Insights from a Study on Decision Making in Enterprise Architecture

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Abstract. Although there are many frameworks for Enterprise Architecture (EA), they focus mainly on the holistic structure of an enterprise and rarely take decision making into account. This is surprising, given the large role that (design) decision making seems to play in EA. A lack of empirical work offering insight into decision making in practice might be the cause of this. To address this knowledge gap we report on some first insights from an empirical study on how the practice of decision making in EA is perceived by professional enterprise architects. We sketch an outline of designing and decision making in contemporary EA, including a high level of politicization, emotional decision making, and subordination to business management. We discuss the implications of these findings for further research and work centered around EA.

Keywords: Enterprise Architecture, professional practice, empirical study, practitioner perception, qualitative study

1 Introduction

Enterprise Architecture (EA) is not just about modeling static descriptions of an enterprise, but also about steering it towards a desired future state. This is reflected in The Open Group's description of EA in TOGAF [15], where a two-fold definition is given being: (1) "a formal description of a system, or a detailed plan of the system at the component level, to guide its implementation", and (2) "The structure of components, their inter-relationships, and the principles and guidelines governing their design and evolution over time". This second part describing normative principles and guidelines to affect an enterprise's design is where much of the architecting actually happens, as is reflected in the plethora of other EA definitions focused on it, such as Hoogervorst's view [5] of EA being "a consistent set of design principles and standards that guide design", and Lankhorst's view [8] describing it as the "realization of an enterprise's organizational structure, business processes, information systems, and infrastructure".

What is it *like* to actually work on decision making in EA? How do these high-level definitions translate to the actual decision making practice? There is work that focuses on what makes an architect a *good* architect – but those studies often still leave in the middle just what the investigated people do in a regular day's

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work (cf. [13,4]). As such, while prescribing skills and characteristics architects ought to have, they offer little empirical insight into what architects currently do, especially in regards to decision making. Other studies do attempt to investigate how EA (or parts of it) is done, but are limited to understandings of the authors themselves from prior or concurrent industrial roles (cf. [7], or anecdotal evidence gathered in industrial cases (cf. [3]). Some studies are limited to specific literature (cf. [2]). Some studies investigate actual companies, but usually in limited scope, for example a single aspect of Federal Government [14], Czech companies [10]. Comparing the findings of such studies in order to gain a general understanding of the EA practice brings additional issues of interpretation along. Attempts at understanding how EA is perceived by those practicing it are for example Dankova [1] and Mentz *et al.* [9]. However, Dankova's work is limited in this regard by being essentially a corpus analysis of existing definitions. Mentz *et al.*'s more ambitious attempt incorporating hermeneutic phenomenology to compare understandings of EA between practitioners and researchers also only focuses on existing definitions and frameworks and does not actively investigate the views these people have themselves. Thus, investigating the perception of the EA decision making in practice remains an open topic.

1.1 The Use of Understanding Practitioner's Perceptions

Gaining a deeper insight on how EA practitioners are involved in decision making contributes to several aspects, both practice and research oriented:

1) *Understanding the way they make decisions.* First, an increased understanding of how practitioners make decisions and what they consider to be and not be part of their tasks can serve as an empirical grounding for other theory-backed efforts to improve the decision making process.

2) *Understanding the issues they have in decision making.* Second, both by explicitly asking what aspects practitioners perceive to be most critical during their decision making process and investigating the characteristics of that process, we can have a more empirically grounded list of focal points for research (and practical) efforts to address.

3) *Understanding what their experience is similar to.* Finally, by understanding practitioners' perceptions, we can also investigate how similar and different they perceive decision making in other related fields to be, like for example software or information architecture. For example, some decision capturing framework for EA bases themselves on theory and foundations from software architecture without rationalizing why they are applicable to EA. Other researchers continue to build in such frameworks (cf. [6,20]), without questioning that, leading to a continued lack of proper grounding (and potentially validity) of the design artifacts offered to practitioners. Insight into what software architects do, and feel they should do [12,11] can be used to compare how similar these fields are experienced to be.

Our research objective is to study these aspects and in doing so elicit data that gives insights into the general practice of EA as well. We will do so by performing qualitative work with a diverse amount of participants active as enterprise architects.

