Agile Enterprise Architecture Management: An Analysis on the Application of Agile Principles

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Abstract: Enterprise Architecture (EA) management has proven to be an efficient instrument to align business and IT from a holistic perspective. Many organizations have established a permanent EA management function responsible for modeling, analyzing, and defining the current and future EA state as well as the roadmap. Similar as in software development, EA management initiatives face challenges that delay results, complicate the collaboration, and deteriorate the overall work quality. While in software development, agile principles and values reflected in tangible methods like Scrum and Extreme Programming are increasingly adopted by organizations, there is little known whether these practices have already made their way into EA management. Based on three research questions, this paper sheds light on the status-quo of agile principles applied to EA management. We present results of an online survey among 105 industry experts working for more than 10 industry sectors across 22 different countries.

1. INTRODUCTION

Globalization, frequently altering market conditions, and the pressing need to reduce operating costs force organizations to carry out complex business transformations at a regular interval. However, performed without a holistic and explicit picture of the organization, these transformations are likely to fail (Ross, Weill and Robertson, 2006). An Enterprise Architecture (EA) serves as a common means to look at an entire organization as a whole. It captures both, business aspects (e.g., business processes, business objects) and IT aspects (e.g., interfaces, networks, devices) as well as their interrelations (Buschle, Grunow, Matthes, Ekstedt, Hauder and Roth, 2012).

Being applied by an increasing number of enterprises, the corresponding discipline EA management fosters the mutual alignment of business and IT (Weill and Ross, 2009).

EA management deals with capturing, modeling, analyzing, and defining the current, planned, and future architecture in conjunction with the roadmap leading from the as-is to the target state (The Open Group, 2011). However, EA management faces various challenges ranging for instance from the late return on investment to the delayed valuation of the disciplines by concerned stakeholders (cf. e.g. (Hauder, Roth, Matthes and Schulz, 2013), (Lucke, Krell and Lechner, 2010) and (Lucke, Bürger, Diefenbach, Freter and Lechner, 2012).

When looking on the domain of software development, researchers likewise to practitioners propose the adherence to so-called agile values helping to address these types of challenges (Schwaber, 2004). Key to these values are agile principles like the avoidance of waste (Gloger, 2010), an early stakeholder involvement (Beck, Beedle, Bennekum, Cockburn, Cunningham, Fowler and Grenning, 2001), and gathering feedback at an ongoing basis (Highsmith and Cockburn, 2001).

In many cases these principles are based on lean production practices initially applied by the Japanese car manufacturer Toyota (Deming, 2000), (Holweg, 2007). As of today, the benefits of agile principles to software development are still discussed controversially (Reifer, Maurer and Erdogmus, 2003).

Several similarities between software development - centering rather on single systems -

and EA management - focusing on the holistic management of systems of systems - can be drawn. Both disciplines have to handle frequently changing requirements while ensuring a close collaboration among the multi-disciplinary stakeholders. Focusing on the latter, researchers have already proposed to apply agile practices known from the development of software (Ambler, 2010a), (Buckl, Matthes, Monahov, Roth, Schulz and Schweda, 2011).

Given that in many cases EA management is initially promoted through IT (Hauder, Roth, Matthes and Schulz, 2013), EA initiatives are well aware of agile practices, e.g. Scrum, Extreme Programming (XP), Feature Driven Development (FDD), and might apply their according principles in their day-to-day business. From an empirical standpoint, we witness that EA management endeavors of our industry partners increasingly apply these agile practices. In addition, we diagnose agile prescriptions are implicitly incorporated in today's EA management frameworks, e.g., (The Open Group, 2011).

Yet, literature documenting the agile nature of EA management is scarce; in particular empirical ground is missing. Against this background, we conclude to the following research objective:

'Which agile principles known from the software engineering domain should be applied for the design of an organization-specific agile EA management practice?'

The research approach and the deliverables are illustrated in Figure 1: After defining the scope and the research questions, we conducted a literature review to identify agile principles from other domains. Based on these principles we designed an online survey to evaluate their usage in EA management. In order to answer the research questions and gain a deeper understanding on the application of the principles, we correlated them with the specific EA management challenges of the organizations (Hauder, Roth, Matthes and Schulz, 2013).

