Literature Review on the Role of Enterprise Architecture Management in Digital Transformation – EAM as driver and barrier of Digital Transformation

Seminar paper

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Abstract

The Enterprise Architecture Management (EAM) has its origins in the 1960s and is meanwhile a topic of high maturity. EAM aligns business and IT leads to high complexity and slow adaptions to changes. It grants a holistic overview and organization's strategy is part of EAM. More than 50 frameworks exist to support Enterprise Architects in their work of handling the complexity. In the last years, Digital Transformation affects more and more industries and organizations fight to stay competitive. Those changes affect IT landscapes, business and IT processes as well as business culture. As a result, complexity rises and the role of EAM needs to change.

The purpose of this literature review is to create an overview on EAM and its influence towards Digital Transformation. This includes three main-aspects of EAM regarding Digital Transformation: Barriers, drivers and new requirements from which organizations can benefit for their digital transformation.

Keywords: Enterprise Architecture Management; EAM, Digital Transformation; Enterprise Architecture Management Framework; IT management; IT governance; EAM requirements; Enterprise Architecture Management agile; EAM agile.

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1   Introduction

Digital Transformation (DT) affects organizations in almost every industry. New digital technologies arise and existing technologies become more powerful, which lays in context to Moore's Law. These technologies are mostly in SMACIT (Social, Mobile, Analytics, Cloud and IoT) areas. This results in new business models and competitors. Therefore, organizations must react and change their architectural infrastructure, management and organizational structure. DT is complex and not easy predictable. Organizations become more flexible and start to invest money to stay competitive (2015). Enterprise Architecture Management (EAM) enables organizations to control and guide their investments. It grants holistic overview, alignment of business and IT and supports managements in strategical decisions (2012).

EAM struggles with DT. Traditionally, EAM has high maturity and covers a broad range of organizational aspects with slow adaption processes. Organizations often see EAM as IT aspect, whereas DT is about whole organizations and industries. EAM is at a crossroad (2013). Only a few publications focus on the role of EAM in DT. Additionally, literature about approaches of EAM are mostly case studies or highly specific cases. This is regardless if the author's academical or practical background (2010).

In this literature review, I do a research on the role of Enterprise Architecture Management in Digital Transformation. My focus is on EAM as a barrier and driver of DT and my research questions are:

- Which aspects of EAM hinder organizations in their DT?

- Which aspects of EAM drive organizations in their DT?

- What are the requirements of successful EAM in DT?

I structured my literature review as followed: Firstly, I describe necessary background information in context to EAM. Secondly, I review literature and describe my reviewing process. Thirdly, I present my results followed by discussion of my findings. Fourthly, I provide a short conclusion in context to my research questions.

2   Background to Enterprise Architecture Management

To start with, I give a short overview on necessary background information regarding Enterprise Architecture Management (EAM). The concept of EAM splits up to Enterprise Architecture (EA) and Management (M).

EA describes the organizational structure of an organization (enterprise) linking business and IT. Business characteristics reach from the organizational aspects (e.g. organigrams) to business processes, while IT characteristics include technical aspects such as data and applications. Commonly, EA descriptions are in layers, which are a core principle of EA. They are necessary to be able to look at the EA from different granularities or focus different requirements of each layer. Artifacts are objects, regardless their granularity or context, in EA. Managing an organization's EA aims for ensuring a transparent model of EA for operational and strategic decisions (as-is). Operational EA reflects the status quo of an organization, whereas strategic EA also includes a future view on EA (to-be). Additionally, EA includes a roadmap of necessary changes to follow an organization's strategy and perform the transformation from status quo to ideal EA. To do so, EA must respect specific guidelines and principles.

Bringing EA and management together leads to EAM as a mechanism to get an overview of an organization's architecture by aligning business and IT. EAM is an IT-Governance aspect. Organizations improve their decision-making because of the operational and strategical orientation of EAM. Summarized, EAM enables organizations to improve transparency in terms of key processes and requirements. It creates vision of future architecture and developments as well as principles and guidelines for synergetic effects. As a result, organizations can reach better business performance with the help of EAM. It

needs an active management of status quo and strategic architecture to maintain its positive effects. (2012)

As mentioned before, EAM needs guidelines and principles to handle organizational complexity. These guidelines include recurring patterns, methods and designs, summed up as "framework". A framework uses a specific set of rules and patterns for related problems. Enterprise Architects reuse them to describe solutions to related problems. (1991) More than 50 relevant frameworks of EAM existed in 2011 and their number increases. This high amount of frameworks is due to the fact that frameworks must cover specific needs of the respective target groups and organizations. (2011)

3   Literature Review

My process to identify relevant literature is a three-step approach: Choosing relevant data sources (1), identifying keywords regarding my research questions (2) and selection of relevant literature (3).

(1) I started with IEEE Xplore, ResearchGate, Google Scholar and EBSCOhost as data sources. Since literature at EBSCOhost and Google Scholar is mostly not in context to DT or focusses specific approaches only, these results are not relevant for my research question. I excluded both databases from my following research.