2 Method

2.1 Participants

We specifically targeted EA practitioners by posting an invitation to the study on several LinkedIn groups centered around (the use of) Enterprise Architecture, EA methods, or tools (e.g., groups such as Enterprise Architecture, EA Forum, EA Group, The EA Network, ArchiMate, TOGAF). Doing so we specifically attempted to target a diverse number of participants, from both geographical as professional background, attempting to prevent the limited professional context of earlier studies focusing on single companies or geographical areas. Participants were asked to fill out the questionnaire online, and were offered no reward except a copy of the research results, when available.

2.2 Procedure

The study consisted of a questionnaire with three main parts, building a professional profile of the participant, understanding the difficulties they face in EA decision making, and testing how they feel about certain aspects of the decision making process. The profile of the participants was built based upon the following questions.

- What are your main activities as an Enterprise Architect during the decision making process?
- What modeling languages and techniques do you use?
- Are you internal or external to the company you perform EA activities for?
- Do you have experience with other architecture fields such as software or information architecture? If so, to what degree do you find the decison making process to be different than in Enterprise Architecture?

These are followed by more specific open questions about the difficulties they face in their role as an architect, their involvement and views on design decisions, and what kind of data they use.

- To what degree are you involved in the process of making EA design decisions?
- What makes an EA design decision difficult for you?
- Related to the last question, what are the most important (or critical) aspects of an EA design decision for you?
- What kinds of input do you use for EA design decisions, and of those, do you favor qualitative or quantitative data to base your decisions on?

Finally, we asked participants to judge to what extent they agreed with a number of statements on a 5 point Likert scale (ranging from ‘strongly disagree’ to ‘strongly agree’). These were created to give insight into how participants feel about the decision making aspects detailed below.

- Where the authority resides: is there a difference between who *makes* (i.e., prepares) the decisions and who *takes* (i.e., is responsible for) them?

- Collaboration in decision making: is the decision making process a collaborative effort or not, and to what degree so?
- Decision refinement: are decisions iterated upon and refined before they are decided upon, and can they be reconsidered and revised afterwards?
- Data used to support decisions: is there a preference for particular types of data, and is the desired data available in the first place?

Table 1: Used Likert Scale Statements.

#	Group decision-making, Decision authory	Decision refinement	Supporting data
1	I take a decision by myself	Time constraints do not allow me to consider all decision alternatives	I prefer numerical data to base my decisions on
2	I take decisions after consulting others	I take a decision without knowing exactly what the outcome will be	I prefer discussions with people to base my decisions on
3	Decisions are taken by a committee	Decisions often have to be reconsidered, which also affects other decisions	It is easier to make decisions that are based on hard data
4	Decisions are taken by a group of architects	Decisions are often refined	In general there is sufficient numerical data available to make decisions
5	The final decision comes down to a single person	When I make a decision, it is final	Discussions with stakeholders offer more insight than numerical data

2.3 Analysis

The results from all open questions were gathered and classified per question. We then used progressive coding to identify common threads between participants, both on single word and phrase basis (e.g., multiple occurrences of the term 'time constraints' for the question what makes EA design decisions difficult). This coding was used to build an overview of the general trend for the answers. After doing so we went through the answers again to find answers that specifically conflicted with this trend, and use them to discuss the attitudes of the participants towards the questionnaire. To estimate the general tendency for each answer in the Likert scale we calculated the median of each question's answers (given the ordinal nature), which we used to determine whether the majority of participants had a polarized (i.e., strong agreement or disagreement) or neutral attitude towards them.

3 Results

We received **35** full responses to the questionnaire, with many more partial or empty responses discarded. The textual answers were analyzed and coded, and will be discussed in more detail in Sec. 4. There was no strong bias towards external or internal employees, with 17 indicating being external to the companies they provided EA services for, 15 being internal, and the remaining 3 gave

no answer. The location of the participants was diverse, with many countries represented. A total of 18 participants were from (> 5) European countries, 9 from North America, 3 from South America, 2 from Australia, 1 from Africa, 1 from Middle East, and finally 1 from an unknown origin.

For the Likert scale, we selected the statements with strong responses (either positive and negative), and emphasized those with a low response variation in their responses (indicating consensus among the participants). These statements are not used as statistically generalizable findings, but as verification for the analysis of the qualitative data, and to ensure they both corroborate each other.

Table 2: Strongly polarized (≥ 4 and ≤ 2, pos and neg) Likert Scale Items. Statements in *emphasis* had particularly low variation and were thus most strongly (dis)agreed on.