The following section (Section 2) provides the findings we made when perusing EA management literature looking for agile pointers. In Section 3 we explain how agile principles and values from the software development world could be adopted by EA management. In addition to the introduction of our research hypotheses, Section 4 outlines the main setup of an online survey we conducted among 105 experts in the field. We analyze and discuss the data in Section 5 and 6 before concluding the paper with remarks on future research.

2. AGILE PRINCIPLES IN ENTERPRISE ARCHITECTURE

To identify tangible material on agile principles and values in EA management, we applied a structured approach as recommended by Webster and Watson (Webster and Watson, 2002). During April 2013 we perused different IS journals, conference proceedings, and books using the Web of Science, Google Scholar, IEEExplore, Citeseer, SpringerLink and the library of our research institution. Thereby, we carried out electronic full-text searches on the following English keywords: 'enterprise architecture management' and 'agile' as well as their German translations. After a first analysis of the overall 53 sources (title, abstract, outline) adhering to the method of hermeneutic text comprehension, the following sources have been identified as relevant given their focus on the topic.
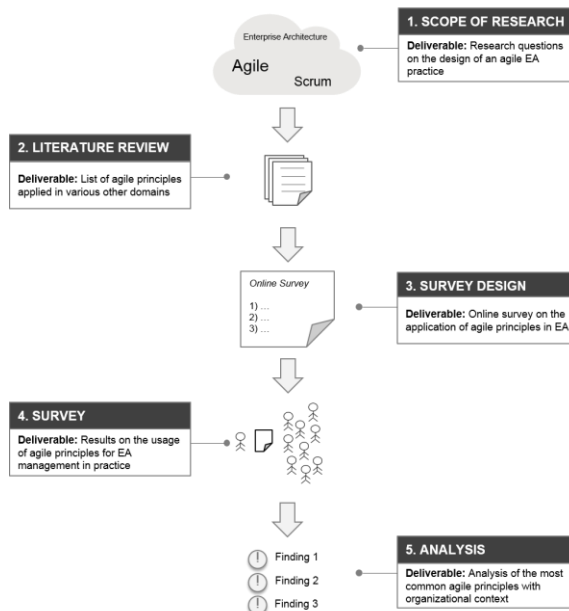

Figure 1: Research approach and deliverables

Ambler accentuates that EA management has to be business driven, evolutionary, collaborative, and focused on producing valuable artifacts (Ambler, 2010a). Based on an examination of problems EA management is typically coping with, the practitioner points out six pieces of advice to make the management of enterprise architectures more agile, among others, simplicity, focus on people, and an iterative and incremental approach (Ambler, 2009). In the latest of his reports, Ambler goes even further, proposing an agile architecture process

complemented by several key techniques (Ambler, 2010b). The findings published by Ambler all root in practical work experience with no evaluation on a quantitative scale.

Bob Rhubart describes how an EA management could be turned more agile (Rhubart, 2010). The Oracle representative highlights the necessary buy-in from architects, developers, and other stakeholders at all levels of the organization. Next to the importance of conversation in particular with the developing teams, the manager considers the involvement of enterprise architects at the project level as very crucial. Again, all suggestions are based on in-the-field work based on a single company (employee) perspective.

Friedrichsen and Schrewe see typical EA management problems (e.g. losing sight of fundamentals, becoming a slave of the EA management framework) as a reason to introduce agile values (Friedrichsen and Schrewe, 2010). The consultants advise to launch an EA management initiative with clear goals and a limited scope while always keeping potential risks in mind. In their eyes, frameworks and tools have to be considered as toolboxes that ensure to reach the stated goals more efficiently.

While Eric Landes recommends applying concrete techniques like retrospectives and lessons learned action items, iterative cycles, as well as automated acceptance criteria in the emergent design of an architecture (Landes, 2012), Scott Nelson assumes two distinct viewpoints when discussing the similarities and differences of managing enterprises architectures vs. developing software in an agile manner (Nelson, 2012).