(2) I used following keywords for my queries to search for relevant literature: "Enterprise Architecture Management" or "EAM" in combination (AND) with "Digital Transformation", "Transformation" or "agile". Additionally, I proceeded my search without the term "Management" in the first part of my search queries.

(3) In the last step, I identified relevant literature. To structure the results and identify whether literature is relevant or not, I funnelled my findings (s. figure 1). Firstly, I read title and keywords. Secondly, I reviewed abstracts. Thirdly, I took a deeper look on introduction as well as conclusions.
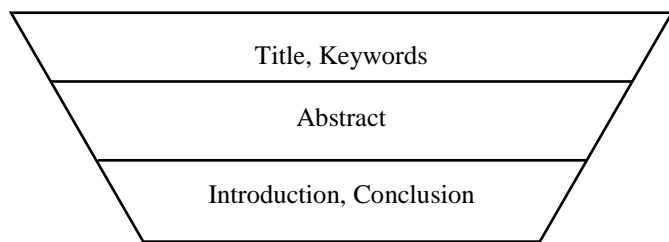

Title, Keywords

Abstract

Introduction, Conclusion

Figure 1.   Funnel for literature identification

ResearchGate and IEEE Xplore are the main source of my literature. Relevant results are mostly conference papers. My findings base on 23 different publications. I visualized the distribution of publication dates in figure 2. Researchers published most of the results over the past few years. I noticed the lack of publications about EAM in context to DT in my research process. This is similar to Buckl, Schweda and Matthes' literature review in 2010 (2010).
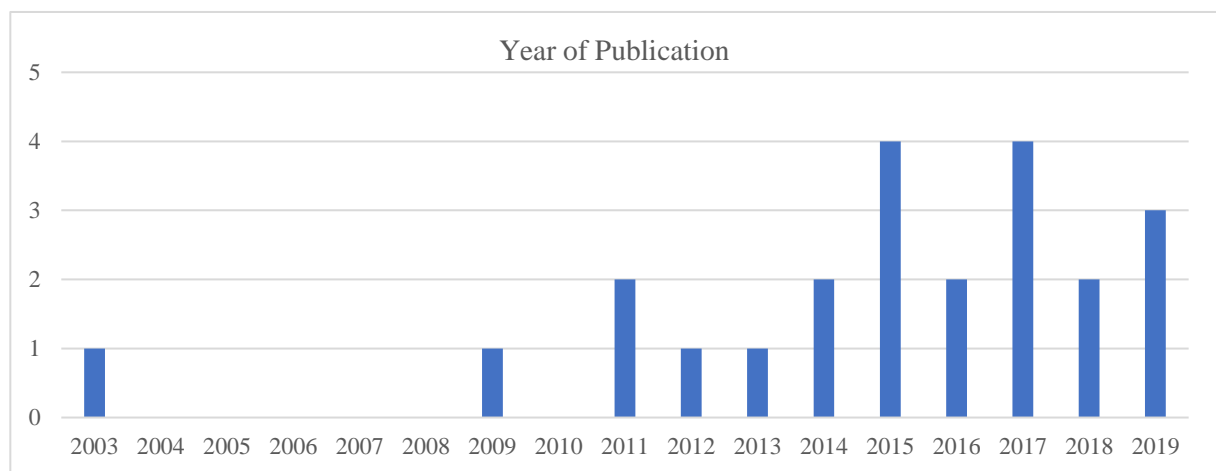

Figure 2.   Distribution of publication date

Unfortunately, ResearchGate does not provide statistical values in their results overview. In table 1, I listed my results at IEEE Xplore. I cleansed my overall results by removing duplicates and funnelled my results:

Search Term ("Enterprise Architecture Management" AND)	Overall results	Relevant results
"Digital Transformation"	2	1
"Transformation"	12	4
"agile"	5	4

Table 1.   Results of search-queries at IEEE Xplore

4   Findings and Results

Therefore, the concept of EAM has its origins in 1960s and is continuously developed (2016), hence, a broad selection of literature exists. Existing literature generally refers to basics of EAM, such as traditional frameworks, or practical implementations for specific kinds of organizations. Actual topics such as DT and agility are less common in literature. My focus is to review literature focussed on these topics.

I structured my findings within the literature in three different topics: *"Barriers"*, *"Drivers"* and *"Requirements of EAM in DT"* as shown in table 2. Afterwards, I aggregate these findings in sub-categories for each topic and explain them. To mention, the role of EAM in DT is often two-sided. Therefore, I start with barriers and continue with drivers. My last part is about requirements for organizations to benefit from EAM in DT to close gaps between DT-driven challenges and EAM, to handle recognized barriers as well as exploit drivers.

