Roles of Different Artifacts in Enterprise Architecture Practice: An Exploratory Study

Completed Research Paper

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Abstract

Enterprise architecture (EA) is a description of an enterprise from an integrated business and IT perspective consisting of multiple diverse documents, or artifacts. However, the existing EA literature does not offer any comprehensive theories explaining the practical usage and roles of individual EA artifacts constituting EA. To address this gap, based on five case studies of established EA practices and confirmatory interviews with ten EA experts, we develop a descriptive theory explaining the roles of different EA artifacts in an EA practice. The resulting theory articulates six general types of EA artifacts (Considerations, Designs, Landscapes, Outlines, Standards and Visions) and explains their type-specific practical roles, including their informational contents, typical usage scenarios and ensuing organizational benefits. This paper presents the first available theory describing the usage of EA artifacts in organizations and suggests that EA scholars should switch their focus from studying EA in general to studying individual EA artifacts.

Keywords: Enterprise Architecture (EA), Artifacts, Roles, Usage, Taxonomy, Grounded Theory

Introduction

The role of information technology (IT) in modern companies is significant with companies investing substantial amounts of money in IT. However, in order to realize the full potential value of IT investments the IT strategy of a company should be aligned with its business strategy (Gerow et al. 2014). Enterprise architecture (EA) is a description of an enterprise from an integrated business and IT perspective intended to bridge the communication gap between business and IT stakeholders. Using EA helps companies improve business and IT alignment and brings a number of other benefits (Schmidt and Buxmann 2011).

EA is typically described as a comprehensive blueprint of an enterprise covering its business, data, applications and technology domains and consisting of individual EA artifacts (Spewak and Hill 1992; TOGAF 2018). EA artifacts that can be used as part of EA range from high-level principles and policies to detailed technical diagrams and models (Bernard 2012; Kotusev 2019; TOGAF 2018; van't Wout et al. 2010). Potential stakeholders of EA range from business executives and middle managers to rank and file IT specialists (Niemi 2007; Thornton 2007; van der Raadt et al. 2010). EA supports corporate strategic planning (Simon et al. 2014), helps coordinate organizational transformations (Radeke 2011), facilitates communication between different stakeholders (Lankhorst 2013), enables informed decision-making (Narman et al. 2012a) and provides actionable guidance for implementing IT systems (Spewak and Hill 1992).

However, despite a wide variety of different EA artifacts, EA stakeholders and EA use cases, the available EA literature does not explain clearly what specific purposes are fulfilled by different types of EA artifacts for these stakeholders in these use cases. In other words, the existing EA literature fails to explain what roles different EA artifacts fulfill in practice. The EA discipline exists for decades (Kotusev 2016), but no theories explaining the usage of EA artifacts in organizations have been developed (Niemi and Pekkola 2017). At the same time, the most significant reported practical problems associated with EA can arguably be attributed specifically to an insufficient understanding of the roles, purposes and usage of different EA artifacts in an EA practice (Kotusev et al. 2015). Therefore, the roles of different types of EA artifacts still remain an unexplored area of the EA discipline of significant theoretical and practical importance.

In order to address this longstanding gap in the EA literature, in this paper we explore the roles of different EA artifacts in an EA practice. Based on five case studies of established EA practices and subsequent confirmatory interviews with accomplished EA experts, we develop a descriptive theory explaining the practical roles of different types of EA artifacts. Since the term "role" in relation to EA artifacts has no commonly accepted definition, the role of an EA artifact in the context of this paper can be understood as the contribution made by an artifact provisioned by the set of its key properties including its informational contents, regular users, typical use cases and respective organizational benefits.

This paper is structured as follows: (1) we discuss EA, EA artifacts, their stakeholders and usage in organizations and explain why the practical roles of EA artifacts are insufficiently understood, (2) we describe our research design, data collection and data analysis procedures, (3) we present the resulting theory explaining the roles of different EA artifacts in an EA practice, (4) we discuss our findings in the context of the existing EA literature, (5) we describe the contribution of our study to EA theory and practice and (6) we conclude the paper and outline directions for further research.

Literature Review

In this section we discuss the concept of EA with its artifacts, stakeholders and usage in organizations, explain the motivation of this study and formulate its research question.

Enterprise Architecture and Its Artifacts

The mainstream EA literature views EA essentially as a comprehensive blueprint describing various business and IT aspects of organizations as well as their interrelationship (Bernard 2012; FEAF 1999; TOGAF 2018). EA generally covers business, data, applications and technology domains of organizations (Narman et al. 2012a; Spewak and Hill 1992; TOGAF 2018). It is also typically assumed that EA includes the current state, future state and roadmap describing the transition from the current state to the future state (Bernard 2012; Lange et al. 2016; Shanks et al. 2018). An EA practice is a complex set of organizational activities that imply using EA for facilitating IT-related decision-making and improving business and IT alignment (Ahlemann et al. 2012; Fallmyr and Bygstad 2014; Kotusev 2017).

EA is composed of multiple individual documents usually called EA artifacts (Abraham 2013; Kotusev 2019; TOGAF 2018; Winter and Fischer 2006). An EA artifact is a separate document describing a specific narrow aspect of an organization from the perspective of its business and IT (Abraham 2013; Kotusev et al. 2015; Winter and Fischer 2006). EA artifacts can be very diverse and vary in their informational contents, representation formats and other properties. For example, a non-exhaustive list of EA artifacts that can constitute EA includes business drivers, organization model, context diagram, principles, policies, standards, guidelines, business process models, business service views, information components, logical data models, data flow diagrams, system integration views, network diagrams, transition plans, roadmaps as well as a multitude of other artifacts (Bernard 2012; DoDAF 2007; Kotusev 2019; Spewak and Hill 1992; TOGAF 2018; van't Wout et al. 2010).