As another industry expert and active blogger, Gabhart advises to avoid big bang EA management projects attempting to "boil the ocean", thus are too big in scope (Gabhart, 2013). Instead of that, the author proposes to start off small, building up an EA management capability in an incremental and iterative 4-step process. Lastly, the staff member Gattadahalli of the former IT Company EDS shares the knowledge of an agile management of EAs in terms of seven critical success factors (Gattadahalli, 2004).

After having introduced EA management to the reader of their book, Bente, Bombach, and Langade proposes six so-called building blocks helping to render the discipline more agile and lean (Bente, Bombach and Langade, 2012). Benefiting from examined sources paired with their professional experience, Bente et al. describe how to streamline the architecture processes, setup an agile EA project,

and foster collaboration and participation. Even though their explanations are backed by several fictitious examples, no quantitative results are provided that would prove the adoption of agile practices in EA management.

To respond to the problems often encountered in EA management, Shirazi et al. propose a framework rendering the discipline more agile (Shirazi and Rouhani, 2009). Named Agile Enterprise Architecture Framework (AEAF), the artifact consists of seven models and eleven interactions both based on agile principles and values. Even if the authors do not indicate any relations, the five viewpoints and six project aspects also included in AEAF resemble the Zachman framework (Zachman, 1987).

Although AEAF touches on several agile aspects like regular feedback or focus on cooperation, the research group's paper neither proves the empirical relevance of an agile EA management nor it validate the framework work in practice.

Rooted in lean principles, information technology architectures, and systems engineering methods, Comm and Mathaisel propose the Lean Enterprise Architecture (LEA), a three-phase structure to organize the activities for the transformation of the enterprise to agility (Comm and Mathaisel, 2010). The researchers combine their framework with concepts from the Lean Enterprise Transformation Engineering while also incorporating lean principles and practices in the resulting process. However, their work does not detail on these principles or explains how an agile enterprise should evolve its EA.

As one of the most popular approaches, The Open Group Architecture Framework (TOGAF) 9.1 does not explicitly recommend to manage an EA in an agile style (The Open Group, 2011). In turn, a more agile organization is considered as a surplus brought along by a "good" enterprise architecture. Notwithstanding, with concepts like iterations to develop a comprehensive architecture landscape and architecture, to manage changes to the organization's architecture capability, as well as appropriate stakeholder management the EA framework TOGAF promotes important agile principles.

The striving for agile principles and values enhancing the efficiency of EA management is mainly found in practitioners' circles. While only a small number of experts emphasize the misfit of both disciplines, e.g. (Nicholette, 2007), the majority of industry authors consider agile means as being well suited for EA management (Banerjee, 2011). As of January 2014, few academic publications and frameworks embrace or even mention to apply an
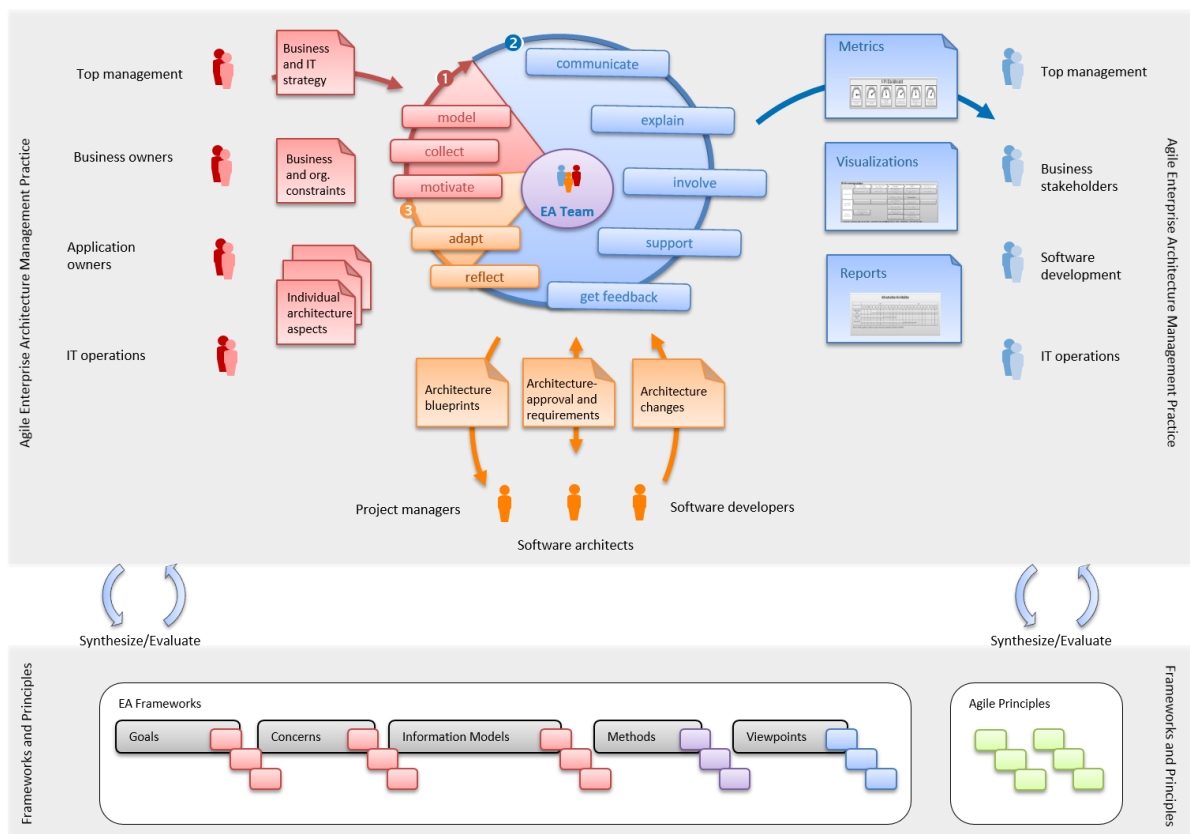
Figure 2: Design of an organization-specific agile EA management practice based on theoretical concepts often found in current EA frameworks which are extended by agile principles, cf. (Roth et al. 2014).