Literature		Barriers		Drivers		Requirements of EAM in DT	
Author	Year	Complexity	Organizational / management aspects	Scaling / handling complexity	Organizational / management aspects	Organizational and management transformation	New methods
BITKOM	(2011)			X			
Drews et al.	(2017)	X		X	X	X	X
Härting, Reichstein and Sandkuhl	(2019)	X			X	X	
Hartmann	(2017)	X		X			
Kamariotou and Kitsios	(2017)						
Khosroshahi, Hauder and Mattes	(2016)			X	X		
Kotusev, Singh and Storey	(2015)	X			X	X	
Pattij, van de Wetering and Kusters	(2019)				X	X	
Schilling	(2018)		X				
Schmidt et al.	(2015)			X	X		
Schulz et al.	(2014)		X		X		X

Shirazi, Rouhani and Shirazi	(2009)		X		X		X
Vries and van Rensburg	(2012)				X		
Wegmann	(2003)	X			X		
Wißotzki, Köpp and Stelzer	(2015)		X			X	
Zimmermann et al.	(2017)	X		X			X
Hanschke, Ernsting and Kuchen	(2015)	X					X
Buckl et al.	(2011)	X	X		X		X
Hauder et al.	(2014)	X					
Hess, Lautenbacher and Fehlner	(2013)	X					X
Nowakowski et al.	(2018)	X	X	X			
Aier et al.	(2016)		X	X	X	X	
Assar and Hafsi	(2019)		X		X	X	

Table 2.   Structured findings of literature research

4.1   Barriers

Literature points out variety of challenges and barriers of EAM in context to DT. I aggregate them in two main categories: *"Complexity of EAM"* (1) as well as *"organizational and management aspects"* (2). In the next parts, I point out key elements of each category.

(1) Complexity of EAM

Literature calls *"complexity of EAM"* as a very common barrier. Drews et al. (2017) researched on the complexity of traditional EAM. Traditionally, EAM's role is to plan, define and control an organization's architecture in a centralized approach. It aims to cover all relevant parts of an organization and has slow adaption cycles. Because of DT, business and IT aspects require high flexibility as well as high frequency of changes. Handling these aspects as well as their interrelation results in an increasing overall complexity of EAM. Kotusev, Singh and Storey (2015) also compared a traditional approach of EAM with other approaches and got similar results. Their findings highlight a top-down approach of traditional EAM, which is highly detailed and inflexible. Successful implementations of traditional EAM demands an extensive upfront planning. Härting, Reichstein and Sandkuhl (2019) have similar findings. They emphasize traditional and very common EAM frameworks like TOGAF and COBIT (rather IT-Governance tool than framework), but also ESARC as IoT-specialized framework, as complex and expensive. Especially for small and medium sized organizations, complexity and costs are often too high. In addition, Hartmann (2017) mentions an increasing complexity of IT because of digital transformation processes. Furthermore, he recognized gaps between agile software development methods and EAM, which is supported by Nowakowski (2018), too. The rising complexity is also named by Zimmermann (2017) regarding microservices. They are a common solution to develop customer-centred services. Microservices are often not complex, but their rising number as well as their interdependencies increase an organization's overall complexity. For Hess, Lautenbacher and Fehlner (2013) complexity correlates with redundancy. Several project-teams work within an organization simultaneously, e.g. development of microservices. Dependencies between existing and new developed artifacts may focus on same specific objects of an EA that might results in redundancy. High amount of coordination is necessary to avoid such barriers. Even in 2003 Wegmann (2003) highlights complexity of EAM frameworks as a barrier, although DT proceeded not as fast as nowadays.

Since 2003, frameworks got reworks, but a steep learning curve and high complexity still exists. In context to commonly used frameworks, Hauder et al. (2014) mention generic, extensive and not self-explainable descriptions as reason for high complexity of EAM frameworks. This aspect hinders DT.

For example, they see fault with TOGAF, which is one of the most used EAM frameworks. Buckl et al (2011) refer to these findings. They draw a conclusion, that TOGAF 9, which is the actual version, does not support methods to handle complexity of organizations caused by DT. Although, TOGAF includes a method of incremental and iterative cycles, which is an important part of agile methods used in DT processes, it lacks timings and continuous processes for adapting an EA. A similar conclusion is from Hanschke, Ernsting and Kuchen (2015) regarding TOGAF: It supports iterative cycles, but the framework itself is not developed for an agile usage. Organizations tend to structure their IT departments amongst other things for agile software development. Therefore, if organizations want to use common EAM frameworks, like TOGAF, as specified, they have to work with them in less agile approaches, which is in contrast to their normal way of working. Therefore, a rise of complexity results by different ways of working within organizations. This is also in context to the next aspect of barriers.

(2) Organizational and management aspects

"Organizational and management aspects" is another aspect of EAM hindering DT, as Nowakowski et al. (2018) aggregate from interviews. IT is a stand-alone department and separated from operating departments at historically grown organizations. Therefore, IT departments manage EA and must communicate with operating departments. Buckl et al. (2011) refer to EAM as stand-alone solution for IT only. EA models will bloat up and hinder an organization's DT, if there is neither communication nor coordination between stakeholders. Similar results are conducted by research of Assar and Hafsi (2019). In many organizations, EAM only affects IT, whereas DT affects a whole organization. Additionally, EAM has its weaknesses in psychological aspects. On the one hand, this results in neglecting or not anticipating positive aspects of EAM regarding DT. On the other hand, EAM has limitations regarding an organization's overall strategy because of its focus on IT. A similar aspect noticed Aier et al. (2016). They realized missing acceptance of EAM in organizations. Additionally, stakeholders often see EAM as overhead caused by IT. Wißotzki, Köpp and Stelzer (2015) highlight poor communication and missing responsibilities in their publication. They conducted a research on role concepts of EAM in which they reviewed EAM frameworks and its specific literature. Only 7 out of 33 frameworks of their study include a role concept. The consequence is missing communication and institutionalization of EAM in organizations.