The EA literature describes multiple different ways of classifying EA artifacts into various categories based on their essential properties along different orthogonal dimensions including domains, viewpoints, states, perspectives, interrogatives, abstraction levels and representations. These dimensions and corresponding classifications of EA artifacts are summarized in Table 1.

Table 1. Proposed Dimensions and Classification Schemes for EA Artifacts

Dimension	Classification	Source(s)
Domains	Business, data, applications and technology	FEAF (1999), Schekkerman (2006), Covington and Jahangir (2009), van't Wout et al. (2010), TOGAF (2018) and Bernard (2012)
	Infrastructure, data, application and organization	PRISM (1986)
Viewpoints	Operational, systems and technical	C4ISR (1997) and DoDAF (2007)
	Functional, information, organizational and infrastructure	TEAF (2000)
States	Current and future	PRISM (1986), FEAF (1999), TOGAF (2018) and Bernard (2012)
Perspectives	Planner, owner, designer, builder and subcontractor	Sowa and Zachman (1992) and TEAF (2000)
Interrogatives	What, how, where, who, when and why	Sowa and Zachman (1992), Schekkerman (2006) and van't Wout et al. (2010)

Table 1. Proposed Dimensions and Classification Schemes for EA Artifacts

Stakeholders and Usage of Enterprise Architecture

EA has a wide circle of potential users and stakeholders (Niemi 2007; Thornton 2007; TOGAF 2018; van der Raadt et al. 2010). A non-exhaustive list of EA stakeholders and users includes members of the board, senior business executives, CIOs, middle managers, enterprise architects, software architects, project managers, developers, testers, IT operations staff and other specialists (Niemi 2007; Thornton 2007; van der Raadt et al. 2010).

EA can be used by IT staff since it provides actionable guidance for implementing necessary information systems and moving an organization closer to the desired target state (Bernard 2012; Spewak and Hill 1992; TOGAF 2018). EA can also be used by senior management stakeholders for the purposes of corporate strategic planning (Simon et al. 2014). EA can facilitate the coordination of strategic changes and transformations in organizations (Radeke 2011). EA can be used as a tool for general communication between executives, managers and other stakeholders (Bernard 2012; Lankhorst 2013; TOGAF 2018). Multiple formal analysis techniques can be used to support informed decision-making on the basis of EA including, among others, estimating costs of system maintenance (Lagerstrom 2007) or system modifications (Lagerstrom et al. 2010), evaluating IT service quality (Narman et al. 2008), analyzing IT risks and opportunities (Sousa et al. 2013) and estimating service response times (Narman et al. 2012a).

Insufficient Understanding of the Roles of EA Artifacts

As discussed above, the existing EA literature mentions various EA stakeholders (Niemi 2007; Thornton 2007; van der Raadt et al. 2010) and describes multiple ways to use EA (Narman et al. 2012a; Radeke 2011; Simon et al. 2014). At the same time, EA is not a single overarching document or plan, but a collection of diverse EA artifacts with very different properties and informational contents (Bernard 2012; DoDAF 2007; Spewak and Hill 1992; TOGAF 2018; van't Wout et al. 2010). However, while discussing the usage of EA, the existing literature rarely refers to concrete EA artifacts leaving the practical roles of individual artifacts constituting EA largely unclear. Moreover, all the proposed classification schemes for EA artifacts (see Table 1) essentially explain only the differences in their informational contents, but none of these classifications explains the differences in the roles of different EA artifacts in an EA practice from the perspective of their stakeholders, use cases and purposes.

Although the existing EA literature provides in-depth role descriptions for a limited number of concrete EA artifacts including principles (Greefhorst and Proper 2011), standards (Boh and Yellin 2007), business capability models (Khosroshahi et al. 2018) and project-start architectures (Foorthuis and Brinkkemper 2007), it does not offer any generic theoretical models explaining the roles of all the various types of EA artifacts that can be used as part of EA. The lack of clarity on the roles of EA artifacts in the EA discipline also has negative practical implications. As explicated by Kotusev et al. (2015), all the most frequently reported practical problems with EA (Gaver 2010; Lohe and Legner 2014) can be attributed to an insufficient understanding of the roles of EA artifacts. In particular, it is still unclear what types of EA artifacts are actually valuable, which of them can be helpful to different stakeholder groups and how exactly these artifacts are used (Kotusev et al. 2015).

This knowledge gap related to the roles of EA artifacts is consistently acknowledged by EA researchers (Kotusev et al. 2015; Niemi and Pekkola 2017; Simonsson et al. 2005). For example, Simonsson et al. (2005, p. 2) fairly noticed that “current Enterprise Architecture Frameworks, propose that a plethora of models should be developed and maintained. However, it is rarely evident when and why a particular model is to be preferred over others and what questions they are created to answer”. More recently, Niemi and Pekkola (2017, p. 327) confirmed that “currently a theoretical model of EA artifact use does not exist”. Accordingly, Niemi and Pekkola (2017, p. 326) “call for further research in these respects”.

In order to address this long-standing gap in the EA literature, this study intends to explore the roles of different EA artifacts in an EA practice. Specifically, the research question of this study can be formulated as follows: “What are the roles of different artifacts in an EA practice?” Answering this research question implies explaining (1) what useful information different types of EA artifacts provide, (2) who uses these EA artifacts, (3) how exactly these EA artifacts are used and (4) what organizational benefits ensue from their usage.

Research Design

This research is qualitative, inductive and exploratory in nature because the question under investigation is not described in the existing EA literature well enough to formulate any reasonable deductive propositions or quantitative hypotheses. Since this study intends to build a new inductive theory, the grounded theory method (GTM) has been selected as the key research strategy (Corbin and Strauss 1990; Strauss and Corbin 1998). Due to the inherent qualitative nature of this study, case studies have been selected as a subsidiary data collection method to complement the primary grounded theory approach (Fernandez 2004; Fernandez and Lehmann 2011).

