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TOGAF-based Enterprise Architecture Practice: An Exploratory Case Study

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Abstract:

Organizations use enterprise architecture (EA), which describes an enterprise from an integrated business and IT perspective, to improve business and IT alignment. The literature describes many different methodologies to organize EA practice. However, organizations typically adapt these EA methodologies to their specific needs rather than use them directly “out of the box”. As a result, actual EA practices often differ substantially from the original EA methodologies. Unsurprisingly, establishing a successful EA practice remains troublesome even though multiple detailed methodologies exist. However, researchers have yet to investigate the adaptation of EA methodologies in organizations. In this paper, based on an in-depth qualitative case study, I explore the adaptation of the most popular EA methodology, TOGAF, to address this gap. In this paper, I holistically describe a TOGAF-based EA practice and analyze the adaptation of the TOGAF methodology in an organization. From my findings, I conclude that none of the TOGAF-specific recommendations proved useful in the studied EA practice. Supported by ample indirect evidence available in the existing EA literature, this study questions the value of TOGAF as a standard for EA practice. Moreover, the studied EA practice hardly resembles any established EA methodologies or theoretical conceptualizations. Therefore, the EA practice that this case study describes presents a new, largely unexplored empirical phenomenon. Although this study raises multiple “inconvenient” questions challenging the status quo in the EA discipline, it does not provide definite answers to most of these questions, which calls for further research on methodological aspects of EA practice.

Keywords: Enterprise Architecture (EA), Methodology, TOGAF, Adaptation, Case Study, Management Fads.

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1 Introduction

IT has a significant role in contemporary enterprises. Companies spend considerable amounts of money investing in IT. However, in order to realize the full potential value of IT investments, an enterprise needs to align its IT strategy with its business strategy (Byrd, Lewis, & Bryan, 2006; Gerow, Grover, Thatcher, & Roth, 2014; Henderson & Venkatraman, 1993). While we may broadly understand an enterprise as “any entity that has a bottom line and a set of goals to meet it” (Armour, Kaisler, & Liu, 1999b, p. 35), enterprise architecture (EA) describes an enterprise from an integrated business and IT perspective that the enterprise can use to bridge the communication gap between business and IT stakeholders. Using EA helps companies to improve their business and IT alignment and brings a number of other benefits (Bradley, Pratt, Byrd, & Simmons, 2011; Schmidt & Buxmann, 2011). Unsurprisingly, the majority of large companies practice EA (Ambler, 2010; van der Raadt, Slot, & van Vliet, 2007), and it significantly contributes to their success (Lagerstrom, Sommestad, Buschle, & Ekstedt, 2011; Ross, Weill, & Robertson, 2006; Tamm, Seddon, Shanks, & Reynolds, 2011).

The EA literature describes many different EA methodologies to organize EA practice (Bernard, 2012; FEAF, 1999; Spewak & Hill, 1992), such as TOGAF (TOGAF, 2011), currently the most popular EA methodology (Cameron & McMillan, 2013; Obitz & Babu, 2009). However, their straightforward usage often results in significant practical problems (Lohe & Legner, 2014). Moreover, the strict following of EA methodologies and frameworks is recognized as one of the worst EA practices (Bloomberg, 2014; Burton, 2009). Therefore, companies typically adapt existing EA methodologies to their specific needs or even use them only as idea contributors (Aziz & Obitz, 2007; Buckl, Ernst, Lankes, Matthes, & Schweda, 2009a; Lange & Mendling, 2011; Obitz & Babu, 2009).

Due to this adaptation, actual working EA practices often differ substantially from the original prescriptions that popular EA methodologies provide (Haki, Legner, & Ahlemann, 2012; Holst & Steensen, 2011). Unsurprisingly, even in the presence of detailed EA methodologies, successfully practicing EA remains a challenging endeavor for many companies, and as much as 40 percent (Zink, 2009), 66 percent (Roeleven, 2010), 80 percent (DiGirolamo, 2009), or even more than 90 percent (Jacobson, 2007) of them fail to reap the envisioned benefits from using EA.

Despite the evident practical importance, researchers have not yet adequately described or thoroughly investigated the adaptation of EA methodologies in organizations (Winter, Buckl, Matthes, & Schweda, 2010). In particular, researchers have yet to clearly explain how exactly organizations should modify EA methodologies as part of this adaptation and to what extent resulting EA practices overlap with the actual prescriptions of the original EA methodologies. In order to address this gap, in this paper, I study how organizations adapt the most prominent EA methodology, TOGAF. Specifically, I answer the following research question (RQ):

> **RQ**: What does a resulting TOGAF-based EA practice look like and to what extent does it resemble the framework’s original prescriptions?

I deliberately focus only on the “hard” side of EA practice (e.g., what activities organizations perform and what documents they produce) rather than on some “softer” aspects (e.g., motivation, success factors, etc.). In this study, I 1) systematically describe the EA practice in an organization after it has adapted TOGAF with its main actors, artifacts, and processes and 2) analyze how the organization adapted the TOGAF methodology, understand what specific prescriptions it found useful and adopted, and what recommendations it found impractical and rejected.

Importantly, in this study, I do not develop any new theories but rather make an empirical contribution to EA theory (Agerfalk, 2014; Avison & Malaurent, 2014; Hambrick, 2007); that is, I provide “a novel account of an empirical phenomenon that challenges existing assumptions about the world or reveals something previously undocumented” (Agerfalk, 2014, p. 594). This paper is deliberately “atheoretic” (Miller, 2007) and belongs to “theory-light” papers (i.e., to papers “where theory plays no significant part in the paper and the contribution lies elsewhere, for example, new arguments, facts, patterns or relationships” (Avison & Malaurent, 2014, p. 327). These papers “might be rich qualitative descriptions of important but unexplored phenomena that, once described, could stimulate the development of theory and other insights” (Hambrick, 2007, p. 1350). They “focus on describing interesting empirical phenomena that may eventually have theoretical implications” (Agerfalk, 2014, p. 595).

This paper continues as follows: in Section 2, I describe existing EA methodologies including TOGAF, their adaptation to the needs of organizations, and the reasons for this study. In Section 3, I describe the research design and data-collection and data-analysis procedures. In Section 4, I describe in detail a TOGAF-based EA practice in the studied organization. In Section 5, I analyze how the organization adapted TOGAF methodology. In Section 6, I explain why the observations from this single case can generalize to the overall industry situation. In Section 7, I discuss the implications of this study, its contributions and limitations, and directions for future research. Finally, in Section 8, I conclude the paper.