Schulz et al. (2014) did a literature review, followed by a qualitative research. They interviewed EAM stakeholders in organizations and identified three main challenges: 65% see reluctant information provider as challenge, 51% see challenges regarding late valuation of EA management through stakeholders and 38% have to face outdated results. Shirazi, Rouhani and Shirazi (2009) also identified several challenges in this context. They brought these challenges together under the term of focussing processes and tools rather than individuals and interactions, which is in contrast to the agile manifesto. Schilling (2018) validates the need of dynamic approaches. His research about the dynamic nature of EA recognized a focus of publications on static views of EAM, which do not support practical experiences. Furthermore, the research worked out five theories about an EAM's dynamic and the need for considering them in EAM.

4.2   Drivers

I identified two major categories regarding EAM and its frameworks as driver of DT: *"Scaling and handling of complexity"* (1) and *"organizational and management aspects"* (2). Following, I grant a structured insight for each aspect.

(1) Scaling and handling of complexity

Although, I mentioned "complexity" of EAM and its frameworks as barrier in previous paragraphs, it also enables *"scaling and handling of complexity"* of organizations. I start with the same publication as in the part before: Drews et al. (2017) compares "traditional EAM" and "fast IT EAM". Unlike traditional approaches, fast approaches fulfil a supportive and consulting role in a decentral manner. By doing so, organizations stay on the most actual status of their EA. Project teams within an organization

are committed to update their changes. This commitment leads to a self-reportable EA and a better overview. Reduction of coordination effort is another result. EAM also shifts from traditional approaches to modern ones as a consequence of DT and change management processes as recognized by Khosroshahi, Hause and Matthes (2016). Their publication focusses on EAM patterns, which are templates of best practices and solutions to common problems. They developed the EAM pattern catalogue (EAMPC) that is an overview of EAM methods created by the chair for Software Engineering for Business Information Systems (sebis) at TU Munich in 2008. They updated EAMPC in 2015 to support organizations in business environments. Their publication highlights differences between EAMPC2008 and EAMPC2015. Enterprise architects focussed on operational aspects of EAM in 2008. Therefore, they needed a wide range of methods, as included in EAMPC2008. In contrast, EAMPC2015 covers the shift of EAM from operating requirements to strategical ones as well as optimization aspects. EAMPC2015 reduced the amount of operational methods from 20 to three and added nine strategical methods, leading to 12 methods at all. Additionally, EAMPC2015 reduced the number of viewpoints, which are visualizations of an organization's status, and allocated them in one overview. Considering this process, EAM enables organizations to handle their rising complexity and align it to their business needs as well as strategy. Modern EAM focusses on a holistic and strategical overview of an organization rather than a detailed and operational one.

Aier et al. (2016) mention EAM as a provider of holistic overviews and, therefore, a reduction of organizational complexity. They show three dimensions of the term holistic: Covering the entirety, dependencies and life cycles of EA artifacts. Therefore, EAM is a driver for organizations to detect synergy effects, exploit synergy effects and provide transparency as well as coordination for business transformation. Therefore, reduction of complexity, as mentioned before, leads to a better business and IT alignment. Hartmann (2017) adds that organizations must not focus single applications or aritfacts. It is important to see an organization as holistic and EAM is a suitable approach. Nowakowski et al. (2018) highlight, if organizations bypass problems in their communication between IT and operational departments, a holistic overview is available. An empirical research was conducted by Schmidt et al. (2015). Their qualitative research includes a survey with 126 IT-experts and analysed their answers. The conclusion of their survey revealed a positive link between IT complexity and perceived benefits of EAM. Further, hypothesis discovered a positive correlation of EAM benefits and handling of complexity confirmed.

Zimmermann et al. (2017) expand traditional EA by taking digital architectures into consideration. Business and IT requirements change constantly and digital architectures are suitable to face rising complexity caused by DT. They allow new kind of technological services that speed up transformations of goods and services. Additionally, they include support for IoT, mobile devices or microservices.

(2) Organizational and management aspects

The findings I mentioned before lead to the conclusion of more agile and less heavy EAM approaches to handle complexity. Agility is an *"organizational and management aspect"*. Drews et al. (2017) explains the driving role of fast IT EAM with high customer-focus. Organizations develop new services with the need of continuous improvements. Organizations start to establish fast (agile) IT business areas additionally to existing structures to cover this needs. This results in bimodal IT. Organizations do not adapt their EAM in connection with their organizational changes consequently, although several benefits of agile EAM exists to support DT. The awareness of this topic increases and recent literature covers it, but even some older publication mention the importance of agile or dynamic approaches as done by Wegmann (2003) and his Systematic Enterprise Architecture Methodology (SEAM). He did not call his methodology agile by name, but mentioned attributes that match with agile characteristics. One of SEAM's main characteristic is an iterative implementation as used in Scrum. A main factor of complex organizations is a continuous change process. By implementing EAM in this way, organizations are able to handle their complexity. Shirazi, Rouhani and Shirazi (2009) is one of the first publications that addresses driving aspects of agile EAM based on the Agile Manifesto. Buckl et al. (2011) published also an early research of EAM in context to agile methods like Scrum. Both researches highlight agile meth-