Data Collection

According to the canons of the case studies-based grounded theory (Fernandez 2004; Fernandez and Lehmann 2011), both the case selection and within-case data collection processes have been driven by theoretical sampling considerations. To achieve better theoretical saturation and eliminate potential industry-specific biases, our primary intention was to analyze diverse organizations operating in different industry sectors. At the same time, organizations having no permanent EA teams, no consistent EA-related processes or practicing EA for less than three years, as well as small organizations employing less than 100 IT staff, were deemed unsuitable for the purposes of our study and excluded from further consideration. Therefore, as part of this research we successively selected and studied five Australian organizations satisfying the inclusion and exclusion criteria formulated above. Basic information on the five case organizations is summarized in Table 2. Due to strict confidentiality requirements, real organization titles, precise numbers and other highly organization-specific details cannot be provided.

Table 2. Summary Information on the Five Case Organizations

Organization	Organization 1	Organization 2	Organization 3	Organization 4	Organization 5
Industry	Academe	Finance	Telecom	Delivery	Retail
Staff	~8000	~40000	~6000	~30000	~100000

IT staff	~500 in total[1]	~3000 in total	~2000 in total	~900 in total	~2000 in total
Architects	~20 in total[2]	~120 in total	~80 in total	~65 in total	~25 in total
EA experience	At least 3 years	At least 8 years	At least 6 years	At least 5 years	At least 4 years
EA practice	TOGAF-based, but only rhetorically[3]	TOGAF-based, but only rhetorically	Homegrown approach	Homegrown approach	Homegrown approach
EA artifacts	10 main types	13 main types	15 main types	11 main types	12 main types

Table 2. Summary Information on the Five Case Organizations

Data in the studied organizations was collected predominantly from semi-structured interviews. However, numerous samples of EA artifacts provided by the interviewees were also analyzed and in one case full access to the organizational EA repository was granted. Analogously to case selection, the interviewee selection process was guided by theoretical sampling considerations as well. In particular, the aim of within-case sampling was to contact all key representatives of EA functions (e.g. enterprise architects, domain architects, lead architects, solution architects, etc.) and thereby cover all organizational levels of planning (e.g. enterprise level, business unit level and project level) to ensure that all types of EA artefacts used in the studied organizations are identified and their practical roles understood. Summary information regarding the interviews taken in each of the studied organizations is provided in Table 3.

Table 3. Interviews Taken in the Five Case Organizations

Organization	#	Interviews	Period
Organization 1	9	Director of architecture (3), solution architect (1), two solution consultants (1), engagement manager (1), project manager (1), business analyst (1) and communication systems engineer (1)	February to July 2016
Organization 2	6	General manager for architecture and strategy (1), enterprise architect (2), solution architect (2) and technical architect (1)	May to August 2016
Organization 3	7	Enterprise architect (2), domain architect (2), lead architect (2) and solution architect (1)	January to March 2017
Organization 4	5	Enterprise architect (1), principal architect (2) and solution architect (2)	February to March 2017
Organization 5	4	Manager of architecture (1), enterprise architect (2) and solution architect (1)	September to October 2017

Table 3. Interviews Taken in the Five Case Organizations

In total, we conducted 31 one-hour face-to-face interviews with direct participants of the EA practices in the studied organizations covering all levels of architectural planning in each organization, from global enterprise-wide planning to local project planning. All interviewees were asked to list the main types of EA artifacts used in their organizations and then to describe in detail the informational contents, developers, users, purposes, benefits and other relevant aspects of each of these types of EA artifacts. All the interviews were recorded with the permission of the interviewees and transcribed verbatim for further analysis. The data collection in each organization stopped when a comprehensive list of all EA artifacts utilized in that

[1] These numbers represent estimated full-time equivalent (FTE) employee numbers that include all permanent, contract and outsourced IT staff

[2] These numbers include architects of all the various denominations employed in the studied organizations (e.g. enterprise, principal, line-of-business, domain, lead and solution architects), both permanent and contractors

[3] Some interviewees declared that their EA practices were based on TOGAF, but at the same time readily admitted that they actually do not adhere to the essential TOGAF prescriptions, e.g. do not follow the steps of the architecture development method (ADM) and do not produce most of the deliverables of the architecture content framework (ACF)

organization had been composed, the roles of these artifacts had been unambiguously understood and a theoretical saturation had been achieved (Glaser and Strauss 1967; Strauss and Corbin 1998).

Data Analysis

Since the research question of this study addresses an insufficiently explored area of the EA discipline, the grounded theory method (Glaser and Strauss 1967; Strauss and Corbin 1998) was selected as the most suitable approach to data analysis. During the data analysis we followed the essential steps of the grounded theory method: open coding, axial coding and selective coding (Corbin and Strauss 1990; Strauss and Corbin 1998). The first step, open coding, included reading the recorded text line-by-line and identifying significant concepts and categories relevant in the context of the studied phenomenon. This step resulted in the list of major concepts and categories including artifacts, contents, stakeholders, usage, purpose and benefits. The second step, axial coding, included rereading the recorded text and establishing the relationship between various concepts and categories relevant in the context of the studied phenomenon. This step resulted in the relationship network explaining the connections between all the concepts and categories previously identified during the open coding step. The final step, selective coding, included selecting EA artifacts as the core category and unifying all the previously established concepts, categories and relationships between them around this core category into a consistent logical picture describing the studied phenomenon. This step resulted in an initial descriptive theory of the roles of different EA artifacts in an EA practice. Illustrative samples of the applied coding procedures with original quotes, identified codes and resulting general types of EA artifacts are provided in Table 4.