agile management means for EAs. Studied sources are very new, indicating that the mind-set of an agile EA management is still nascent. No contribution was found that investigated on the current status quo of agile practices in industry.

3. APPLYING AGILE SOFTWARE DEVELOPMENT PRINCIPLES TO ENTERPRISE ARCHITECTURE

The application of agile software development principles to EA is illustrated in Figure 2. The lower part of the figure shows the framework and agile principles that are synthesized and constantly evaluated to design an organization-specific EA management function. In the following, we illustrate the application of these principles for EA management.

When focusing on the working style applied for managing EAs, the Agile Manifesto recommends an early and constant delivery of results while maintaining a responsive attitude with regards to

changing requirements (Beck, Beedle, Bennekum, Cockburn, Cunningham, Fowler and Grenning, 2001), (Cohn, 2005). Translated into an EA management context, enterprise architects should strive to ship their deliverables as early as possible, pursue an incremental and iterative approach, and embrace changes regarding their working style and results. Similar to their software developing counterparts, an EA management team should always take care of the most important tasks first with a valuation of time over completeness and quality (Stal, 2012).

As goes the Agile Manifesto (Beck, Beedle, Bennekum, Cockburn, Cunningham, Fowler and Grenning, 2001), an EA management team should advance in a constant pace trying to avoid overtime while having enough leeway for reflections and retrospectives. Speaking of flexibility, agile literature recommends a modus operandi where members are allowed to experiment and try out new things (Coldewey, 2012). In conforming to the pull-principle (Gloger, 2010) as well as the one-piece flow (Fisher, 2000), the EA management team should create deliverables only upon stakeholders' demand

within an environment with little or no distraction and interference during the work (Schwaber, 2004). On the other side of the spectrum, stakeholders should be eager to give regular feedback (Ross, Weill and Robertson, 2006) on the results delivered through the EA management team. However, the latter should be incorporated into the work of the team.

In the sense of working software and simplicity (Beck, Beedle, Bennekum, Cockburn, Cunningham, Fowler and Grenning, 2001), (Highsmith and Cockburn, 2001), EA management results should be as usable, simple, and accessible as possible for EA management stakeholders. Benefiting from each individual deliverable the EA management team releases, stakeholders should be satisfied with the outcome and value the EA management team creates. As called for in agile literature (Highsmith, 2002), (Gloger, 2010), EA management results should be of the highest quality, crafted in a way that they only respond to the stakeholders' demand with a level of done that is understood and agreed upon.