odologies to handle complexity of organizations and EAM. Scrum principles based on the Agile Manifesto allow addressing organizational as well as structural barriers and include continuous changing requirements. A survey conducted by Schulz et al. (2014) highlights benefits of agile methods in EAM to address challenges I mentioned in the previous part. Therefore, agile EAM supports organizations is a driver for DT. Kotusev, Singh and Storey (2015) received a similar result. DT requires fast, flexible processes and change management to keep up with new requirements. Flexible and lightweight EAM approaches, which include agile methods, are driving these requirements.

Pattij et al. (2019) conducted one of a few empirical researches. They did a two-sided construct: Firstly, they researched on direct effect of EAM towards organizational agility. Secondly, they included IT capabilities as mediator. IT capabilities consist of IT infrastructure and IT human skills. 481 EAM stakeholders participated on their survey. EAM has moderate direct effect on organizational agility, whereas IT capabilities as mediator leads to a positive, strong and significant effect. Thus, EAM standardizes IT infrastructure and reduce complexity. It also aligns IT stakeholders, which results in better acceptance of EAM in organizations. Both aspects drive organizational agility, which is a key component of successful DT.

Vries and van Rensburg (2012) identified EA as a strategy approach in context to IT-Governance. Instead of focussing ROI and cost reduction on operational level, EA creates value by supporting strategical decisions on management level. Generally, it is one of EAM's core principles to align business and IT as well as granting a roadmap from as-is EAs towards to-be EAs. Khodroshahi, Hauder and Matthes (2016) considered business and IT alignment in EAMPC2015 by adding strategical methods. Enabling a precise roadmap for an organization's DT is a driving EAM aspect, too. Assar and Hafsi (2019) researched on management strategy support through EAM. Explicit implemented artifacts within EAs can support DT with low effort, but compound and superordinate artifacts require high effort because of necessary aggregation, analysis or interpretation of them. Especially in context to IT-requirements, EAM is a driver of DT and provides holistic and precise information.

Härting, Reichstein and Sandkuhl (2019) conducted an empirical research. They developed determinants to measure benefits of EAM in context to DT. Their research is partially based on Schmidt et al. (2015) and restructured some of their hypothesis. Their research validated six determinants, with two of them being moderating variables and four of them being hypothesis. Hypothesis 1 "Business environment", which focusses on external aspects such as dynamic business requirements or technology, implicates DT aspects. They also positively validated their other hypothesis "organized IT-landscape", "structured internal business" and "EAM establishment". Well-managed EAs with high transparency lead to stronger business and IT strategy vision as well as more effective business processes. This results in better business and IT alignment, which is required for a successful DT.

4.3 Requirements of EAM in Digital Transformation

In the previous part, I displayed my findings of EAM as barrier as well as driver regarding DT. Additionally, literature states several *"requirements of EAM in DT"* to close existing gaps in order to face barriers and exploit drivers. I identified two categories of requirements: *"Organizational and management transformation"* (1) and "*new methods"* (2).

(1) Organizational and management transformation

DT has *"organizational and management transformation"* as consequence. Drews et al. (2017) state these transformations in context of automation and development of customer-centric digital services. To cover these new requirements, organizations change their way of working to more agile and interdisciplinary approaches. Legacy systems cannot change as fast as new or restructured business units, which leads to bimodal IT. EAM often focusses legacy systems due to its complexity and maturity. Organizations can establish additional fast IT EAM to avoid dichotomy between legacy systems and new business systems. Whereas fast IT EAM focusses on a supportive or consulting role for project teams to cover

customer-needs, traditional EAM stays relevant for overall strategy on an organization-wide level. Kotusev, Singh and Storey (2015) also consider a consolidated view of traditional and agile approaches, such as MIT as a compromise between heavyweight and lightweight and DYI as a lightweight approach. MIT and DYI enable organizations to cover their agile needs. Organizations must select relevant approaches by considering indicators and determinants in relation to their transformational needs of organizational structure.