2 EA Methodologies, TOGAF, and Their Adaptation

In this section, I discuss existing EA methodologies, TOGAF as the most popular EA methodology, the adaptation of these methodologies in organizations, and, finally, formulate the reasons and motivation for this study.

2.1 Existing EA Methodologies

An EA methodology refers to a repeatable and consistent process that defines the steps that an organization should follow to practice EA and the EA deliverables that it should develop during each of these steps (Bernard, 2012; Spewak & Hill, 1992; TOGAF, 2011). The EA literature describes numerous EA methodologies that various organizations, consultancies, and independent experts have proposed (Armour et al., 1999b; Bernard, 2012; Bittler & Kreizman, 2005; Boar, 1999b; Carbone, 2004; Covington & Jahangir, 2009; FEAF, 1999; Holcman, 2013; IBM, 2006; Longepe, 2003; Niemann, 2006; Schekkerman, 2008; Spewak & Hill, 1992; TAFIM, 1996b; Theuerkorn, 2004; TOGAF, 2011; van't Wout, Waage, Hartman, Stahlecker, & Hofman, 2010), and these methodologies describe in detail what processes organizations should follow and what documents they should develop to practice EA. Spewak and Hill's (1992) seminal EA methodology has arguably inspired all these methodologies (Spewak & Tiemann, 2006), which generally recommend following five essential steps to practice EA: 1) document the current state of an entire enterprise in detail, 2) describe comprehensively the desired future state of the entire enterprise, 3) analyze the gaps between the current and future states, 4) prepare a roadmap to transition from the current state to the future state, and 5) implement the roadmap. Some of these EA methodologies are more "lightweight" (Theuerkorn, 2004), while others emphasize the importance of a formal EA development process (Spewak & Hill, 1992; TOGAF, 2011), extensive formal modeling (Boar, 1999b; Longepe, 2003), or the partitioning of enterprises into independent units (Bernard, 2012; FEAF, 1999). However, all these EA methodologies are conceptually similar because they share the same general five-step logic that Spewak and Hill's (1992) seminal EA methodology pioneered.

The literature suggests that an EA documentation should necessarily include the current state, future state, and roadmap (Bernard, 2012; FEA, 2001; Joseph, 2009) and that one should structure it to a certain EA framework that one should choose when beginning to practice EA (Armour, Kaisler, & Liu, 1999a; Armour et al., 1999b; Bernard, 2006, 2012; Blumenthal, 2005; Boar, 1999a, 1999b; Schafrik, 2011). Therefore, despite the existence of multiple different EA methodologies, the EA literature generally describes EA practice as a five-step process that involves documenting the current state, describing the future state, analyzing the gaps, preparing the roadmap for transition, implementing it, and using frameworks to structure the EA documentation.

2.2 TOGAF as the Most Popular EA Methodology

Even though multiple similar EA methodologies exist, industry surveys have found that more organizations use The Open Group Architecture Framework (TOGAF, 2011) as their EA methodology than any other (Cameron & McMillan, 2013; Obitz & Babu, 2009). The Open Group claims that TOGAF is "the most prominent and reliable enterprise architecture standard in the world" that 80 percent of companies from the Global 50 list and in 60 percent of companies from the Fortune 500 list use (The Open Group, 2016b, p. 1). Currently, TOGAF has more than 75,000 certified individuals worldwide (TOGAF, 2018), and The Open Group positions it as a universal EA framework applicable to diverse industries (The Open Group, 2016a). Unsurprisingly, some authors (Brown & Obitz, 2011; Dietz & Hoogervorst, 2011; Gosselt, 2012; Lankhorst, Quartel, & Steen, 2010; Sarno & Herdiyanti, 2010; Sobczak, 2013) even consider TOGAF to be a de facto industry standard in EA practice.

TOGAF has two critical elements: the architecture development method (ADM) and architecture content framework (ACF). As TOGAF (2011, p. 330) notes: "The ADM describes what needs to be done to create an architecture and the content framework [ACF] describes what the architecture should look like once it is done". Both the ADM steps and ACF deliverables are considered as either core elements ("fundamental concepts that form the essence of TOGAF" (TOGAF, 2009, p. 18)) or mandated elements ("normative parts of the TOGAF [which] are central to its usage and without them the framework would not be recognizably TOGAF" (TOGAF, 2009, p. 18)) of TOGAF. Therefore, TOGAF as a comprehensive EA methodology defines both the steps and deliverables of EA practice in detail. Similarly to other EA methodologies (Armour et al., 1999b; Bernard, 2012; Spewak & Hill, 1992), TOGAF describes EA practice essentially as a five-step iterative process that comprises documenting the current state, describing the future state, analyzing the gaps, developing the roadmap, and implementing it. One can combine TOGAF with popular modeling languages and notations including ArchiMate (Lankhorst & van Drunen, 2007), UML and BPMN (Desfray & Raymond, 2014).

2.3 Adaptation of EA Methodologies in Organizations

Despite the apparent consensus in the EA literature on the essential elements of EA methodologies, such as the steps organizations should follow and how they should organize EA documentation, organizations that use these methodologies in a straightforward way often encounter three practical problems (Kotusev, Singh, & Storey, 2015; Lohe & Legner, 2014): 1) companies need to expend unreasonable efforts to develop and maintain the EA documentation due to high organizational complexity, large scope, and vibrant environment; 2) the EA documentation is barely used due to its poor quality, obsolescence, wrong level of detail, and mismatch with real information needs; and 3) organizations poorly accept the EA practice due to its isolated nature and insufficient integration with normal organizational processes. Moreover, practitioners recognize strictly following EA methodologies and frameworks as one of the worst EA practices (Bloomberg, 2014; Burton, 2009).

Unsurprisingly, most companies simplify and adapt existing EA methodologies to their specific needs or even use them only as idea contributors (Anderson, Backhouse, Townsend, Hedges, & Hobson, 2009; Aziz & Obitz, 2007; Bloomberg, 2014; Buckl et al., 2009a; Lange & Mendling, 2011; Obitz & Babu, 2009; Smith, Watson, & Sullivan, 2012; Winter et al., 2010). For instance, Buckl et al. (2009a) surveyed 18 companies and found that none used EA methodologies and frameworks without appropriately adapting them. Consequently, to use a particular EA methodology, an organization normally needs to adapt its steps and deliverables to its specific needs.