Centering on the actors performing the work, agile sources emphasize a cross-organizational team whose members are specialized to perform various tasks (Gloger, 2010) in a self-organized manner (Beck, Beedle, Bennekum, Cockburn, Cunningham, Fowler and Grenning, 2001). From an educational perspective (Coldewey, 2012), the EA management team members should have special skills and training in multiple organizational areas (e.g., infrastructure, processes, application) while being capable to manage the sequence order their tasks are eventually completed.

Both, high education and expertise permit the team to speak the same language as stakeholders and information providers on a daily basis. In line with the fifth agile principles (Beck, Beedle, Bennekum, Cockburn, Cunningham, Fowler and Grenning, 2001), the EA management team leader has to create a positive work environment while catering to the team's self-organization. Besides an intrinsic motivation (Beck, Beedle, Bennekum, Cockburn, Cunningham, Fowler and Grenning, 2001), and work satisfaction, each EA management team member should have a notion of his/her colleagues' duties and results. Looking on the overall organizational structure (Fisher, 2000), EAM tasks should be accomplished through small sub-teams in which roles and responsibilities are clearly defined and understood. Finally, the team requires strong diplomacy and negotiation skills employed when interacting with stakeholders and EA information providers.

4. RESEARCH QUESTIONS, SURVEY DESIGN, AND EMPIRICAL BASIS

In above outlined literature the application of agile principles for EA management has been widely suggested by authors in the community. However, to date neither a comprehensive list of practical applied agile principles in EA management is published nor an empirical validation thereof exists.

Since in many cases EA management is initially promoted through IT (Hauder, Roth, Matthes and Schulz, 2013) which adopts agile principles more or less eagerly, we formulate the first research question as follows:

Research Question 1: What are frequently applied agile principles for EA management in practice?

Our second research question aims at validating observations, e.g. on the shift towards an incremental and iterative work fashion for certain EA management challenges. Not only this enhances the scoping during the launch of EA initiatives, incremental and iterative developed products might provide stakeholders with early results and, thus, lead to an increased buy-in.

Research Question 2: Which agile principles are used in enterprises for certain EA management challenges?

Typically EA management puts focus on a long term plan how organization should evolve, while agile practices promote the constant change of ongoing projects. Since both approaches appear contradictory at the first look, we formulate the third research question as follows:

Research Question 3: What are challenges for the design of an organization-specific agile EA management practice?

To evaluate these three questions on an empirical basis, we compiled an online questionnaire using 3-point Likert scale questions. The contained questions were based on the collection of agile principles we explained above. To optimize the questionnaire's design, we conducted a pre-test with three independent non-related researchers who were requested to complete our survey.
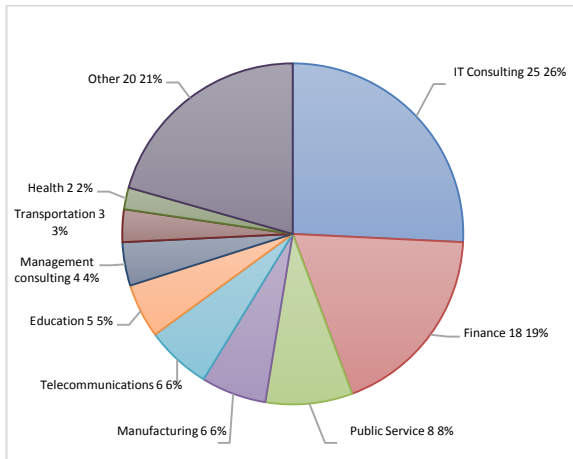
Figure 3: Industry sector of organizations (n and %)