Härting, Reichstein and Sandkuhl (2019) focussed on benefits of EAM in DT. Additionally to determinants, I mentioned in the chapter before, they introduced firm size and industry complexity as moderating variables. Both influence a linkage between business environment, IT landscape, internal business and EAM establishment towards EAM's benefits positively. The more complex an industry and the bigger a firm is, the better are the benefits of EAM. Therefore, organizations must see EAM as a method to support handlings of DT processes by transparency, reduction of coordination and complexity as well as a holistic overview. Pattij et al. (2019) see institutionalization of EAM as a requirement. Organizations must get their stakeholder involved to enable IT capabilities as mediator for EAM towards organizational agility. Aier et al. (2016) analysed a case of EAM in an organization over a period of 20 years. They set EAM's role up to its support of business transformation. Their analysis led to four principles, which an organization must ensure to enable EAM as a driver of DT: Firstly, Norms and values must be consistent organization-wide to enable transparency and guidance. Secondly, EAM should reinvent instead of mature. In contrast to the first principle, EAM's focus is to grant an overall strategy and guidelines. If an organization reinvents its EA, it can react fast to new requirements of DT. Thirdly, EAM must consistently analyse its projects by importance and potential success to select relevant projects or strategies. Fourthly, transformational processes require holistic perspectives. This enables organizations to make decisions on centralized as well as aggregated information. Altogether, EAM must be a fundamental part of an organization and fully respected by its stakeholders to be a driving part of DT. Assar and Hafsi (2019) proceed on the stakeholder's point of view. I stated their findings in the previous chapter, which are EAM's driving role of DT regarding internal IT viewpoints, but hindering role of DT in context to psychological, complex and external viewpoints. Managements need to change their approach of one-solution-fits-all and merge several methods or disciplines. In their opinion, EAM's role is the underlying base for internal aspects, such as alignment of business processes and IT. Transparency within internal aspects enables better strategic decisions. EAM guides strategical realizations with roadmaps.

Wißotzki, Köpp and Stelzer (2015) extend the perspective on selection criteria of EAM approaches. They include role concepts and responsibilities, which EAM lacks. While DT proceeds, organizations change business processes and organizational structures. Therefore, responsibilities also change. To maintain EAM's benefits, organizations have to assign roles with clear responsibilities. In the selection process, they must consider necessary skills and qualifications. Due to EAM's complexity, assigned responsibilities must not change fluently.

(2) New methods

Frameworks are guidelines of EAM and DT caused new requirements for EAM frameworks. To handle them, organizations reworked traditional frameworks and created new frameworks as well. DT requires new and existing frameworks to rely on *"new methods"* such as Agile Manifesto to cover new organizational needs.

In the group of reworked frameworks, literature states TOGAF as dominant. The dominance is shown by BITKOM (2011). They published a guide about EAM as a holistic discipline for organizational transformation, which focusses on TOGAF only. The reason for TOGAF's dominance bases on its initial development as collection of best practices and continuous adaption to new requirements. This enables a broad range of organizations to use it for their specific needs. Hanschke, Ernsting and Kuchen (2015) researched about integration of Scrum and TOGAF 9. The framework is modular and, therefore, enterprise architects can use single parts of it in other solutions. TOGAF's Architecture Development Method (ADM) is fundamental for the process of creating new artifacts in TOGAF and all other parts build up

around ADM. It is incremental and covers architectural development from artifacts in high-level or detail-level. Therefore, ADM is close to Scrum principles, but does not cover it fully. Huge differences are top-down implementations (TOGAF) in contrast to bottom-up (Scrum) ones as well as long-term/strategical alignment (TOGAF) in contrast to short-term/project-level (Scrum) focus. Organizations need to adapt TOGAF based on their agile methods and ensure cooperation between enterprise architects and operating teams. To mention, respective agile methods cannot cover needs of TOGAF fully and, therefore, TOGAF must adapt to them. Altogether, TOGAF grants a basis for agile methods in EAM. Their findings extended the research of Buckl et al. (2011). While they only map Scrum to TOGAF's counterparts, it is necessary to adapt TOGAF to ensure coordination as well as respecting needs of different stakeholders. A slightly different approach regarding TOGAF is from Hess, Lautenbacher and Fehlner (2013). They point out business building blocks (BBB) to support transformational processes. The function of BBB is to present objects in direct linkage to an organization's value chain. Their aim is an increase of transparency by assigning responsibilities for specific business artifacts. Therefore, BBBs are part of EAM's business architecture. Further approaches of existing frameworks are not as viable or extendable as TOGAF or created for highly specific use cases.

ESARC (Enterprise Service Architecture Cube) is a framework proposed by Zimmerman et al. based on digital architectures (2017). New business models and micro-structured sub-systems are results of DT processes. Organizations use digital architectures to cover the needs. ESARC is a framework designed for digital architectures and supports organizations in their EAM in this specific use case.

Another agile framework is Scaled Agile Framework (SAFe). Drews et al. (2017) describe SAFe as framework with an focus on IT and IT vision. SAFe works as a guide for agile project-teams to align their projects with an organization's technical basis and roadmap. It has synergy effects with DevOps and, therefore, supports continuous, fast and incremental creation of value (e.g. for customers).

To support an organization's transformational needs, some more frameworks exist, but are not further explained: Agile Enterprise Architecture Framework (AEAF) was introduced by Shirazi, Rouhani and Shirazi (2009). As the name says, AEAF implements agile methods and attempts to support organizations. It provides dynamic structures to cover changing requirements. Schulz et al. (2014) criticize AEAF for no empirical background and missing validation. They also mention Lean Enterprise Architecture (LEA) as framework to enable agility in organizations. LEA lacks detailed principles and descriptions. Their research also states missing validation of LEA.