Table 4. Illustrative Samples of the Applied Coding Procedures

Interviewee quote	Identified code(s)	Resulting type
Solution architect: "[I use [1] inventories [2]] during design, I mean when I design something [3] and I need a tool that can do the data integration, should I be using IBM or should I be using Informatica? [...] You cannot reuse assets [4] unless you have a list of assets [5]"	[1] Architects (Users) [2] Inventories (Artifacts) [3] Project Planning (Usage) [4] Asset Reuse (Benefits) [5] List of Assets (Information)	Landscapes
Enterprise architect: "Then we go down to the design, we are calling it a high-level design [1]. High-level design is something like a mixture of bits of architecture and bits of design [2]. [...] It is how that architecture is going to be implemented [3], so more getting towards how many boxes, how many wires, more detail [4]"	[1] High-Level Designs (Artifacts) [2] Implementation Plans (Information) [3] Project Implementation (Usage) [4] Implementation Plans (Information)	Designs
Solution architect: "We have the technology reference model [1] which we use to say "this is all of the technologies that we have right now [2]". Everything [all projects] we do should line out with the TRM [3]"	[1] Technology Reference Models (Artifacts) [2] Available Technologies (Information) [3] Implementation Guidance (Usage)	Standards

Table 4. Illustrative Samples of the Applied Coding Procedures

Validation of the Findings

After the data collected from the five case organizations had been analyzed and the initial theory had been developed, this theory, including both the corresponding roles of EA artifacts and their titles, has been discussed with ten Australian and international EA experts, including seven active EA practitioners and three EA academics with significant practical experience. The resulting theory has been generally confirmed and considered as valid, though a number of suggestions have been proposed by the interviewed EA experts to clarify various aspects of the theory, improve some descriptions and titles. All these suggestions have been incorporated into the resulting theory, the respective descriptions and titles have been amended. The final descriptive theory of the roles of EA artifacts developed in this study is presented in the next section.

Descriptive Theory of the Six Roles of EA Artifacts

The analysis of the data collected from the five studied organizations working in diverse industries shows that each of these organizations used from ten to 15 different artifacts considered by the interviewees as relevant to EA (61 artifacts in total, 12.2 on average per organization)[4]. The grounded theory analysis shows that all the identified EA artifacts can be classified on the basis of their conceptual differences and similarities into six consistent groups rather accurately describing their roles in an EA practice. These six general types of EA artifacts have been conditionally labeled as Considerations, Designs, Landscapes, Outlines, Standards and Visions (ordered alphabetically). The lists of the identified EA artifacts related to these six general types (under their original peculiar labels adopted in organizations), sample constructs relevant to these general types and the explanations of their titles are provided in Table 5.

Table 5. Lists of EA Artifacts Related to the Six General Types

General type	Related EA artifacts[5]	Sample constructs	Explanation
Considerations	Core drivers, data models, maxims, policies, principles (four organizations), strategic papers and strategy papers	Guiding imperatives, long-term directions and conceptual business objects	All these EA artifacts provide some general *considerations* defining global architectural decision-making
Designs	Detailed designs, full solution architectures, high-level designs, key design decisions of SAs, preliminary solution architectures, solution architectures (two organizations), solution blueprints and solution designs	System architectures, requirement specifications and implementation plans	All these EA artifacts provide some technical *designs* of proposed IT solutions
Landscapes	Asset register, domain roadmaps, inventories (two organizations), one-page diagrams, platform architectures, platform roadmaps, reference architecture model, technical reference architectures, technology blueprints and technology roadmaps	Existing systems, databases and platforms, component relationships and planned changes	All these EA artifacts provide some views of the organizational IT *landscape* from the technical perspective
Outlines	Blueprints, conceptual architectures, idea briefs, key design decisions of	Conceptual solution structures, basic	All these EA artifacts provide some brief

[4] Various EA frameworks like TOGAF (2018), DoDAF (2007) and IAF (van't Wout et al. 2010), as well as other prescriptive EA sources (Bernard 2012; Spewak and Hill 1992), provide extensive sets of EA artifacts to be created. However, empirical evidence from the industry demonstrates that EA artifacts that actually proved useful in organizations barely correlate with these sets and do not relate to EA frameworks in any real sense (Kotusev 2019). For example, TOGAF-based EA practices do not leverage EA artifacts recommended by TOGAF (Kotusev 2018b; Smith et al. 2012) (same situation was also observed in this study, see Table 2), while the EA program at the U.S. Department of Defense that leveraged the set of EA artifacts prescribed by DoDAF turned out unsuccessful (GAO 2005; GAO 2013). For this reason, the lists of EA artifacts offered in popular EA frameworks cannot be treated seriously and cannot be taken as a reliable basis for any research purposes, e.g. for validating the developed theory

[5] Since the titles of various EA artifacts are inconsistent across organizations (Kotusev 2019), the fact that some EA artifacts from different organizations with identical titles (e.g. blueprints and principles) actually relate to different general types of EA artifacts in Table 5 should not be surprising or confusing

	SOs, solution overviews and solutions on a page	requirements, value and cost estimates	*outlines* of proposed IT initiatives
Standards	Data schemas, IT principles, patterns, principles, reference architectures, standards (four organizations) and technology reference model	Utilized technologies, proven approaches and logical data entities	All these EA artifacts provide some technical *standards* influencing the designs of all information systems
Visions	Blueprints, business capability models (four organizations), business reference architectures, capability model, divisional roadmaps, enterprise investment roadmap, function roadmaps, process model, program of work and roadmaps (three organizations)	Desired future, required capabilities and planned investments	All these EA artifacts provide some *visions* of the long-term future agreed by business and IT stakeholders

Table 5. Lists of EA Artifacts Related to the Six General Types

Each of the six general types of EA artifacts fulfills a specific role in the context of EA practice and combines a unique set of related properties including its typical informational contents, stakeholders, usage and associated benefits. Each of the 61 EA artifacts identified in the studied organizations can be allocated to one and only one of these six general types, though with some caveats[6]. Even though each of the five studied organizations leveraged a unique collection of EA artifacts to enable its EA practice, no articulate industry-specific patterns in the adopted sets of artifacts or their practical roles could be discerned. In other words, despite the numerous differences in details, the general roles of EA artifacts seem to be consistent across different organizations and industries (this observation matches with the earlier conclusion of Kotusev (2019) on the absence of correlation between the utilized sets of EA artifacts and industry). The practical roles of the six general types of EA artifacts listed in Table 5 are described in detail in the following subsections.

