.e. an enterprise architect, for an organization.

Nevertheless, some studies on EA skills exist. Tambouris et al. indicate that the enterprise architects need business and social knowledge in addition to technological and management competences (Tambouris, Zotou, Kalampokis and Tarabanis, 2012). Steghuis and Proper provide a list of more specific skills, such as ability to create abstractions, skills of negotiation and communication, and having ability be empathic and analytical (Steghuis and Proper, 2008). Ylimäki and Halttunen list 19 skills that the architects could find beneficial (Ylimäki and Halttunen, 2005). EA frameworks also provide their own skill lists. In TOGAF, the necessary skills are divided into seven groups: Generic skills; Business skills and method; Enterprise architecture skills; Program or project management skills; IT general knowledge skills; Technical IT skills and Legal Environment skills all of which contain extensive listings of necessary skills.

It can be concluded the enterprise architects need skills in varying fields and disciplines. However, simply by dividing the skills into groups such as technical skills, system development skills, business skills and social competence, the relation between them remains unclear. These groups provide little understanding of what are the most critical skills for an enterprise architect.

3   Research method

To gain better understanding of what are the enterprise architects' critical skills in their work, we conducted a Delphi study (Skinner, Nelson, Chin and Land, 2015) among acknowledgeable Finnish enterprise architect professionals. Our objective was to create a skill list or lists, that can be utilized for instance when hiring new enterprise architects. At the same time, studying the skills increases our understanding of the tasks the enterprise architects are expected to do. Thus, in order to correctly address different situations, we also need to analyze the architects' works.

Delphi study is a research method where a group of experts work with a complex problem in a structured manner. This is often done by enabling the group to communicate about individual contributions in order to create a combined view. Often the individuals are given opportunities to revise their views in relation to the group view in attempt to come to an agreement or agree on the disagreement. (Okoli and Pawlowski, 2004)

The study reported in this paper continues our earlier research where the views of an Enterprise architecture professional community were asked to define what are the skills enterprise architects consider the most important in their work (Ylinen and Pekkola, 2018). Earlier paper was a survey study identified different skills but did not provide in-depth understanding of their importance. Hence, in the Delphi study, knowledgeable EA professional panel is used to classify the skills based on their importance in EA work. As the earlier study was conducted in Finnish and due to the complex nature of discussed skills, also the Delphi study was limited to the Finnish context. This was done to avoid situation where the skills would be misunderstood due to language barriers.

As discussed in the related research section earlier, there is a lack of a specific and generally accepted definition of EA or EA work. This means that to understand the skills and competences of enterprise architects, we need to gather a group, or groups, of experts with different backgrounds and different EA perceptions to provide their view of the current EA skill needs. The Delphi method provides a structured method for finding out an agreement among the experts, and enabling us to gain more in-depth knowledge on what are the most critical skills, instead of creating another all-inclusive skill list (Okoli and Pawlowski, 2004).

In this Delphi study, we followed the instructions by Okoli and Pawlowski (2004). They provide a structured process of selecting the participants, getting their opinions, and forming a consolidated view. This process and how we utilized it is described next.

3.1 Procedure for selecting the experts

The process of selecting the panelists is illustrated in Figure 1. Panel formation begun by contacting a group of EA professionals who had participated in the writing process of national EA regulation. The professionals were asked to suggest five or more individuals who they considered as the most prestigious EA professionals in Finland to be invited to the panel. This group was selected as the preliminary source of potential panelists as they had shown clear interest in the development of Finnish EA work by participating in the writing process and being accepted to the working group by their EA knowledge. Additionally, the group was not connected to the researchers, and therefore enabled unbiased panelist selection. All 32 individuals listed as participants in the regulation writing process were contacted. Five of them could not be reached due to changed contact information or retirement.
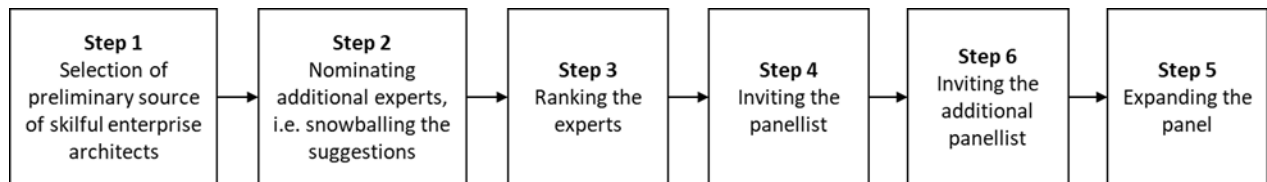

Figure 1   Steps of selecting the panellist.