At the same time, adapting EA methodologies in practice can significantly distort their original prescriptions. For instance, Haki et al. (2012, p. 1) argue that "very few" companies actually follow the specific steps that EA methodologies prescribe. Feedback from EA practitioners suggests that the comprehensive EA documentation that EA methodologies recommend is unnecessary, impractical, or even unachievable (Basten & Brons, 2012; Beeson, Green, Sa, & Sully, 2002; Erder & Pureur, 2006; Kim & Everest, 1994; Lohe & Legner, 2014; Schmidt & Buxmann, 2011). Many companies do not use any specific EA frameworks (taxonomies) to organize their EA documentation as EA methodologies recommend (Aziz & Obitz, 2007; Basten & Brons, 2012; Buckl et al., 2009a; de Vries & van Rensburg, 2009; Fallmyr & Bygstad, 2014; Haki et al., 2012; Holst & Steensen, 2011; Janssen, 2012; Lange & Mendling, 2011; Molnar & Proper, 2013; Obitz & Babu, 2009). Therefore, organizations often reject even the most essential prescriptions of existing EA methodologies when adapting them in practice.

2.4 Research Question

Despite the evident difference between popular EA methodologies that the literature describes and the actual EA practices that organizations adopt after adapting them, the adaptation of EA methodologies and frameworks in practice has never been adequately explained or purposefully researched. For instance, Winter et al. (2010, p. 6) notice that "adapting an approach to company-specific needs is neglected in all investigated EA management approaches except TOGAF, which only states that the ADM should be adapted without specifying how". Therefore, the adaptation of existing EA methodologies in organizations still remains an unexplored area in EA research that has significant practical importance.

In order to address this gap in this research I study how organizations adapt TOGAF as the most definitive and widely known EA methodology. Specifically, I describe what an organization's EA practice looks like after it has adapted TOGAF and analyze the extent to which it resembles the framework's original prescriptions (see research question in Section 1). In other words, I explore how exactly an organization adapted the TOGAF methodology, which TOGAF steps and deliverables it actually used after adapting it, how the resulting EA practice worked, and to what extent the resulting EA practice correlated with the TOGAF methodology's original prescriptions.

3 Research Design

This research is qualitative, inductive, and exploratory in nature because the EA literature does not describe the question I investigate well enough to formulate any reasonable deductive propositions or quantitative hypotheses. Therefore, I selected the case study research method because it constitutes the most suitable approach to qualitatively study a contemporary unexplored phenomenon in its full complexity and natural settings (Eisenhardt, 1989; Yin, 2003). I focused specifically on a single case study because the approach suits both my research question and a detailed exploratory analysis, which prioritizes depth over breadth (Benbasat, Goldstein, & Mead, 1987; Yin, 2003).

3.1 Data Collection

To answer my research question, a case organization needed to have: 1) been large and complex enough to really need a full-fledged EA practice, 2) had a permanent EA team and consistent EA-related processes, 3) practiced EA for a prolonged period of time, and 4) used TOGAF as the basis for its EA practice. Therefore, I chose a large educational institution with a reputation as one of the most advanced IT adopters among Australian universities as a case organization for my research. From the perspective of the TOGAF adaptation, one can consider this case to be typical (Yin, 2003) because 1) the organization had a reasonable “average” size of around 500 IT staff; 2) The Open Group positions TOGAF as a universal industry-agnostic framework that numerous organizations across the globe from 26 diverse industries use, which includes 19 universities (The Open Group, 2016a); and 3) neither TOGAF nor any other EA literature suggests any possible industry-specific methodological differences in EA practice.

I collected data for this study from two sources: semi-structured interviews and documents. First, I conducted nine face-to-face interviews with individuals who had directly participated in the EA practice in the organization: three with the director of architecture, one with a solution architect, one with an engagement manager, one with two solution consultants, one with a project manager, one with a business analyst, and one with a technical subject-matter expert. The interviews lasted between 30 and 60 minutes. In order to ensure I collected consistent data, I used two separate interview protocols (one for architects and one for non-architects) to guide the interviews. In particular, the interview protocol for architecture-side participants involved discussing the overall mechanics of the organization’s EA practice, the main EA documents and their stakeholders, key EA-related processes and their participants, and other relevant questions. The interview protocol for non-architecture participants involved discussing their role in the EA practice, their use of EA documents, their benefit from using EA documents, their communication with other participants of the EA practice, and other relevant questions. I recorded all interviews with the permission of interviewees and transcribed them verbatim for further analysis.

Second, I received full access to the organizational EA repository and analyzed more than 200 various EA documents, including samples of all the different document types that the interviewees described. In analyzing the EA documentation, I focused specifically on studying their informational content, volume, format, and representation. Further, I matched the documents against their typical use cases that the interviewees described to ensure consistency and triangulate the findings. With this procedure, I could validate the observations from two independent sources and ask appropriate clarifying questions during the subsequent interviews when inconsistencies arose. As a result, I studied, analyzed, and cross-checked all types of EA documents used in the organization against their regular usage.

When collecting data, I used a theoretical sampling technique to select interviewees that would likely provide new, interesting, and unique perspectives on the organization’s EA practice (Eisenhardt, 1989). Although I used the standardized semi-structured interview protocols that I describe above to guide all the interviews, I prepared slightly different questionnaires for each interviewee in order to leverage the knowledge I gained from all the previous interviews. In each interview, I also asked additional and clarifying questions that covered theoretically important aspects in order to construct an unambiguous conceptual picture of the organization’s EA practice. I stopped collecting data when a consistent picture emerged and I reached theoretical saturation (i.e., new interviews did not add any significant facts about the mechanics of the studied EA practice) (Glaser & Strauss, 1967; Strauss & Corbin, 1998).