The final version of the questionnaire was available for 21 days. To receive relevant information we targeted participants working in EA management or related fields. Using e-mail, we sent over 1100 survey invitations to industry experts we collaborated with during the last 8 years.
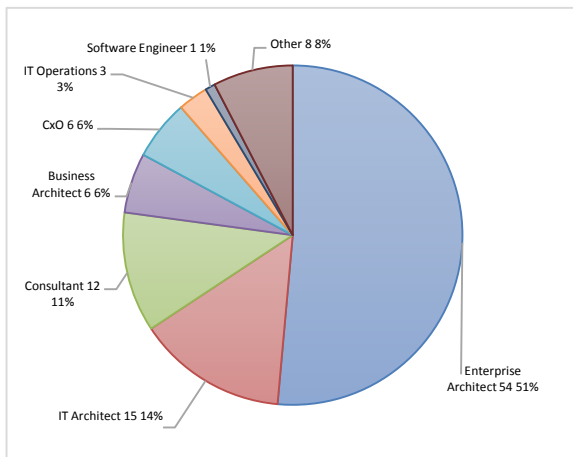

Figure 4: Job titles of participants (n and %)

In addition, the survey has been published in the two online forums Xing and LinkedIn, announcing them as topics related to EA or strategic IT management. We received input from 178 survey participants, filtered duplicate answers, and ended up with 105 completed answers for the evaluation, i.e. a dropout quote of ~41%.

As the survey was conducted primarily in Germany, 61 (~58%) participants are employed in Europe. 18 (~17%) work in the USA and 26 (~25%) are employed in other countries having less than 10 responding participants. Figure 3 illustrates the

distribution of the industry sectors of the participating organizations. IT consulting is the largest sector, whereas all consultancies were requested to answer on behalf of one particular EA management engagement. IT consulting is followed by the Finance and Public sectors.

Figure 4 depicts the participants of the online survey divided by job title. The largest groups consist of Enterprise Architects followed by IT Architects and Consultants. Among the participants are also Business Architects and members of the management board. In average, questioned organizations have an experience of 5 years in EA management.

5. AGILE PRINCIPLES FOR ENTERPRISE ARCHITECTURE MANAGEMENT IN PRACTICE

In the following three subsections the research questions are evaluated based on our empirical data set. The second research question is evaluated by applying the Pearson's chi-square test to validate the dimensions in our data set.

5.1 Application of Agile Principles

The first research question deals with the application of agile principles for EA management in practice. Figure 5 illustrates the practical adoption of agile principles in EA management ordered by frequency. As depicted, organizations adhere to agile principles with a different degree of intensity, confirming our assumption that the applicability of agile principles varies for EA management. For instance, while most organizations perform retrospectives within their EA management team, only few value time over quality. Most EA management initiatives apply an iterative (~79%) and incremental (~87%) approach. About 93% of the organizations apply EA management in a self-organized manner. Moreover, ~75% say that they act cross-functionally.

While the overwhelming majority of organizations apply several agile principles for the introduction and operation of their EA management initiatives in practice, some principles are less frequently traceable. In particular some of these less frequent agile principles are related with the quality and completeness of the developed EA products.

Only ~42% of the participating organizations apply time over completeness and only ~25% rate time over quality for the developed EA products.