All suggested professionals were asked to name top five EA professionals in Finland. The respondents had also possibility to suggest themselves as a panelist. When individuals outside the original group were suggested, they were contacted and asked to similarly name the most prestigious enterprise architects in Finland. This process was continued until no new names were suggested.

Altogether 79 professionals were suggested to the panel, 31 of whom were mentioned more than once. As only 26 of them were willing to participate, we also invited those individuals (9), who had participated in the panelist suggestions and had been suggested to the panel by someone else. The rationalization behind this choice was that we expected these individuals to be more willing to participate in the actual panel as well, as they had already shown interest in the topic by providing their view of the top enterprise architects. As most of the additional panelist agreed to participate on the panel, we did not contact the other potential panelist, who had been suggested once by either themselves or by someone else.

The final panel included 35 EA professionals who had agreed to participate in the process of identifying the most important skills for EA work. The panel is presented in Table 1.

Field	Number of participants
Private sector organization (excluding consultancy organizations)	14
Consultant organization	13
Public sector organization	8

Table 1   Division of panellist into different fields

3.2 Data collection and analysis method

Administrating the questionnaire: The questionnaire for the panelist was administrated via web-based questionnaire system Webropol. Invitations to the questionnaire were sent by email. This approach provided an easy access to the questionnaire, consequently encouraging participation, and enabled us to send remainders and receive the responses fast.

Phase 0 *Identifying the skills*: In this phase, the panelists were asked to identify possible skills. This was done by first creating the core skill categories according to the TOGAF framework and its skill areas. Although TOGAF may confine the brainstorming, it provided very generic areas headers as a starting point. In fact, we tried not to use TOGAF but the pilot test resulted very narrow list of ideas. The panelists were asked to name three or more EA skills each skill categories of the TOGAF framework. This resulted in 257 unique skills. This phase is reported as a survey study in (Ylinen and Pekkola, 2018).

Phase 1 *Questionnaire 1 Defining EA and partial narrowing down:* In this phase, the panelists were asked to define EA work and then choose 20 skills from the skill they considered most important for EA work. 32 responses were received.

Analysis of the questionnaire 1: Answers in the first iteration varied a lot. This was the case when all answers were compered as a group and when they were grouped according to the respondents' fields. As no sufficient coherence was identified, the panelists were divided into two groups according to their definitions of EA work. The groups were identified in our earlier study (Ylinen and Pekkola, 2018). Two views on EA were Modelling focused EA work and Strategic development focused EA work.

Both authors and one another researcher, knowable of EA, divided the panelists to these two groups independently. In the two instances where the categorizations differed, an agreement was reached by group discussion. Altogether, sixteen panelists were considered as Modelling focused, whereas fifteen focused on Strategic development. Two examples of EA work definitions are presented below.

Modelling focused respondent: *"[EA work is] planning and depicting operations, information, information systems, the particles of information systems and their relations, in accordance with organizations strategy and objectives"*

Strategic development focused respondent: "*EA work is holistic study of the organizations business environment and its change, where the correlations inside and between different levels of examination are considered*."

Phase 2 *Questionnaire 2 Ranking the skills:* Based on the categorization of the panelists, two questionnaires where the skills are ranked according to the group's opinions were created. The order of skills was based on the number of times each skill had been selected in that group. Now the panelists were asked to revise their ratings when they see how the group had valued the skills. Despite several contacting attempts, the response rate lowered, and only nine of the sixteen modelling focused and thirteen of the fifteen strategic development focused panelist responded to the questionnaire.

Analysis of the questionnaire 2: Based on the responses a new classification of the most important EA skills was formed. From the responses to the Questionnaire 2, it became clear that besides the few top ranked skills the panelist had not reach a consensus in their skill categorization.

Phase 3 *Questionnaire 3: Choosing the most important skills.* Again, the panelists were approached and given the skill lists for their revisions. We showed each respondent their previous ranking and the group ranking, and asked whether they want to revise the order. Also, a chance to provide a reason for answers was given. Unfortunately, only four Modelers and six Strategic developers replied.