3.2 Data Analysis

Since I focus on making an empirical contribution with this study (Agerfalk, 2014; Avison & Malaurent, 2014; Hambrick, 2007), it is deliberately atheoretic (Miller, 2007); that is, it neither uses any theories for data analysis nor produces any theories as a result. On the one hand, an empirical contribution "reveals insights into a phenomenon, and does not have to rely explicitly on any a priori conceptualizations" (Agerfalk, 2014, p. 594), and atheoretic research in general "may bear little or no connection to pre-existing or future theory" (Miller, 2007, p. 182). On the other hand, using any theoretical lenses for data analysis can have several significant downsides. First, focusing an analysis around any specific theory can essentially mean "to look under the lamppost because that is where there is light (i.e., theory) rather than at other phenomena that may be as or even more important" (Helfat, 2007, p. 186). Second, choosing an inappropriate theory for analysis often results in "a contorted, misshapen, inelegant product, in which an inherently interesting phenomenon has been subjugated by an ill-fitting theoretical framework" (Hambrick, 2007, p. 1349). Third, "the empirical account would be unlikely to be as rich because only facts relevant to the chosen theory would be reported" (Agerfalk, 2014, p. 595). Fourth, "it is just those data that do not fit the theory that might signal further research and potentially provide a much greater contribution" (Avison & Malaurent, 2014, p. 329). Fifth, "it may create a sense of theoretical belonging of the findings that may militate against the use of the findings in future studies with different theoretical affinities" (Agerfalk, 2014, p. 595). Therefore, with this study, I focus on "provid[ing] a rich account of an empirical phenomenon without theorizing about the findings" (Agerfalk, 2014, p. 594).

Even though I do not focus on developing any theories, I selected the Straussian version of the grounded theory method (GTM) (Corbin & Strauss, 1990; Strauss & Corbin, 1998) as the most suitable data-analysis approach because it can help one to richly describe "a phenomenon based on a systematic exploration of the accounts of the phenomenon" (Birks, Fernandez, Levina, & Nasirin, 2013, p. 2). Similarly, Fernandez (2004, p. 45) argues that one can use "the constant comparative method [constituting the core of the grounded theory]…to produce either conceptualizations or rich descriptive accounts". Therefore, using the Straussian GTM as the data-analysis method suits my focus on systematically describing an organization's EA practice after it has adapted TOGAF.

When analyzing the data, I followed the Straussian GTM's essential steps: open coding, axial coding, and selective coding (Corbin & Strauss, 1990; Strauss & Corbin, 1998). The first step (open coding) involved 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 a list of major concepts and categories including documents, events, processes, actors, and entities. The second step (axial coding) involved 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 a relationship network that explained the connections between all the concepts and categories that I previously identified during the first step. The final step (selective coding) involved selecting EA documents 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 that described the studied phenomenon. This step resulted in a rich, systematic, and rigid description of the organization's EA practice (see Section 4). Table 1 provides examples of the open-coding procedure applied as part of the grounded theory data analysis.

As the grounded theory method suggests, I concurrently analyzed the data as I collected it (Glaser & Strauss, 1967; Strauss & Corbin, 1998). Therefore, I analyzed the data in an iterative and adaptive fashion and relied on the constant-comparison technique. In order to minimize the potential influence of existing theories on my analysis and stay atheoretic (Miller, 2007), I followed the principles of "direct" research that Mintzberg (1979) advocates. In particular, I tried to be as purely descriptive as possible, as purely inductive as possible, to rely on first-hand data-collection methods, and to formulate questions in "real organizational terms".

Table 1. Examples of the Open Coding Procedure

Original quotes	Concepts and categories
Director of architecture: "Engagement managers [1] speak directly with the business [2] to understand the demand for projects [3] we have coming in. They will be engaged with a solution consulting team [4], …and the solution consulting team internally engages the architecture team [5]. Typically within the architecture engagement what happens is first we take the captured requirements and turn those into the conceptual architecture [6]. That is basically enough, so we can size up the piece of work, decide roughly where the solution space is, figure out how big it is and give the business stakeholders an idea of how much do they need to invest in order get this. [7]".	[1] Engagement managers (actors) [2] Business customers (actors) [3] Identify needs (processes) [4] Solution consultants (actors) [5] Solution architects (actors) [6] Conceptual architectures (documents) [7] Estimate projects (processes)
Director of architecture: "There are a number of different prioritization aspects [1] that occur. ...Stuff like maxims [2] fit is an input into that process. ...We have certain custody of projects where they are prioritized. Essentially what happens is we decide what gets above the line, what gets done [3]. That goes to seniors stakeholders within the university and there is a governance process that goes up to ICT steering committee [4] and they approve what projects will go ahead [5].".	[1] Prioritize projects (processes) [2] Maxims (documents) [3] Prioritize projects (processes) [4] ICT steering committee (actors) [5] Prioritize projects (processes)
Project manager: "Conceptual architecture document [1] will say "the business case of the project is we want to do this, this and this, and this is what it all looks like conceptually". Then to go to the next stage we actually do a very detailed solution design document [2]. This is actually the next document that we produce architecturally [...]. The architect [3] does the actual solution design [4] and this is what we are going to implement specifically as part of that project [5].".	[1] Conceptual architectures (documents) [2] Solution designs (documents) [3] Solution architects (actors) [4] Design projects (processes) [5] Implement projects (processes)

4 EA Practice at Central Australian University

In order to accomplish the first goal of this study (i.e., provide a holistic methodology-focused description of the TOGAF-based EA practice), I describe the organization's overall context, its EA function, participants in the EA practice, EA documents, and EA-related processes in the organization.

4.1 Organization Overview

Central Australian University[1] is one of the largest Australian teaching and research universities and provides various educational services to international undergraduate, postgraduate, and vocational students across a wide spectrum of specialties including business, law, engineering, information technology, chemistry, social sciences, arts, medicine, and other areas. The university has a long history and consistently ranks in the QS World University Rankings. Currently, it has several academic campuses in Australia and overseas that serve more than 38,000 students from different countries from which it earns close to one billion Australian dollars in revenues. Central Australian University has several faculties that comprise multiple academic schools. In total, it employs more than 7,000 people including administrators, permanent academic staff, casual teachers, and invited researchers.

Central Australian University has a central IT department that provides planning, delivery, and support services to all faculties and schools. The IT department reports to the vice-president of resources and includes the following subunits: engagement, application delivery, infrastructure delivery, client computing, service management, and enterprise architecture. At the time of writing, the IT department employs more than 500 IT specialists including system administrators, developers, and architects.

Central Australian University, an early IT adopter, has critically depended on IT in its daily operations for more than a decade. Its IT landscape implements the unification operating model (Ross, 2005; Ross et al., 2006; Weill & Ross, 2009) and includes more than 200 applications, varieties of technologies, and infrastructure. The investments in new IT projects in the yearly IT budget exceed 55 million dollars. The university follows a standardized staged project delivery methodology and actively leverages other

[1] I have modified the name and some quantitative facts about the university due to strict anonymity requirements.

established IT management practices (e.g., it uses ITIL for service management and plans to adopt COBIT in the future). Central Australian University is committed to using cutting-edge technologies to provide high-quality educational services to its students. It is among the leading universities in adopting and using IT for supporting education in Australia.