Considerations

Considerations (e.g. principles, maxims and policies, see Table 5) describe global conceptual rules and fundamental considerations important for business and relevant for IT. Essentially, they document some significant organization-wide business decisions having direct impact on IT. Considerations represent the overarching organizational context for information systems planning. They are expressed in simple intuitive formats, often as brief verbal statements. They are typically either unrelated to specific timeframes or focus on the long-term future.

All Considerations are developed collaboratively by senior business leaders and architects[7] and then used to influence all architectural decisions. They represent a certain consensus achieved between senior business and IT stakeholders on the essential questions relevant from the perspective of the relationship between business and IT. The general purpose of all Considerations is to help achieve the agreement on basic principles, values, directions and aims. They allow multiple different stakeholders tune on the same

[6] Specifically, a few individual samples of EA artifacts described by the interviewees bordered between two different general types, e.g. "some of our principles we discuss with business [i.e. relate more to Considerations], but others are purely technical [i.e. relate more to Standards]". Likewise, some project-related EA artifacts exhibited in different proportions the characteristic properties of both Outlines and Designs. However, none of the identified EA artifacts fell outside the six general types of EA artifacts

[7] Here and further we deliberately use the generic term "architects" to refer to all organizational actors performing architectural planning regardless of their formal titles. On the one hand, in small organizations dedicated full-time architects can be absent and architectural responsibilities can be fulfilled by IT managers on a part-time basis (though such organizations were missing in our sample). On the other hand, different organizations tend to establish different, often inconsistent and peculiar positions for architects (FEAPO 2018). In fact, all the five studied organizations had different structures of their EA functions in terms of existing architecture positions

"wavelength" and develop a shared view of what is important for the organization. The proper use of Considerations leads to improved overall conceptual consistency between business and IT. They help architects avoid making inconsistent architectural decisions contradicting the most essential business needs agreed with senior business executives.

Designs

Designs (e.g. high-level designs and solution architectures, see Table 5) provide detailed technical descriptions of specific IT projects actionable for project teams. Essentially, they describe how exactly particular IT projects should be implemented from the technical perspective. Designs represent communication interfaces between architects and project teams. They are expressed as a mix of complex diagrams, tables and text. They often use formal modeling notations and can be voluminous. They usually focus on the short-term future up to 1-2 years ahead and evolve along with the corresponding IT projects, but their lifespan is limited to the project implementation phases.

All Designs are developed collaboratively by architects, project teams and business representatives and then used by project teams to implement IT projects. They represent a certain consensus achieved between all project participants regarding how the essential requirements of the IT project will be met. The general purpose of all Designs is to help implement approved IT projects according to business and architectural requirements. The use of Designs ensures the connection between local implementation-specific details and global organization-wide implementation standards. The proper use of Designs leads to improved quality of the project delivery. They help diverse project participants agree on the essential design decisions and select the most appropriate, proven and risk-free project implementation approaches.

Landscapes

Landscapes (e.g. platform architectures and inventories, see Table 5) provide high-level technical descriptions of the organizational IT landscape. Essentially, they describe what IT assets exist in an organization, how they are related to each other and how they are used. Landscapes represent a knowledge base of reference materials on the IT landscape. They are expressed in strict formats, often as complex one-page diagrams using formal modeling notations. They usually, but not always, focus on describing accurately the current state of an organization.

All Landscapes are developed and maintained by architects and used to rationalize the IT landscape, manage the lifecycle of IT assets and plan new IT initiatives. They often document the existing IT landscape from different perspectives, updated after completion of new IT projects and provide a baseline for IT planning to architects. The general purpose of all Landscapes is to help understand, analyze and modify the structure of the IT landscape. Architects using Landscapes are able to see more easily what IT assets exist in an organization, which IT assets may cause problems in the future and how these IT assets should be reused, decommissioned or modified as part of new IT projects. The proper use of Landscapes leads to increased reuse and reduced duplication of IT assets, improved IT agility and decreased dependency on legacy IT systems. They provide high-level views of the organizational IT landscape helping eliminate inefficiency, complexity and redundancy as well as plan new IT projects more quickly.

Outlines

Outlines (e.g. solution overviews and conceptual architectures, see Table 5) provide high-level descriptions of specific IT initiatives understandable to business leaders. Essentially, they describe what approximately will be implemented as part of particular IT initiatives and what business value is expected from these initiatives. Outlines essentially represent benefit, time and price tags for proposed IT initiatives. They are expressed as a mix of simple diagrams and textual descriptions and detailed enough to evaluate the project. They usually focus on the short-term future up to 1-2 years ahead and evolve along with the corresponding IT projects, but their lifespan is limited to the project initiation phase.

All Outlines are developed collaboratively by architects and business leaders and then used to evaluate, approve and fund specific IT initiatives. They represent a certain consensus achieved between project sponsors and architects regarding what should be implemented as part of the IT project and which major implementation options should be preferred. The general purpose of all Outlines is to help estimate the overall business impact and value of proposed IT initiatives. They help clearly see what business value is delivered with each IT project and for what price. The proper use of Outlines leads to improved efficiency and ROI of IT investments. Via using Outlines, senior business stakeholders are able to make informed IT investment decisions and approve only the IT projects with the maximum expected payoff.