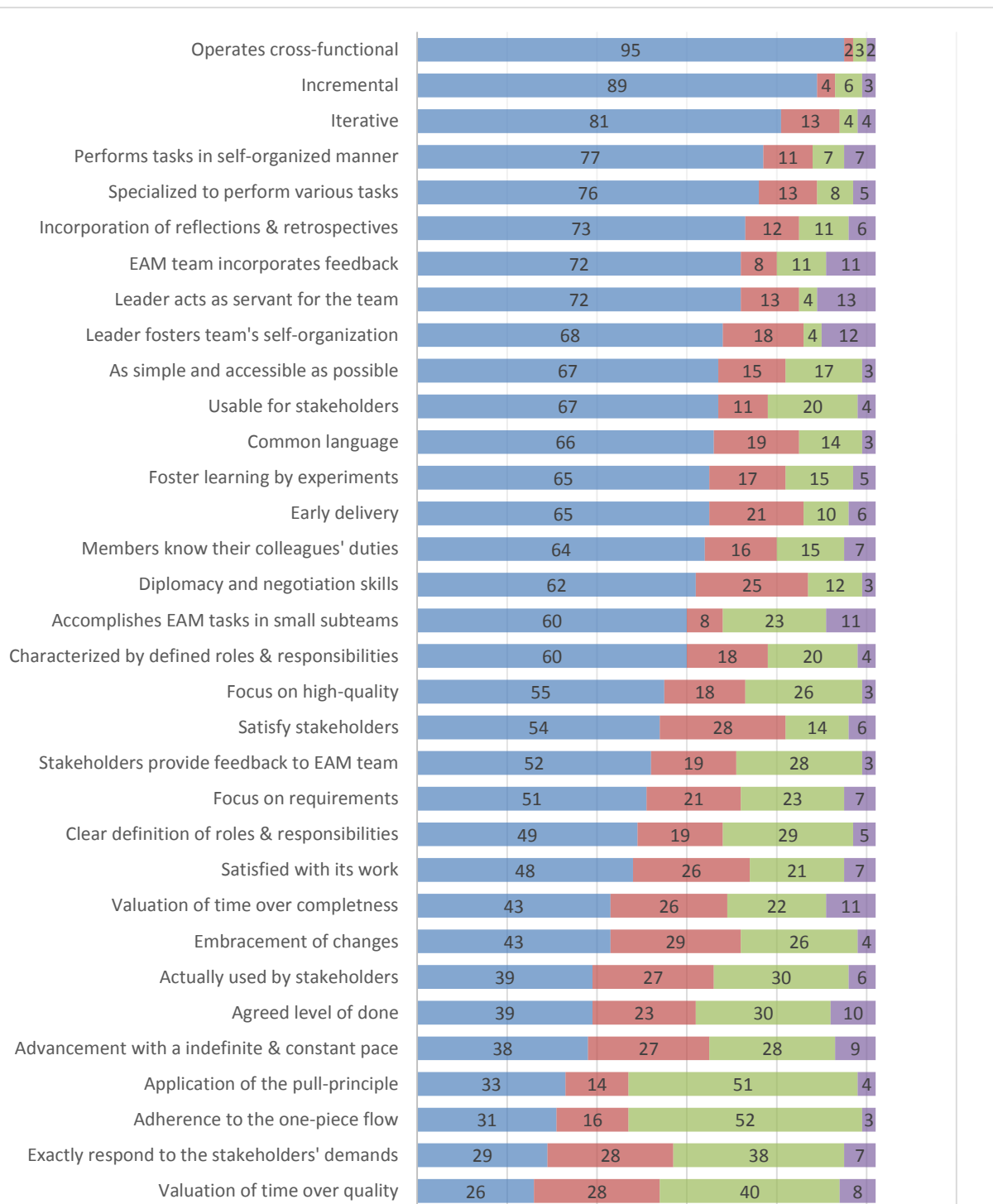| Principle				
Operates cross-functional	95	2	3	2
Incremental	89	4	6	3
Iterative	81	13	4	4
Performs tasks in self-organized manner	77	11	7	7
Specialized to perform various tasks	76	13	8	5
Incorporation of reflections & retrospectives	73	12	11	6
EAM team incorporates feedback	72	8	11	11
Leader acts as servant for the team	72	13	4	13
Leader fosters team's self-organization	68	18	4	12
As simple and accessible as possible	67	15	17	3
Usable for stakeholders	67	11	20	4
Common language	66	19	14	3
Foster learning by experiments	65	17	15	5
Early delivery	65	21	10	6
Members know their colleagues' duties	64	16	15	7
Diplomacy and negotiation skills	62	25	12	3
Accomplishes EAM tasks in small subteams	60	8	23	11
Characterized by defined roles & responsibilities	60	18	20	4
Focus on high-quality	55	18	26	3
Satisfy stakeholders	54	28	14	6
Stakeholders provide feedback to EAM team	52	19	28	3
Focus on requirements	51	21	23	7
Clear definition of roles & responsibilities	49	19	29	5
Satisfied with its work	48	26	21	7
Valuation of time over completness	43	26	22	11
Embracement of changes	43	29	26	4
Actually used by stakeholders	39	27	30	6
Agreed level of done	39	23	30	10
Advancement with a indefinite & constant pace	38	27	28	9
Application of the pull-principle	33	14	51	4
Adherence to the one-piece flow	31	16	52	3
Exactly respond to the stakeholders' demands	29	28	38	7
Valuation of time over quality	26	28	40	8

Figure 5: Applied agile principles for EA management in practice (n=105)

Next to agile principles related to quality and completeness of the developed EA products, actual stakeholder demands and utilization of the produced EA products by these stakeholders are only applied by the minority of the organizations in our dataset. With ~38% only a small number organizations are truly concerned whether these EA products are actually used by stakeholders.