Although the educational business is not very dynamic compared to many other businesses, the speed at which it changes has continued to accelerate. In order to attract research funding and collaborate on an international basis, education businesses now must have a support network and infrastructure technologies in place. The emergence of free online education through which people can receive information that has a comparable quality to traditional education has made universities look for new and innovative value propositions. The ongoing deregulation of education in Australia allows many private education providers to compete with established public universities. All these changes in the business environment make universities struggle to keep up with the required rate of change.

The accelerating pace of the educational business has forced Central Australian University to improve how it plans its IT systems with EA. Additionally, the pressing need to reduce complexity of the IT landscape, improve efficiency, integrate and consolidate the disparate parts of the organization promoted the EA program. Thus, the university had two major milestones. First, it sought to introduce EA as far back to 2007 when the chief architect and two subordinate solution architects started developing first architectural documents. Although this effort did not establish a true enterprise-wide architecture planning, it stimulated architectural thinking and resulted in a disciplined approach to solution architecture planning and delivery at the university. Second, the organization sought to improve its EA practice from solution-level architecture planning established previously to enterprise-level architecture planning. As part of this endeavor, the university started to attract architects who had previous experience with EA in the public sector instead of relying on internal staff. The inflow of external expertise helped the university organize a permanent EA function and mature its EA capability initially to enterprise-wide technology planning and then to true business-oriented EA planning. Therefore, the university established its consistent value-adding EA practice in its present form in 2012, but it continues to evolve toward greater maturity.

4.2 EA Function

The EA function at Central Australian University is centralized and responsible for planning the information systems for all units of the university. The deputy director of architecture, who focuses on maturing the EA practice and who describes himself as a manager of architects and not a chief architect, heads the EA department. The EA function uses TOGAF (2011) as its key guiding framework.

The EA function employs 20 architects (four enterprise architects and 16 solution architects). Enterprise architects work on an enterprise level and constitute the core of the architecture team. Each of the four enterprise architects is responsible for one major domain (business, applications, integration and data, and infrastructure) across the organization. They develop global principles, standards, roadmaps, and other architectural documents relevant to their domains. On the contrary, solution architects work on a project level in project teams and spend most of their time developing architectural documents for their individual IT projects. Solution architects closely collaborate with enterprise architects in order to ensure that the project architectures they produce conform to the established maxims, principles, and standards of the corresponding domains. Many of the solution architects are contractors that the university specifically hires to work on particular types of projects. The university encourages all architects to obtain TOGAF certification, and most had it when I conducted the study. Figure 1 shows the organization of the EA function at the university.

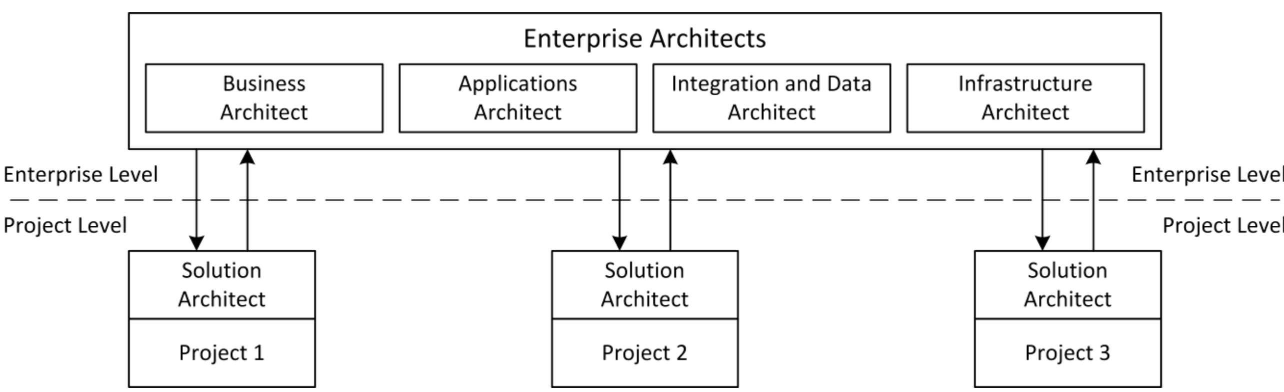

Figure 1. Organization of the EA Function

4.3 Other Participants of the EA Practice

Apart from enterprise and solution architects, the EA practice at Central Australian University has several other participants who collaborate with architects on various EA-related activities. These groups of participants range from executive-level business managers to rank-and-file IT specialists. Table 2 describes major participants of the EA practice.

Table 2. Major Participants of the EA Practice

Participant	Description
ICT steering committee	The information and communications technology (ICT) steering committee is the top-level governance body of the university and comprises the most senior executives who approve, prioritize, and fund IT projects.
Business customers	Business customers are typically the heads or representatives of various business units of the university who run and manage their units.
Engagement managers	Engagement managers are the "front door" to the IT department for business customers of the university. They communicate with business customers from different units of the university and discover their demand for new IT projects.
Solution consultants	Solution consultants collect high-level business requirements for IT projects from business customers.
Business analysts	Business analysts elicit and collect detailed business requirements for IT projects from their future users.
Project managers	Project managers manage project implementation activities and communicate with users and other business stakeholders of IT projects.
Project implementers	Project implementers include software developers, team leads, technical designers, testers, database administrators, infrastructure experts, and other IT specialists responsible for actually implementing IT projects.

4.4 EA Documents

A well-defined set of architectural documents logically separated into four broad categories—investment and planning, consulting, governance, and project documents[2]—supports the EA practice at Central Australian University:

- The investment and planning documents help business managers to plan and make decisions about investments and include the program of work, business capability model (BCM), and roadmaps.
- The consulting documents help technical architects to understand possible options for project implementation and include the technology reference model (TRM) and one-page diagrams.
- The governance documents describe global enterprise-wide rules applicable to all projects or to certain types of projects and include maxims, principles, and standards.
- The project documents describe designs of individual IT projects, their alignment and fit to the overall architecture, and include conceptual architectures and solution designs.

Table 3 briefly describes each category. Appendix A describes these EA documents in more detail and provides examples.

[2] The university itself uses the titles of documents and categories that I present here; however, some of them arguably poorly reflect the purpose and usage of the corresponding documents.