Analysis of the questionnaire 1: In the modelling focused panel, all panelist wanted to stick to their previous categorization. This means that the most agreed on the most important skills, but no one with the list as a whole. In the Strategic developer group, the agreement with the most popular skills was better as three out of six agreed with the consensus list. Despite the low response rate, this result indicates that even when EA experts agree with the definition of EA, they do not agree on what skills are critical in that type of EA work. This emphasizes the fact that EA work is rather contextual, each context, situation, and person putting its own emphasis on different issues.

4   Findings

The panelists see EA work either being modelling focused or focusing on strategic development. This division was clear in all industries, meaning that the modelers were working both in the public sector and in the private organizations, or working as consultants in between.

Despite three iterations, the panelist did not reach a consensus of the most critical skills. However, when considering the most popular skills, the types of skills emphasized by different groups varied. The Modelers focused on skills related to providing a clear view of the organization, while the Strategic developers emphasized the role of assisting strategic decision-making.

Despite the order of the most important skills varied, both groups reached a consensus on seven skills on the list of top ten most important skills. The top four skills were same in both panelist groups even though their order differed. These skills were ability to comprehend entities (first in both); ability to identify and focus on essential issues; ability to present things at the appropriate abstraction level, and ability to understand dependencies between the entities (See Table 2). These skills are the most important skills for EA work and indicate the importance to have both social and

technical competence. For example, the ability to understand dependencies requires the comprehension of both the technical environment but also the social context where different technical solutions are utilized.

	Modelers (11 responses)	N.o. Responses	Strategic Developers (15 responses)	N.o. Responses
1	• Ability to comprehend entities • Ability to understand dependencies	10	• Ability to comprehend entities • Ability to present things at the appropriate abstraction level	14
2	• Ability to present things at the appropriate abstraction level • Ability to identify and focus on essentials	9	• Ability to identify and focus on essentials • Ability to understand dependencies	13
3	• Understanding about the business needs • Modeling skills	8	• Communication skills	11
4	• Encapsulating entities • System Thinking • Understanding the operational objectives • Ability to act as an interpreter between IT and business • Ability to support and challenge leadership • Collaborative Skills	7	• Ability to act as an interpreter between IT and business • Ability to be analytical • Encapsulating entities • Ability to divide the whole into parts • Understanding the operational objectives	10
5	• Enterprise architecture understanding • Ability to structure entities • Ability to think at an abstract level • Ability to be analytical • Interaction skills	6	• Understanding about the business needs • Interaction skills • Ability to think at an abstract level	9
6	• Understanding customer needs • Communication skills • Ability to produce useful material	5	• Ability to support and challenge leadership • System Thinking • Enterprise architecture understanding • Modeling skills	8
			• Business competence • Ability to be objective • Collaborative Skills	7

Table 2.   The 20 most popular important skills.

The study also shows that the interpretation of EA work has a significant impact on the skills and competences. What differentiates the two groups is that the Strategist emphasize more skills that are important when working with both the business and the IT. For example, communication skills and the ability to act as an interpreter between IT and business. Consequently, Strategic developers saw themselves more as collaborators between business and IT whereas the Modelers focused on skills necessary when operating inside the IT department. For example, the Modelers considered understanding the business needs more important than the Strategic developers, indicating that the Modelers work for the business while the Strategist work with the business. It seems that the Modelers need to understand the objectives of the organization. However, being analytical or capable to discuss is not seen as that important. In general, the Modelers are providing services and architectural models that are built by the organizational business needs. The Strategic developers, on the other hand, also saw themselves as service providers, but these services can be interpreted to be more holistic in nature.

This difference in focuses was also visible in those skills not being in common. In the top twenty skills, the Modelers considered ability to structure entities, understanding of customer needs, and ability to produce useful material

.   7

necessary skills. Especially the understanding of customer needs and ability to produce useful materials indicate that the view of EA work is about being a customer service operator, not necessarily a collaborator with business. The Strategic developers emphasized the ability to divide the whole into smaller parts, business competence, and the ability to be objective. Last two indicate that the Strategist are not only interested in objectives but want to be able to collaborate with others. This requires for example comprehensive business understanding.