Statement	Polarity
I take a decision by myself	
When I make a decision, it is final	Negative
In general there is sufficient numerical data available to make decisions	
I take decisions after consulting others	
Decisions are taken by a committee	
Time constraints do not allow me to consider all decision alternatives	
Decisions are often refined	Positive
I prefer discussions with people to base my decisions on	
It is easier to make decisions that are based on hard data	
Discussions with stakeholders offer more insight than numerical data	

4 A First Outline of Contemporary EA

In this section we give an outline of contemporary Enterprise Architecture as perceived by practitioners, describing the dominant views held by participants for the different aspects we studied. We will try as much as possible to let the participants speak for themselves, showing their actual responses.

4.1 Main Activities as an Enterprise Architect

Most participants indicate that the majority of their time is spent on working towards *future* states of the enterprise, less so on the current state (e.g., modeling it, analyzing it). This is in some contrast to the TOGAF definitions which give a clear two-fold interpretation of EA and imply equal importance of those parts. As stated, they spend a lot of time and effort to:

> "Seek the strategy, the strategic goals (qualitative) and objectives (quantitative) and then derive the information required to achieve them."

To make it clear that the future is of particular importance, many other participants stated similar foci:

> "... and then use those as inputs to model a set of potential courses of action."; "... providing a recommended course of action if possible"; "Helping investment decision makers consider alternative future change to their business, and monitoring the impact of the change as its being created and implemented."

This focus on future states can be explained by the answers of some participants where it is clear that models and data already exist, and need to be integrated and used towards the future state. The point of these artifacts needing to be harmonized into a form consumable for strategically responsible stakeholders brings forth the other main activity that architects seem to actually do while working on this future state: creating support and convincing management of the use of the design direction to go in.

> "Creating awareness and commitment at management (decision-makers level for a specific solution"; "Creating support within the enterprise for a specific solution or specific solution paradigm so that the decision-makers are confronted with this paradigm"

Already in describing their main activities it becomes clear that while Enterprise Architects work on the future state of an enterprise, there is a clear difference between those who propose (designs, decisions, strategies for) the future of the enterprise, and those who have the power to actually take it there, an aspect that will be explored more in Sec 4.5. See, for example:

> "Often I frame the decisions to be made and then propose various options with supporting data. Usually the option that I feel is the best is clear through that data. *However, the senior leaders who own the decisions need to be the ones who actually make it.*" (emphasis added)

4.2 Used Modeling Languages and Techniques

When asked about the modeling languages and techniques participants used in their daily work, the whole gamut of languages came by. The usual suspects such as UML, BPMN, ArchiMate (for Western European EAs, at least) were represented, as well as long existing techniques like Zachman, Flowcharts, IDEF languages, and so on, but just as well less known languages such as IBM and Oracle suites, ScIAM, SAINT, DNDAF, SCOR, RDF, Rummler-Brache, and so on. Multiple participants make a distinction between the audience of models and information, and that a distinct purpose followed from that: modeling to capture knowledge, and modeling to communicate knowledge. Practically speaking, very little formal or complicated modeling languages and techniques were actually shown to the business stakeholders when communicating with them:

> "Primary tool for communicating is PowerPoint."; "... but really powerpoint, excel and visio are more suitable for a non-technical audience."; "In dialogue with management I do not use modeling languages or techniques."

4.3 Data to be Used

Designing the future state of an Enterprise is considered a systematic activity by many, and as such useful data to base those designs on is needed. To do so, however, data is needed to base all those designs (and design decisions) on. This ranges from quantitative data about the operation of the enterprise, to qualitative data involving the actual people making up the enterprise. Both kinds of data are needed:

> "You need both sets of data. The challenge is introducing a disciplined process for capturing both types of input to align them for one decision and support dependent decisions in other areas."

4.4 Perceived Differences to Other Architecture Fields

Many participants had experience working in other digital architecture fields (e.g, software, information, data architecture). One participant argued that the primary difference between these fields arose simply from the professional culture of their domain. Going into detail on the differences between EA and those fields considered more technical like Software Architecture, participants generally found EA to have a broader focus and depth, with the scope and impact of design decisions potentially far greater in EA. These differences were often explained by EA having a much stronger business focus than comparable fields, from which also a higher abstraction level followed. While some participants state that software architecture is not fundamentally different from EA (at least in regards to the decision making process), they do showcase the different nature of achieving support for a future state or design, corroborating points made earlier by other participants that EA has many more human and 'soft' aspects that need to be dealt with:

> "EA decision making process has more political, personal etc. influences. Demands more communication and soft-skills. Software architecture decision making is (much) more straightforward fact based."