Table 3. Main EA Documents

Category	Document	Description
Investment and planning	Program of work	The program of work contains the list of all projects chosen for implementation in the upcoming year and approved for funding.
	Business capability model (BCM)	The business capability model provides a high-level holistic view of the whole university. It shows all the organizational capabilities/subcapabilities and the organizational goals, customers, suppliers, partners and stakeholders in a simple structured manner (see Figure 5).
	Roadmaps	Each business unit of the university has its own roadmap that shows all the information systems and technologies relevant to this unit. Roadmaps show the systems of four different types: 1) implemented systems currently used by the business unit, 2) systems being implemented now, 3) planned systems approved for implementation in the future, and 4) systems that the business unit needs but not yet approved for implementation. They also show expected beginning and completion dates for planned systems and systems in the implementation stage (see Figure 9).
Consulting	Technology reference model (TRM)	The technology reference model lists all the available technologies that IT projects should use including programming languages, application servers, operating systems, database management systems, integration buses, and many other technologies (see Figure 12).
	One-page diagrams	One-page diagrams show the relationship and interaction between various information systems that depict different parts of the organizational IT landscape in their current states and sometimes in their planned future states (see Figure 7).
Governance	Maxims	Maxims are very high-level business and IT principles applicable to all projects (see Table 7).
	Principles	Principles are brief reusable implementation-level rules applicable to broad categories of IT projects (see Table 8).
	Standards	Standards are reusable low-level technical rules and patterns applicable to narrow and specific situations (see Figure 11).
Project	Conceptual architectures	Conceptual architectures describe goals, objectives, high-level designs, and major design options for individual IT projects detailed enough to estimate their size, time, and cost (see Figure 6).
	Solution designs	Solution designs describe detailed designs of individual IT projects actionable for project teams implementing them (see Figure 10).

Each EA document at the university has specific developers (including principal developers, contributors, and reviewers) and users (including regular users and occasional users). Figure 2 shows the developers and users of EA documents in matrix form.

Central Australian University takes a simplistic approach towards creating, storing, and distributing EA documentation and does not use any specific EA software tools. Google Drive serves as a central repository for all EA documents at the university and has proven to be a useful collaboration platform. The architectural website uses Google Sites and provides a convenient interface for navigating the catalogue and accessing the EA documents stored in Google Drive. Most EA documents are either MS Word documents or graphical diagrams. MS Visio is the key tool used for drawing architectural diagrams, no specific formal modeling notations are used for that purpose. For presentation purposes, architects typically wrap EA documents in MS PowerPoint files. Most EA documents have standardized templates that facilitate their development. Each project has a standardized documentation structure on the shared drive accessible to all staff.

Most stakeholders work with EA documents electronically and sometimes print them for meetings and discussions. However, enterprise architects and engagement managers post the main EA documents (e.g., the business capability model and roadmaps) on their office walls. All participants of the EA practice try to improve and optimize the EA documentation on a continuous basis.

Documents \ Participants		Enterprise Architects	Solution Architects	ICT Steering Committee	Business Customers	Engagement Managers	Solution Consultants	Business Analysts	Project Managers	Project Implementers
Investment and Planning	Program of Work			D						
	Business Capability Model	D	u	d/U						
	Roadmaps	D			u	U				
Consulting	Technology Reference Model	D	d/U							
	One Page Diagrams	D	d/U							
Governance	Maxims	D	U	d/U						
	Principles	D	d/U							
	Standards	D	d/U							
Project	Conceptual Architectures	d	D/U	u			d	U		
	Solution Designs	d	D					d	U	U

[D] – Principal Developers [U] – Regular Users
[d] – Contributors or Reviewers [u] – Occasional Users

Figure 2. Developers and Users of EA Documents

4.5 Processes Constituting the EA Practice

Architects and other participants of the EA practice at Central Australian University work according to established processes that enable business and IT alignment. All alignment processes start from the activities of engagement managers. Five engagement managers visit different business units of the university and communicate with the corresponding business customers in order to understand what new IT projects their business units need and which existing IT systems no one uses anymore and, thus, can be decommissioned. Engagement managers and business customers use roadmaps to facilitate these discussions, which show what IT systems respective business units have now, what IT systems they will have in the short-term future, and what IT systems are envisioned for the long-term future.

After the engagement managers have identified the need for new IT projects, a solution consultant gathers high-level business requirements for each proposed project and then a solution architect uses them to develop a conceptual architecture for the project. Solution architects use the technology reference model (TRM) and one-page diagrams to identify the most reasonable technologies and high-level implementation options for the proposed IT projects. Additionally, solution architects use the business capability model (BCM) to specify which capabilities projects contribute to. After solution architects develop conceptual architectures, the enterprise architects responsible for the corresponding domains approve them in order to ensure they align with and conform to the overall architecture. The resulting conceptual architectures help architects estimate the scope, value, cost, and timelines of all proposed IT projects. After the corresponding business customers agree on these estimates, they make formal business cases for the projects.

Based on these time, cost, and value estimates, once a year, the ICT steering committee prioritizes all proposed IT projects, selects which projects the organization will implement during the upcoming year, and allocates funding for them. However, each business unit also has its own small pool of funding to sponsor the projects critical to it. The ICT steering committee typically selects 80 to 90 percent of all projects that the organization will implement in the following year as a result of the prioritization process, and the centralized IT funding pool funds these projects. In contrast, business units directly fund the other 10 to 20 percent of (mostly small) projects, which avoid the global prioritization process. The ICT steering committee uses the business capability model (BCM) and maxims during the prioritization process to assess how well the proposed IT projects align with the organization's strategic goals, capabilities, and philosophy. However, the organization has only recently introduced BCM and not yet fully mastered it. As a result of these activities, the ICT steering committee produces the program of work for the next year and architects update the roadmaps for all business units to reflect the newly scheduled projects.

Then, after the ICT steering committee has prioritized all proposed IT projects and produced the program of work for the upcoming year, business analysts collect detailed requirements for all IT projects included in the program of work and solution architects develop corresponding solution designs based on these requirements. The conceptual architectures previously developed for these projects serve as a basis for these activities. Solution architects use maxims, principles, and standards in order to ensure that their solution designs comply with established architectural guidelines and reuse standardized solution components. Typically, solution architects develop one solution design for each project based on its conceptual architecture. However, with large projects (which rarely occur), the solution architects split their conceptual architectures into several solution designs to help the organization implement them step by step. Enterprise architects formally review and approve all the solution designs that relate to their domains.

Finally, the solution architects transfer the approved solution designs to project managers and project implementers to implement the projects according to their designs. Solution designs are communicated to all project participants, and they serve as a cornerstone that guides the implementation activities for all projects.