Table 2 presents the responses from the iteration two. When the panelists were asked whether they agreed with their respective group or whether they would like to stick with their own views, all Modelers considered their own order better than the groups view. On the other hand, the Strategist developers agreed more with the group, though some considered their own list better. This indicates that although most agreed on the importance of the skills, they did not agree on their order. Instead, they had varying understanding of the most important skills and the order in which they should be when the most important skills for enterprise architects are defined.

As the response rate to the third iteration was very low, no definite conclusion can be made. It is also possible that task of classifying the most important skills is so demanding that even the enterprise architects themselves had difficulties in giving a classification with which they would be satisfied, or that the order of importance varies according to the context and work situation. However, the lack of consensus indicates versatile roles of enterprise architects. This makes their requirements, skills and competences numerous.

5   Discussion

Our EA panelists and their perceptions were misaligned with the current EA literature. Moreover, their EA definitions were not sufficiently compatible with the existing classifications, such as the three schools of thought by Lapalme (2012). Instead, the definition can be classified under two groups. Some architects perceived that their work is about modelling while the others focus on strategic development.

When this twofold classification of EA and EA work is compared to the previous definitions, it seems that the focus of EA has shifted. Nowadays the use of EA to manage and develop organizations is emphasized over technical aspects, which were considered as the main uses earlier [c.f. Ylimäki and Halttunen, 2005]. This indicates that both the definition and the use of EA have evolved in the past ten years, and geared towards the socio-materialistic perspective of the organizational evolution (Leonardi, 2012).

One explanation for this kind of shift of perceptions is that EA in organizations has matured, and the enterprise architects' views have changed with the increase of organizational capabilities. Consequently, it seems that EA maturity level influences on the EA definition and the skills the enterprise architects considered as the most important. According to (Ross et al., 2006), EA maturity has four stages: the business silo stage, the standardized technology stage, the optimized core stage and the business modularity stage. This means the focus of EA consequently shifts from the development of individual IT applications to the organization and its strategic agility then the organization matures (Bradley et al., 2012). This transformation may thus mean the organizations have become more mature in terms of utilizing EA – either for modelling or for strategic development.

The maturity level of the organization and the enterprise architects also influences the role of EA and enterprise architects (Strano and Rehmani, 2007; Van Den Berg and Van Vliet, 2016) This in turn influences on the way enterprise architects see their work and define EA. This has a significant impact on the EA skills. Our findings support this view. Depending on the EA focus, what skills are emphasized varies. The panelist that identified themselves as Strategist emphasized the skills that supported collaboration with different parts of the organization. They are thus co-contributing the organizational development. The Modelling focused panelist emphasized the skills that enabled them to provide architectural services. However, as our skill lists show, also service provision requires a myriad type of skills. Consequently, enterprise architects are often expected to be jacks-of-all-trades (Ylimäki and Halttunen, 2005; Ylinen and Pekkola, 2018), it is understandable that different trades are highlighted by different professionals.

While the emphasis of the skills differs by the EA definition, the skill lists show a clear EA focus. When the skill lists are compared to other IT specialists such as CIO's or lower level IT workers, there are significant differences. For example, the EA skill lists do not include any skills critical for the CIOs, such as leadership, human resource management, relationship management and vendor management (Lane and Koronios, 2007). Neither the lists show significant technical focus, which could be expected from more IT focused workforce.

However, the experts generally agree on the most important skills. These are: Ability to comprehend entities; Ability to present things at the appropriate abstraction level; Ability to identify and focus on essentials, and Ability to understand dependencies. Compared to for example to the (Ylinen and Pekkola, 2018) study, where the respondents emphasized social skills, or the study by (Ylimäki and Halttunen, 2005) where the social skills were considered to be the future skills of enterprise architects, it is interesting to note that these issues did not actually get much attention. Though both expert groups pointed out some social skills in their top 20 lists, it was evident that they were not considered as the most important. This notion is significant as social skills are generally emphasized when discussing about the critical skills of EA. For example, Steghuis and Proper observed that negotiation, communication and empathy skills are important for enterprise architects (Steghuis and Proper, 2008). This indicates that EA in Finland is seen even among the Strategists as a function of creating models and providing a holistic view of the organization, not necessarily as a communication partner or a bridge between technical and social aspects of the organization.