Standards

Standards (e.g. technology reference models and patterns, see Table 5) describe global technical rules, standards, patterns and best practices relevant for IT systems. Essentially, they define how all IT systems in an organization are implemented from the technical perspective. Standards represent proven reusable means for IT systems implementation. They can be expressed in various formats, often use strict notations. They are typically either unrelated to specific timeframes or focus on the current state.

All Standards are developed collaboratively by architects and technical subject-matter experts and then used to influence architectures of all IT initiatives. They often result from the attempts to document and reuse proven best practices and implementation approaches in new IT projects. The general purpose of all Standards is to help achieve technical consistency, technological homogeneity and regulatory compliance. They help architects to select same technologies for similar purposes, implement same solutions to similar problems and follow same prescriptions in similar cases. The proper use of Standards leads to accelerated initiative delivery, reduced IT-related costs, risks and complexity of the IT landscape. They help organizations consolidate their technology portfolios and avoid “reinventing the wheels”.

Visions

Visions (e.g. business capability models and roadmaps, see Table 5) provide high-level conceptual descriptions of the organization from the business perspective. Essentially, they describe in an abstract manner how an organization works or needs to work in the future. Visions represent shared views of the organization and its future agreed by business and IT. They are expressed in brief informal formats, often as simple one-page diagrams. They usually focus on the long-term future up to 3-5 years ahead.

All Visions are developed collaboratively by senior business leaders and architects and then used to guide IT investments, prioritize IT initiatives and initiate IT projects. They represent a certain consensus achieved between senior business executives and architects regarding the desired focus and intensity of future IT investments. The general purpose of all Visions is to help achieve the alignment between IT investments and long-term business outcomes. Collaborative discussions of Visions help senior business and IT stakeholders agree on the desired future course of action for IT based on the long-term business objectives. The proper use of Visions leads to improved strategic alignment and effectiveness of IT investments. They help senior business stakeholders ensure the direct connection between planned IT investments and the organizational business strategy.

Properties of the Six General Types of EA Artifacts

The six general types of EA artifacts described above can also be viewed and analyzed from the perspective of their essential properties. Each of these types of EA artifacts possesses a unique combination of properties defining both its informational contents and usage scenarios in organizations. The list of relevant properties is rather long and includes such characteristics of EA artifacts as informational content, organizational scope, time focus, representation format, utilized language, covered EA domains, their regular users, use cases, temporal lifecycle, overall purpose, ensuing benefits and some other less significant properties. The top ten most important properties of the six general types of EA artifacts are summarized in Figure 1.

General Type	Considerations	Designs	Landscapes	Outlines	Standards	Visions
Content	Conceptual rules for business and IT	Technical views of IT projects	Technical views of the IT landscape	Conceptual views of IT initiatives	Technical rules for IT	Conceptual views of the business
Scope	Very wide	Narrow	Wide	Narrow	Very wide	Wide
Focus	No focus or long-term future	Short-term future	Current state	Mid-term future	No focus or current state	Long-term future
Format	Often brief written statements	Text, tables and complex diagrams	Often complex one-page diagrams	Text and simple diagrams	Can use various formats	Often simple one-page diagrams
Language	IT-agnostic business language	Technical IT-specific language	Technical IT-specific language	IT-agnostic business language	Technical IT-specific language	IT-agnostic business language
Users	Business leaders and architects	Architects and project teams	Mostly architects	Business leaders and architects	Architects and technical SMEs	Business leaders and architects
Usage	Influence all architectural decisions	Implement IT projects	Plan changes and rationalize the landscape	Evaluate and fund IT initiatives	Shape architectures of all solutions	Guide and prioritize IT investments
Lifecycle	Long-lasting	Project-bound	Long-lasting	Project-bound	Long-lasting	Long-lasting
Purpose	Agree on basic values, aims and directions	Meet business and IT project requirements	Understand and analyze the landscape	Estimate the value of IT initiatives	Achieve technical consistency	Align initiatives and long-term business goals
Benefits	Consistency between business and IT	Quality of the project delivery	Reuse, agility, deduplication and renewal	Efficiency and ROI of IT investments	Delivery speed, costs, risks and complexity	Strategic effectiveness of investments

Figure 1. Key Properties of the Six General Types of EA Artifacts

Discussion

This paper provides arguably the first available comprehensive theoretical model explaining the roles of different EA artifacts in the context of EA practice. The resulting six-type taxonomy (see Figure 1) represents a full-fledged descriptive theory (or theory for analyzing, or Type I theory, see Gregor (2006)) and provides an accurate conceptual depiction of the practical usage of EA artifacts in organizations. A detailed understanding of the roles of EA artifacts offered by this study allows viewing many earlier findings of the EA literature in a different light, interpreting them more precisely and relating them to specific types of EA artifacts, rather than to EA in general.

New Interpretation of Earlier Research Findings

As discussed earlier, the existing EA literature in most cases refers simply to EA without distinguishing different types of EA artifacts constituting it (Alaeddini and Salekfard 2013; Bradley et al. 2012; Lange et al. 2016; Rahimi et al. 2017; Schmidt and Buxmann 2011; Shanks et al. 2018; Tamm et al. 2011). However, many conclusions of the previous studies regarding EA can be actually clearly related to specific types of EA artifacts substantially clarifying their meaning. For instance, the entire sub-stream of EA research on the analysis methods for EA models (Johnson et al. 2007; Narman et al. 2012a; Narman et al. 2012b; Narman et al. 2011; Sousa et al. 2013) can be related specifically to Landscapes since of all the six general types of EA artifacts only Landscapes provide accurate broad-scope descriptions of the IT landscape that can be analyzed with formal methods. Similarly, most publications on EA modeling (Holt and Perry 2010; Lankhorst 2013; Wierda 2017) can be related specifically to Landscapes and Designs since other types of EA artifacts either imply little or no modeling (Considerations and Standards) or require only informal, simplistic and intuitive models easily understandable to business leaders (Visions and Outlines).