During all the alignment processes (see above), enterprise architects produce, maintain, and provide all the supporting enterprise-level EA documents including the business capability model, technology reference model, roadmaps, one-page diagrams, maxims, principles, and standards. At the same time, other participants of the EA practice also contribute to enterprise-level EA documents. Specifically, senior executives from the ICT steering committee contribute to the business capability model and review maxims, which are updated according to the organizational strategy after its approval. Solution architects contribute to technical EA documents, including the technology reference model, one-page diagrams, principles, and standards.

Figure 3 shows the alignment processes that constitute the EA practice at the university, their main actors, and their supporting EA documents.

The processes that constitute the EA practice at Central Australian University arguably have three notable distinguishing features. First, business customers at the university rarely interact directly with architects. Instead, engagement managers serve as an intermediate link between the IT department and business customers and lead the corresponding discussions between them since business customers and architects find speaking with each other uncomfortable. An engagement manager said: "With all due respect, I would never put the business in front of architects because they will confuse the hell out of them".

Second, roadmaps at the university are used mostly to communicate with business customers and understand their future needs, desires, and requirements and how their business units actually use currently available IT systems. An engagement manager said:

> *[Discussing roadmaps] gets my customers think strategically about what they want to do with their applications. For example, what is it that they want to continue to work with, what they say is not being valuable anymore and we can decommission. So, I work with customers around using these roadmaps [because] half of my customers do not even realize half of the applications they have got in their areas. ...We are maintaining, running, supporting at a significant cost to the university a whole stack of technology and if those customers say "oh, we do not use that system anymore", then we may say "well, let us get rid of it". Until you sit down and have those discussions with them they are often not even thinking about it.*

Third, IT projects at the university usually emerge in a bottom-up manner from the specific needs of different business units, while the top managers of the university represented in the ICT steering committee only select which of these projects the organization will implement according to each business unit's strategic goals and allocate the necessary funding for them. Due to the complex decentralized structure, large scope, and extreme diversity, executives of the university can hardly initiate IT projects effectively in a centralized manner. However, as the director of architecture noted, this rather tactical and reactive decision making model distracts architects' attention away from enterprise-level activities to project-level activities. Moreover, some of the effort they put into developing conceptual architectures for proposed IT projects is wasted since the ICT steering committee does not fund many (or most) of these projects that, therefore, do not proceed further to the actual implementation but remain postponed for the indefinite future. Solution architects' available time represents one of the scarcest resources in this model and causes major bottlenecks in the organization's EA practice.

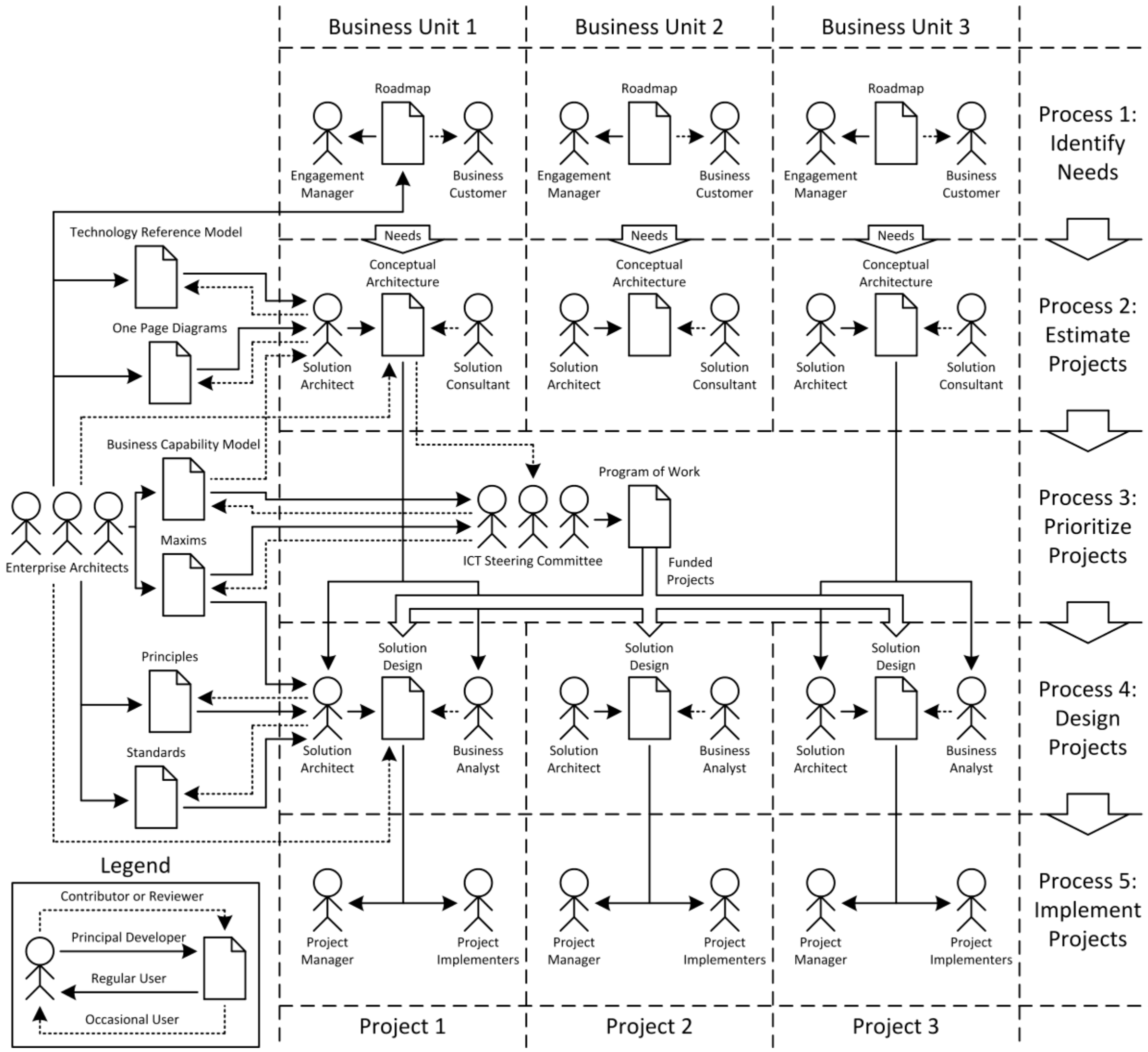

Figure 3. Processes Constituting the EA Practice

5 Adaptation of the TOGAF Methodology at the University

In Section 4, I describe Central Australian University's EA practice after it adapted TOGAF, which answers the first part of the research question. In order to address the second part (i.e., determine the extent to which it resembles the framework's original prescriptions), I compare the actual EA methodology in the organization with the key TOGAF recommendations and then analyze TOGAF's actual influence on the organization's EA practice.