5   Discussion

In my research, I analysed the role of EAM as barrier and driver of DT in organizations. Literature and scientists present the role of EAM in DT commonly. They see barriers, such as complexity of EAM and changing organizational / management aspects. They mention drivers, such as handling of complexity and organizational / management aspects. Furthermore, they highlight requirements for EAM in DT indirectly.

Based on my findings, I visualized dependencies and connections between EAM, organizations and DT in figure 3. In the parts before, I showed barriers, drivers and requirements of EAM in DT. Now I transpose my findings for orientation on organizational needs.
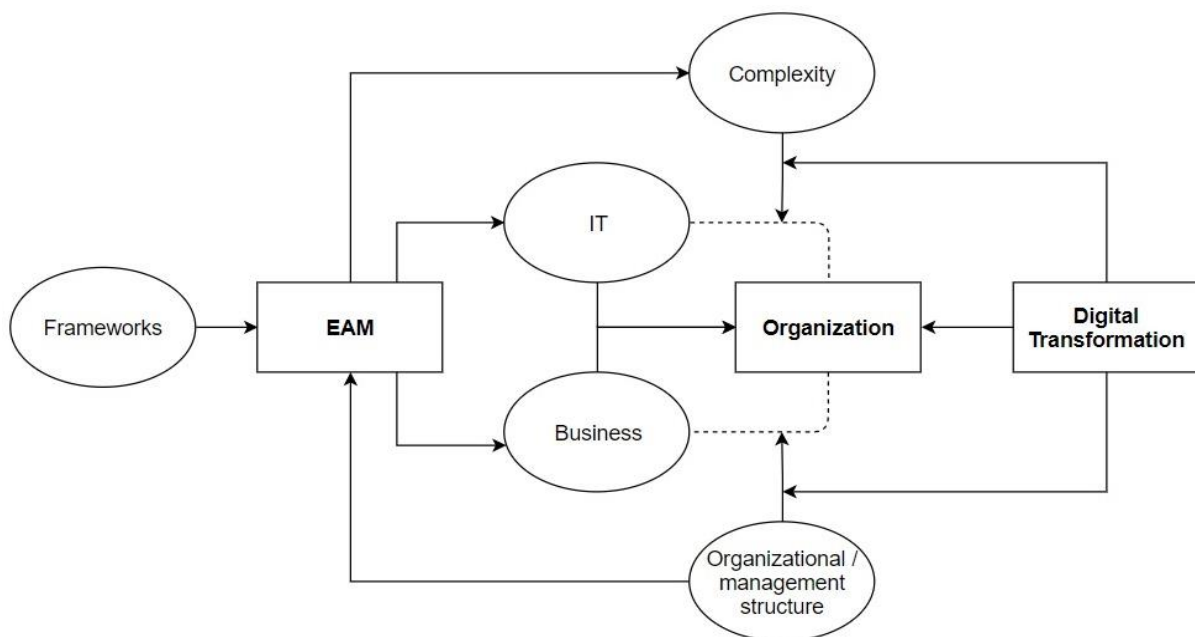
Figure 3.   Dependencies between EAM, Organization and Digital Transformation

Both, EAM and DT, affect organizations, which consist of IT and business and are in correlation with sustainable organizational success. On the one hand, EAM aligns business and IT. On the other hand, DT causes fast changing internal as well as external requirements, which EAM must respect. The purpose of EAM is to enable a holistic overview of EA's status quo (as-is) as well as strategical organizational visions (to-be) including a roadmap. Frameworks as guidelines and toolbox of EAM directly cause EAM's performance.

DT leads to new technologies such as IoT, microservices or cloud infrastructure in organizations. Additionally, pace of change processes increases. This results in rise of complexity. Traditionally, EAM frameworks follow heavy top-down approaches for planning, defining and controlling, which leads to high maturity of an organization's EA. EAM might be barriers of DT processes due to their complexity and slow capabilities of adapting as-is EA. EAM in general changes to lighter and more agile approaches. Their roles tend to be more supportive or consulting and less restrictive than traditional heavy EAM. Well-managed lightweight or bimodal EAs allow transparency and supports IT stakeholders. Therefore, organizations can handle new requirements and rising complexity.

Handling this complexity requires much effort in coordination and cultural change. Therefore, DT also affects organizational and management structures. As mentioned before, overall pace increases and, therefore, organizations must adapt their structure. They become more agile and customer-centred. These new structures impacts role of EAM within an organization. Frameworks often do not follow agile methods and therefore dichotomy of EAM and organizational structure exists. In this context, IT-experts see outdated EAs, reluctant information provider and late valuation from stakeholders as risk. Wrong organizational structures and missing awareness through management results in IT department separated from operational departments, which causes EAM focussing IT and neglecting business. Literature also states missing role concepts and responsibilities as barrier. Only a few EAM frameworks include role concepts, which hinders organizations in including EAM in their organizational structure.