Findings of many other EA studies can also be clarified and positioned in the context of relevant EA artifacts. For example, Alaeddini and Salekfard (2013) and Alaeddini et al. (2017) demonstrate that the use of EA correlates positively with business and IT alignment. However, a detailed understanding of EA artifacts and their practical roles suggests that improved business and IT alignment can be attributed mostly to the use of Visions and Outlines, which represent communication devices helping intertwine business and IT plans, while Standards and Landscapes are not used for communication with business stakeholders at all and, therefore, simply cannot contribute to better alignment between business and IT in any real sense. The same reasoning also applies to the studies of Valorinta (2011) and Bradley et al. (2012) as well. Likewise, Boucharas et al. (2010) identified in the literature 100 unique benefits associated with the use of EA, but many, if not most, of these benefits actually closely relate to specific types of EA artifacts. For example, such benefits as technology consolidation and minimization of IT heterogeneity can be attributed solely to Standards and can hardly be realized with any other types of EA artifacts, while benefits like better project scoping and increased accuracy of requirements specifications clearly refer exclusively to the use of Designs. Therefore, viewing the existing EA literature through the lens of the six general types of EA artifacts identified in this study allows interpreting its findings more accurately. In particular, relating the previous findings on EA in general to relevant types of EA artifacts helps explain and resolve various contradicting conclusions made in the EA literature.

New Relevant Properties of EA Artifacts

The EA literature already provides multiple taxonomies for classifying EA artifacts based on various properties including their domains, viewpoints, states, perspectives and interrogatives (see Table 1). On the one hand, the classification of EA artifacts into Considerations, Designs, Landscapes, Outlines, Standards and Visions developed in this study highlights a number of other properties critical for understanding their practical roles. Of all the properties deemed relevant to the roles of EA artifacts (i.e. content, scope, focus, format, language, domains, users, usage, lifecycle, purpose and benefits, see Figure 1), only a few properties had been mentioned earlier in the existing EA literature. For example, such properties as EA domains and time focus, or state, are widely known in the EA discourse (Bernard 2012; FEAF 1999; PRISM 1986; TOGAF 2018). However, many other essential properties of EA artifacts emerging from this study (e.g. usage, lifecycle, purpose and benefits), to the best of our knowledge, have never been discussed in the EA literature, with the exception of in relation to a limited number of concrete EA artifacts (e.g. principles, business capability models and project-start architectures, as discussed earlier). Generally, all the taxonomies for EA artifacts proposed earlier (see Table 1) classify them only based on some aspects of their informational contents, but fail to provide any classifications based on various aspects of their practical usage, i.e. explain who uses them, how, when and why.

On the other hand, our analysis of EA artifacts utilized in the five studied organizations suggests that many of these artifacts cannot be classified according to some of the dimensions discussed in the literature (see Table 1). Most strikingly, arguably none of the identified EA artifacts can be related to a single interrogative as proposed by some taxonomies (Schekkerman 2006; Sowa and Zachman 1992; van't Wout et al. 2010). Similarly, many or most real EA artifacts cover multiple different EA domains and cannot be clearly allocated to any single domain, as it is widely advocated in the literature (Bernard 2012; Covington and Jahangir 2009; FEAF 1999; PRISM 1986; Schekkerman 2006; TOGAF 2018; van't Wout et al. 2010). This observation is congruent with the earlier observations of Kotusev (2019, p. 110): “The analysis of the actual EA artifacts found in organizations suggests that these EA artifacts generally cannot be classified into one of the four typical EA domains” and “applying more fine-grained classifications proposed by many EA frameworks, for example, what, how and where […], to real EA artifacts is even more problematic”. For this reason, many of the taxonomies for EA artifacts and associated properties proposed in the existing EA literature actually seem questionable, empirically invalid and irrelevant to EA artifacts that proved useful in organizations.

New Theoretical View of Enterprise Architecture

The six general types of EA artifacts identified in this research represent complete and non-overlapping categories to which all the artifacts identified in the studied organizations can be allocated (see Table 5). Since the findings from case studies can be generalized analytically to theoretical propositions (Seddon and Scheepers 2012; Yin 2017), it is possible to hypothesize that the entire concept of EA can be potentially viewed as a set of six distinct components: Considerations, Designs, Landscapes, Outlines, Standards and Visions. This novel hypothetical conceptualization provides a more explanatory view of EA than the existing literature can offer. For instance, all the earlier classification schemes for EA artifacts proposed in the literature (see Table 1) explain only the differences in their informational contents (e.g. domains, abstraction levels or viewpoints), but no aspects of EA artifacts that relate to their use in practice (e.g. stakeholders, usage scenarios and purposes). By contrast, the new view of EA as a set of six components proposed in this study explains all these aspects of EA artifacts.

In line with the earlier calls for reconceptualization of EA (Holst and Steensen 2011; Janssen 2012; Korhonen et al. 2016; Kotusev 2018a; Kotusev 2019), we argue that the most common explanation of EA as a set of business, applications, data and technology architectures prevalent in the mainstream EA literature (Bernard 2012; FEAF 1999; TOGAF 2018; van't Wout et al. 2010) is largely inadequate, overly simplistic and fails to capture many important nuances of an EA practice. Viewing EA from the perspective of its domains, viewpoints or any other facets of its informational contents explains EA only from the informational perspective, but does not address any other critical EA-related questions (e.g. who uses EA artifacts, how, when and why) and inhibits more advanced theorizing around EA (e.g. establishing cause-and-effect relationships between specific types of EA artifacts and respective organizational benefits). A conceptualization of EA as Considerations, Designs, Landscapes, Outlines, Standards and Visions arguably offers a more powerful description of EA, facilitates an in-depth analysis of EA practices and enables deeper theorizing on EA-related activities.