5.2 Agile Principles and Enterprise Architecture Challenges

We answer the second research question by correlating EA management challenges from our empirical basis (cf. Hauder, Roth, Matthes and Schulz, 2013) with the agile principles illustrated in Figure 5. Due to space limitations, we only illustrate the statistical correlations for three major EA management challenges with agile principles using Pearson's chi-square test.

The challenge late valuation of EA management through stakeholders appears in ~51% of the participating organizations. According to our statistical test these organizations apply the principle adherence to one-piece flow with $p = .047$ ($p \leq .05$). In addition, the principle focus on requirements resulted in a goodness of fit test of $p = .00004$ ($p \leq .05$). Further agile principles that correlate with this challenge are advancement with an indefinite & constant pace $p = .002$ ($p \leq .05$), stakeholders provide feedback to EA management team $p = .0002$ ($p \leq .05$), agreed level of done $p = .009$ ($p \leq .05$), useable for stakeholders $p = .042$ ($p \leq .05$), and as simple and accessible as possible $p = .005$ ($p \leq .05$). All other agile principles were not statistically dependent on this challenge for the given relevance.

Around ~38% of the organizations are struggling with outdated EA results. This means that architecture descriptions are often outdated before they are complete and often understood as a project rather than a continuous process. The agile principles characterized by defined roles & responsibilities correlates with $p = .004$ ($p \leq .05$), members knows their colleagues' duties with $p = .0001$ ($p \leq .05$), focus on high quality $p = .005$ ($p \leq .05$), satisfied with its work $p = .001$ ($p \leq .05$), adherence to one-piece flow $p = .00001$ ($p \leq .05$), incorporation of reflections & retrospectives $p = .001$ ($p \leq .05$), agreed level of done $p = .0001$ ($p \leq .05$), and usable for stakeholders $p = .001$ ($p \leq .05$).

Reluctant information providers are a challenge for ~65% of the organizations. This is a very critical problem since enterprise architects heavily rely on the information and knowledge provided by stakeholders. The agile principle satisfied with its work correlates with $p = .043$ ($p \leq .05$), focus on requirements $p = .00001$ ($p \leq .05$), application of the pull principle $p = .009$ ($p \leq .05$), embracement of changes $p = .030$ ($p \leq .05$), valuation of time over quality $p = .004$ ($p \leq .05$), as simple and accessible as possible $p = .00001$ ($p \leq .05$), and exactly respond to stakeholders' demand $p = .003$ ($p \leq .05$) correlate with this challenge.

5.3 Designing an Agile Enterprise Architecture Management Practice

Designing an agile EA management practice is a challenging issue. While EA management frameworks typically work towards a long range vision of the organization or a business case, agile practices incorporate findings from ongoing projects immediately in the process. To put it in another way, both approaches appear contradictory due to their top-down and planning (EA management) respectively bottom-up and emergent course of action.

Regarding the challenges EA management initiatives in organizations are faced with neither of these approaches can solve all challenges on his own. Integrating both approaches within one agile EA management practice that is tailored to the specific demand of the organizational context would be desirable. The findings presented in this paper provide an initial empirical basis for further research on an agile EA management practice. This compromises the development of agile EA management roles, activities, and deliverables.

6 CONCLUSIONS

In this paper we provided an empirical foundation for agile principles applied to EA management by today's organizations. Due to the survey design, the asked industry experts could only confirm or reject the application of an agile principle for EA management. Details about their actual implementation are yet to be revealed. As of today, this might be challenging, given the scarce literature on agile EA management and only the implicit adoption through EA frameworks. Regarding our survey results, a potential bias might originate from the lack of a common understanding on how to operationalize agile principles in EA management.

Further research could examine the impact of agile principles on the success and benefits of EA management initiatives. Thereby, the efforts should account for different organizational factors like the size of the business, structure, EA management experience, industry, and tool support. Further studies could also focus on the correlation (and later causalities) between challenges encountered in EA management and possible mitigation through agile principles.

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