Practical implications

My practical implications for management usage of my literature review relies on ensuring requirements of EAM in DT. It is important to institutionalize IT as well as EAM in organizations. Therefore, management must adapt their mind-set towards EAM. IT and DT are interrelated and EAM enables strategical roadmaps. Additionally, EAM supports operational and IT staff in their daily work. Fast IT EAM,

as needed for successful DT in operational context, grants a holistic overview, reduces complexity and avoids redundancy. EAM is not capable for one-solution-fits-all approaches, but has its strengths in internal aspects especially regarding processes and IT. For external aspects and psychological influenced artifacts (e.g. human resources), other governance disciplines are more powerful. I implicate to consider and merge EAM with other governance disciplines for better strategical decision-making. In the first step, organizations do not need to reinvent existing EAM.

Organizations often use bimodal IT, such as legacy systems and digital services. They can use EAM in a similar manner. They can use their existing traditional heavyweight EAM for long-term strategical decisions and a holistic overview regarding legacy systems and implement agile lightweight EAM for decentral support and consulting on operational level to reduce complexity and cover requirements of digital services. By doing so, organizations avoid barriers of EAM and exploit driving aspects.

Limitations

I mentioned some limitations of my research before. Traditional EAM has high maturity and covers a broad range of internal aspects. DT influences organizations, their management and structures. They must change for sustainable competitiveness. Unfortunately, literature does not keep track with these changes and only a few publications cover the role of EAM in DT. EAM is often highly specific in scientific papers, too. Publications that are more general are rare and without empirical background. Empirical researches are mostly qualitative ones.

Future Research

As a result of mentioned limitations, I identified some gaps for future research. Several researchers developed ideas, frameworks, methods or statements without empirical background or validation. My literature review has these limitations, too. My requirements of EAM in DT are not empirical validated. Another research gap are frameworks. Several frameworks coexist. On the one hand, they are often for specific use cases and not universal applicable. Future research could focus on consolidation of their strengths. On the other hand, TOGAF is universal applicable, but its implementation is complex and it lacks agility. Researches can aim for empirical background about the role of TOAGF in DT for further development of TOGAF.

6   Conclusion

DT causes EAM to change its role within organizations. It increases complexity in organizations. IT becomes more complex, which derives to EAM. Organizational and management structures change, too. Organizations tend to be agile and customer-centric. EAM grants a holistic overview of an organization, its business processes and IT-infrastructure, including a roadmap towards to-be EAM is capable to drive DT in organizations. Literature states the following results regarding my research questions:

(1) Which aspects of EAM hinder organizations in their DT?

Complexity of EAM: EAM is complex and requires a lot of effort to handle, which applies for traditional EAM especially. DT leads to more complexity within organizations and industries. This increases requirements of EAM.

Organizational and management aspects: Organizations consider EAM as stand-alone approach for IT and neglect its potential in business and IT alignment. Additionally, EAM is not able to depict psychological or external aspects. In context to fast changing business conditions caused by DT, traditional EAM approaches are too slow in their adaption processes. EAM's role is planning, defining and controlling. Therefore, organizations cannot keep track with the pace of change.

(2) Which aspects of EAM drive organizations in their DT?

Scaling and handling of complexity: Lightweight approaches allow fast adaption cycles. EAM supports operational business areas by enabling a holistic overview. This avoids redundancy and reduces complexity. Digital architectures respect DT and add further technologies (e.g. SMACIT). Alignment of

business and IT and as-is architectures with roadmaps towards to-be architectures allow for support in strategical orientation.

Organizational and management aspects: EAM changes its focus from operational aspects to strategical ones. Management institutionalizes EAM and use it to support their overall strategical decisions. Its strength is internal view and representation of IT. Decentralization allows fast adaption and EAM's role changes to supporting and consulting.

(3) What are the requirements of successful EAM in DT?

Organizational and management transformation: Organizations change their culture and processes to react to DT. EAM must overcome its traditional approach with high complexity and consider agile approaches to be in line with organization's culture. By doing so, EAM has shorter cycles of implementation to cover fast changing artifacts. Organization must institutionalize EAM and integrate it in their management structures, too. Hence, it still must maintain support of strategical decisions and holistic overviews. Transparency as well as better coordination within organizations leading to reduction of organizational complexity. For example, IT departments require transparency to avoid redundancy. Additionally, new approaches of EAM consider rapid changes of requirements.

New methods: Further development of existing frameworks and new methods are required for successful EAM in DT. Literature states TOGAF as the most common framework. In TOGAF's actual version, it starts to become agile and focuses on strategical aspects, but still lacks coverage of organizational needs in DT. Therefore, organizations must adapt TOGAF to their specific use cases. Other frameworks like ESARC, which focusses on digital architectures, as well as SAFe, AEAF and LEA, which focus on agility, exist. They miss empirical or practical validation. Organizations have to compare existing frameworks and select one that fits best to their specific needs. If organizations merge further disciplines with EAM to cover all relevant aspects within their organizations, they will perform their DT successfully. Altogether, well-managed and institutionalized EAM is a driver of DT in organizations.

Outlook

Overall, EAM is part of IT-Governance and only one out of many aspects to drive successful DT in organizations. Organizations and industry become more and more interconnected. Hence, they must undergo change processes. EAM is one approach to guide organizations in these processes. Without correct attitudes towards DT and its relevance for sustainable organizational success, EAM and other approaches, which guide organizations in DT, create overhead and hinder organizations.

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