4.5 Involvement in the Decision Making Process

In the previous aspects we have already seen hints that while Enterprise Architects are consistently involved in designing and proposing future states of an enterprise, they are not necessarily the ones to take an enterprise there. Most architects seem to choose for future designs or (viable) future states in cooperation with business stakeholders, and then communicate those to management stakeholders who have the actual decision taking power:

> "An architect (EA or otherwise) is responsible for providing recommendations not decisions to the Board. The Board owns the accountability for decisions."

4.6 What makes EA Design Decisions Difficult?

As participants stated already in other aspects, EA design decisions are not simple to make, especially when compared to fields they perceive as more technical and rational like software architecture. The reasons for this are diverse, ranging from the involvement of a large number of stakeholders, difficulty communicating between people with different backgrounds, and dealing with conflicting goals and lack of information. However, besides all these aspects, a difficulty seemingly more specific to EA is shared by many participants, the politics involved in finding support for moving an enterprise to a particular future state:

> "The politics. Making a design decision based on principles and best practices is not difficult. Making it such that my stakeholders see the value in where I'm going, and see the benefit of going there with me, is much more difficult and interesting."

4.7 Most Critical Aspect(s) of EA Design Decisions

After understanding what aspects are most difficult about design decisions in EA, we also explicitly asked participants what aspects they found most critical to making decisions. The main response here is in line with the view of EA being highly politicized, as the most critical aspect to most EA design decisions, and thus to reaching a proposed future state of an enterprise were finding the right arguments to convince the right people at the right time, and keeping them convinced:

> "The most critical aspects of an EA design decision: having the right rational arguments for which conservative IT operators and managers are sensitive for, having the right emotional and business image/impact for the business, getting the right position in project planning"

5 Reflection

5.1 Implications for Research

From the outline that we have sketched, we see several things that research in EA can focus on to provide more support for the decision making process in EA:

Supporting the way they make decisions. Our results indicate that discussions between architects and business stakeholders play a large role in the EA decision making process. This supports the idea that dialogical skills are important for enterprise architects, so that they can "interact with those who are different, antagonistic, or even aggressive towards them". [4]. This is an important aspect that seems to set the decisions making process in EA apart from decision making in other domains such as SA. Recent EA decision rationalisation frameworks (e.g., [20,18], both theoretical frameworks based on formal logic) directly use insights from related domains such as SA (see more on this in point

3). Therefore, the discussions between stakeholders are not part of these framework. Given our results, we believe that in order to truthfully model the EA decision process, these framework would benefit from an extension such that the discussions between stakeholders are part of the rationalization of decisions as well. We report initial finding of applying argumentation to parts of enterprise architecture elsewhere [19], and we aim to further extend it in future work.

In a different direction, the finding that many EA practitioners make a distinction between capturing and documenting knowledge in models and communicating it to business stakeholders means that we can be clearer about the presumed users of modeling languages: they might be only used by experts. This has implications for the design of such languages, how complex they can be, how intuitive their interfaces should be, as novice users or non-IT literature users are, at least in an EA context, likely not active users. Instead, they are communicated the knowledge that architects captured in such models by different means such as Powerpoint slides, and informal drawings.

Dealing with the issues they have in decision making. Ensuring that all stakeholders have the same understandings, and keeping the 'buy-in' of stakeholders on those understandings is one of the critical aspects pointed out by our participants. On the one hand this offers support for such efforts like ArchiMate and other providers of complete and coherent EA approaches. On the other hand given the plethora of used modeling languages and techniques, it stresses the need of research investigating the different conceptual understandings that people have and how to best deal with and accommodate them [16,17]. Furthermore, as the most mentioned issue of day to day practice is the politics of dealing with all involved stakeholders, our study points out the need for more research into understanding the political processes involved in the EA process.

Realizing EA is not interchangeable with all other 'A'. How the decision making process differs from e.g., software architecture presents a number of implications for research, especially of a design nature, whether recommender systems, ontologies, or information capturing schemes. Given the perceived differences between EA and SA practice, frameworks created by researchers should not just assume the two are the same and use SA foundations to build EA frameworks. Such frameworks need to at least account for the perceived extra dimensions of political motivations in decisions, emotions that need to be addressed and the large part that discussions play in the decision making process.

6 Conclusion & Outlook

We have given an outline of the practice of design and decision making in contemporary EA based on an in-depth qualitative study of how enterprise architects perceive their professional work. This has led to a number of insights, namely that the practice of EA is fundamentally perceived as a consultancy service to business, with less rational decision making than other architecture fields, and a highly politicized working context.

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