This was visible even, when reflecting our findings with Ylimäki and Halttunen (2005). The focus has shifted towards management and development. The skill needs have not significantly evolved to the same direction. Consequently, although the enterprise architects themselves have evolved in their views of EA, their tasks in the organizations have not necessarily done the same. This might mean that organizations as whole are not ready to take the steps EA is guiding them. This however may not necessarily result from lack of skills or competencies but can be explained by EA related challenges. Also, as sociotechnical studies show (Mariani, 2019) it is not easy to combine IT with social and organizational aspects. For example, ambiguous terminology, difficulty of determining suitable levels of abstraction, conflicting value systems, and multidisciplinary approach are not challenges limited only to EA, but are common when bridging IT with social aspects of organizations (Baxter and Sommerville, 2011). These challenges however, can be solved by the enterprise architects who are capable of comprehending entities and their social relations, and having abilities to act as interpreters between business and IT.

Generally speaking, our findings are in line with (Ylimäki and Halttunen, 2005). Also, our panelists considered the ability to manage wide and complex issues, ability work at an abstract level, modelling skills, and understanding of the general rules of the business operations, important for enterprise architects. Similarly, to the absence of emphasizing social skills, understanding EA frameworks was not ranked high. This is surprising since the frameworks are often seen as fundamental parts of EA (Ylimäki and Halttunen, 2005; Zachman, 1999). There could be three reasons for this. First, the frameworks are seen so fundamental features of EA that they need not to be mentioned (e.g. similarly reading or writing does not need to be mentioned). Second, they are so complex (Lucke et al., 2010) and laborious to learn (Urbaczewski and Mrdalj, 2006) that they do not need to be known. Third, most organizations have a tendency to choose one framework and hold on to that even though it might not support their needs in the best possible way (Doucet et al., 2009). Consequently, knowing EA frameworks might be a critical need for enterprise architects, but they are not aware of it.

6   Conclusion

It can be concluded that there is no all-inclusive skill portfolio that suites for every enterprise architect. The significance of different skills varies depending on the type, role, and definition of the EA. This means that the enterprise architects need to be jacks-of-all-trades in order to survive with different EA related tasks. Although some skills, such as ability to comprehend entities, seem to be more important than the others, there is no shared understanding of what EA work is or what skills are required. This can be extrapolated to the organizational level where each organization recruit's enterprise architects to very different duties.

This is our main contribution. The list of skills and competences from Table 2 shows those skills that are seen as the most important. The list also illustrates an evolution of EA toward a more sociomaterialist domain in the organization, indicating that the EA field could benefit from integrating sociomaterial perspectives to its definition and perceptions.

Although the groups did not reach a consensus, the lists still provide a base for recruiting and training the architects. The lack of unified view also shows the need to define the work of the architect, who are his/her collaborators, and for whom s/he provides services. This then allows that an appropriate set of skills can be selected. This will help the practitioners. The researchers benefit from the study as it concretizes multifaceted nature of EA work and EA architects. Future EA studies, when the architects' opinions on varying topics is inquired, should thus also consider the differences in the architects' EA definitions as it influences the results for sure.

Other future research avenues opens up with EA work tasks. The skills the enterprise architects currently possess may influence on their views on EA definition or the most important skills there. Consequently, it would be interesting to study whether there is a correlation between the EA work and duties, and different EA related skills. This however, is beyond the scope of this paper.

EA work and skills seem to be highly contextualized. This has its implications to EA skills itself as different skills are emphasized by different EA experts. They stress the skill they and their employees see valuable. This notion may have its implications to EA research since empirical research may get biased by dissimilar standpoints and perceptions. We argue that this issue should be considered and reported in EA papers.

Of course, there are some limitations. First, the panelist did not strongly commit to the Delphi process. The number of panelists thus decreased during the study. While the original number of panelists (11 Modelers and 15 Strategists) was in line with a typical Delphi panel size of 10 to 30 panelists (Skinner et al., 2015), our panel size decreased. This prevents us from determining the internal consensuses of the panels reliably. The exact lists should thus be interpreted with caution. Second, the concepts are very comprehensive, and some terms can overlap. For example, system thinking can be interpreted to include some aspects of the ability to comprehend entities. Third, the panelist might have interpreted the skills differently. However, this risk was mitigated by asking the panelist to reason for their selections. Fourth, as we focused only on skills and excluded other relevant factors such as motivation, our findings do not provide an all-inclusive solution on how to be a successful enterprise architect. However, it can be safely assumed is that EA professional possessing the skills have an excellent starting point for successful enterprise architecting.

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