Contribution

By clarifying the practical roles of various EA artifacts, this study makes both the theoretical and practical contributions to the EA discipline. Even though the EA discipline exists for decades (Kotusev 2016), no theories explaining how exactly different EA artifacts are used in practice have been developed by EA scholars (Kotusev et al. 2015; Niemi and Pekkola 2017; Simonsson et al. 2005). This study presents arguably the first systematic theory describing the practical roles of EA artifacts. Moreover, this study also highlights a number of properties of EA artifacts relevant to understanding their practical roles (i.e. content, scope, focus, format, language, domains, users, usage, lifecycle, purpose and benefits, see Figure 1) most of which have not been recognized earlier by the existing taxonomies for EA artifacts (see Table 1).

Theoretically, this study helps better understand the concept of EA itself. In the current literature, EA is most often described as a comprehensive plan, or blueprint, of an organization covering its various business and IT aspects (Bernard 2012; TOGAF 2018; van't Wout et al. 2010). Accordingly, academic studies usually theorize on the value, benefits and application of EA, but do not provide any more granular views of EA-related activities (Alaeddini and Salekfard 2013; Bradley et al. 2012; Lange et al. 2016; Rahimi et al. 2017; Schmidt and Buxmann 2011; Shanks et al. 2018; Tamm et al. 2011). Put it metaphorically, they consider EA largely as a "black box" and do not try to analyze what is "inside" EA (with the exception of various classifications that take into account only the informational contents of EA artifacts summarized earlier in Table 1). This study develops arguably the first theory explaining what is "inside" EA, i.e. what components constitute EA from the perspective of the roles they fulfill in an EA practice. As discussed earlier, the resulting theory allows more accurate interpretation of the previous findings on EA many of which actually relate only to specific types of EA artifacts (Alaeddini et al. 2017; Narman et al. 2012a; Valorinta 2011; Wierda 2017). An in-depth understanding of EA offered by this study enables more advanced academic theorizing on EA distinguishing different elements of EA as theoretically significant concepts.

From the practical perspective, the findings of this study help address the most typical practical problems associated with EA. The commonly reported problems with EA can be generally summarized into three core issues (Kotusev et al. 2015; Lohe and Legner 2014): (1) extraordinary efforts are needed to develop and maintain the EA documentation, (2) low quality of the EA documentation undermines its usability and (3) EA-related activities are isolated from the rest of the organization. The findings of this study on the roles of

EA artifacts allow formulating specific recommendations for addressing each of these problems. As our study suggests, the first problem can be addressed by mastering a reasonable number (e.g. 10-15) of different EA artifacts fulfilling the purposes of all the six general types (Considerations, Designs, Landscapes, Outlines, Standards and Visions) instead of producing and maintaining heaps of EA artifacts necessary to describe organizations in every detail. The second problem can be addressed by clearly distinguishing business-focused EA artifacts (Considerations, Outlines and Visions) and IT-focused EA artifacts (Designs, Landscapes and Standards). Business-focused EA artifacts should be represented as simple, intuitive, preferably one-page diagrams convenient for decision-makers. They should present only the most essential information in a brief summarized form consumable even to executive-level audience. On the contrary, IT-focused EA artifacts should provide detailed and specific information with all the relevant details. They can be represented in any form using any reasonable formats or special sophisticated modeling notations, e.g. ArchiMate, UML, ARIS or BPMN. Finally, the third problem can be addressed by integrating the processes around Considerations and Visions with normal strategic management and decision-making processes, integrate the processes around Designs and Outlines into the regular project lifecycle, while the processes around Landscapes and Standards can be carried out largely independently within architecture functions. These recommendations can help architects establish working EA practices and increase the unsatisfactory success rate of EA initiatives.

Conclusion

The resulting descriptive theory of the roles of EA artifacts suggests that different types of EA artifacts are used by different stakeholders for different purposes and bring different benefits. Unsurprisingly, different types of EA artifacts have significantly different properties and features. Consequently, EA can be hardly conceptualized as a homogeneous description of multiple aspects of an organization that is developed and then used, but rather as a collection of diverse EA artifacts with their own specific purposes, roles, developers, users and lifecycles. The fact that different EA artifacts have different developers, users and lifecycles suggests that the phrases “develop EA” and “use EA” in most contexts are meaningless and essentially synonymous to “write a library” and “read a library”. As the results of this study demonstrate, no individuals or groups of individuals develop and use the entire EA, but only separate artifacts or subsets of artifacts constituting EA in specific use cases.

Therefore, we argue that all the various types of EA artifacts should not be “lumped” together under the single umbrella title of EA, but should be studied separately instead due to a variety of their roles, purposes and other critical properties. However, as it was discussed above, the existing EA literature typically considers EA largely as a “black box” providing a comprehensive description of an organization, but rarely focuses on the roles of specific types of EA artifacts. Moreover, the inability to recognize the existence of different types of EA artifacts often leads to considerable confusion in the EA discipline. For example, both Ross et al. (2006) and Lankhorst (2013) discuss “enterprise architecture”, but provide very different descriptions of “enterprise architecture” because Ross et al. (2006), in fact, discuss the usage of Visions, while Lankhorst (2013) actually discusses the modeling language suitable mostly for Landscapes and Designs.

To summarize, we argue that the EA research community should refocus from studying the properties of EA in general (as a collection of all artifacts) to studying the properties of individual artifacts constituting EA, including their desired properties, purposes and use cases, since the focus on concrete EA artifacts can arguably lead to a much better understanding of the notion of EA as well as the essence of an EA practice.

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