5.1 Comparison of the Original and Adapted TOGAF at the University

From comparing the actual EA methodology at Central Australian University with the original TOGAF methodology that the university used as a basis for its EA practice, I found that the university's actual EA practice incorporated almost no key TOGAF recommendations. For instance, the university adopted only one significant TOGAF recommendation in practice: the use of four domains. However, it did so in an adapted form (business, applications, integration and data, and infrastructure) and added two additional domains that the infrastructure architect largely handled: client computing and security. At the same time, it did not adopt all other core TOGAF recommendations, which includes the architecture development method (ADM), architecture content framework, and enterprise continuum. The university did adopt some less significant TOGAF notions, such as the technology reference model (TRM), principles, and patterns (subtype of standards). The university largely did not use TOGAF terminology. Table 4 summarizes the original TOGAF prescriptions and the extent to which the university adopted them.

Consequently, even though the university used TOGAF as its key EA framework, the actual EA practice at the university largely did not relate to it and differed substantially from its main recommendations. Most importantly, the university did not follow the architecture development method (ADM) that "forms the core of TOGAF" (TOGAF, 2011, p. 45), nor did it follow most other key TOGAF recommendations. Moreover, the university did not even follow the more general "plan the whole enterprise and then implement" logic that the vast majority of EA methodologies advocate (Armour et al., 1999b; Bernard, 2012; Boar, 1999b; FEAF, 1999; Niemann, 2006; Schekkerman, 2008; Spewak & Hill, 1992; van't Wout et al., 2010). Instead, it used a more lightweight, flexible, reactive, and decentralized EA methodology.

The director of architecture admitted that the university did not follow most TOGAF recommendations even though it used TOGAF as its key EA framework:

> *TOGAF is the key framework that we use. [However,] we do not use very much of TOGAF at all. ...The key aspect of TOGAF that is really active at the moment is the partitioning. The domain partitioning that we are using follows the TOGAF type of approach.*

Table 4. TOGAF Recommendations and Their Adoption at Central Australian University

Original TOGAF recommendation	Adopted?	Actual practice (adapted TOGAF)
Four domains (business, data, applications, and technology)	Adopted with modifications	Adapted four TOGAF domains (business, applications, integration and data, and infrastructure) and two additional domains (client computing and security).
Architecture development method (ADM)	Not adopted	Five EA-related processes: needs identification, project estimation, project prioritization, project design, and project implementation (see Figure 3).
Architecture content framework	Not adopted	Ten types of EA documents structured into four categories: investment and planning, consulting, governance, and project documents (see Table 3).
Enterprise continuum	Not adopted	No analogs used.
Reference models	Partially adopted	Used adapted version of the technology reference model (TRM).
Architecture capability framework	Not adopted	Used company-specific governance and maturity models unrelated to TOGAF.
Terminology	Not adopted	Used company-specific terms for all documents, actors, activities, and processes except common terms (enterprise architects, solution architects, principles, standards, etc.). Some architects used the TOGAF terms "architecture building blocks" and "solution building blocks" as synonyms for standards and patterns.
Other recommendations	Some adopted	Used architecture principles and patterns.

The director of architecture explained that one essentially cannot apply the main TOGAF recommendations to a true enterprise-wide architecture:

> *TOGAF really leans itself more to solution architecture, rather than enterprise architecture. It tends to go into a lower level, and if you are trying to mature it to the business architecture space then something like the ADM, which leans itself to the solution architecture space, does not really work.*

An interviewed TOGAF-certified solution architect also argued that one cannot simply successfully follow the core TOGAF recommendations:

> *No one really works according to TOGAF anywhere. ...If you are too rigidly following TOGAF you would never get anything done. ...You cannot blissfully follow the methodology, but you look at it as a collection of tools that you can use.*

He explained that using TOGAF does not imply anything in particular and that even his TOGAF instructor said as much:

> *My TOGAF instructor did say "The whole point of it is take the framework, modify it to work within your organization and from there you get your version of TOGAF". If there is a bunch of things you do not do, just strike them out. If there is a bunch of things you do differently, just modify them.*

5.2 Influence of TOGAF on the Actual EA Practice at the University

The TOGAF recommendations that Central Australian University adopted and rejected (see Table 4) suggest that TOGAF had an insignificant impact on its EA practice since it adopted or partially adopted only a small number of minor TOGAF recommendations and since it rejected and did not incorporate its most significant recommendations into its actual EA practice. At the same time, the TOGAF recommendations that the university adopted or partially adopted are *not* TOGAF specific and do not originate from it. For instance, organizations and researchers have known about the separation of architecture into four domains (business, data, applications, and technology) since at least the PRISM framework appeared (PRISM, 1986), and this separation has arguably become conventional common sense in EA. Different authors have also described the idea of using architecture principles long before TOGAF appeared (Davenport, Hammer, & Metsisto, 1989; King, 1978; PRISM, 1986; Proper & Greefhorst, 2011; Richardson, Jackson, & Dickson, 1990). The notion of architecture patterns originated in software architecture (Gamma, Helm, Johnson, & Vlissides, 1994) and then diffused to enterprise applications architecture (Fowler, 2002), integration architecture (Hohpe & Woolf, 2004), and enterprise architecture (Perroud & Inversini, 2013). Technology reference models were also used before TOGAF (JTA, 1996; TAFIM, 1996a).

Therefore, TOGAF at Central Australian University arguably did not prove useful in *any real sense* because the university did not adopt the core TOGAF features (the ADM most importantly) and the features it did adopt are not TOGAF specific but conventional. Although researchers have already noted that organizations should not follow TOGAF strictly end to end but rather use it only as a toolkit (Anderson et al., 2009; Bloomberg, 2014; Smith et al., 2012), I found that the university did not find the individual tools that TOGAF offers to be useful and that it developed homegrown approaches for the most critical aspects of its EA practice, including both EA documents and processes, from scratch (see Table 4). Consequently, the university's EA practice that it adapted from TOGAF scarcely overlapped at all with TOGAF's actual recommendations. Figure 4 shows the overlap between TOGAF's recommendations and the university's actual EA practice.

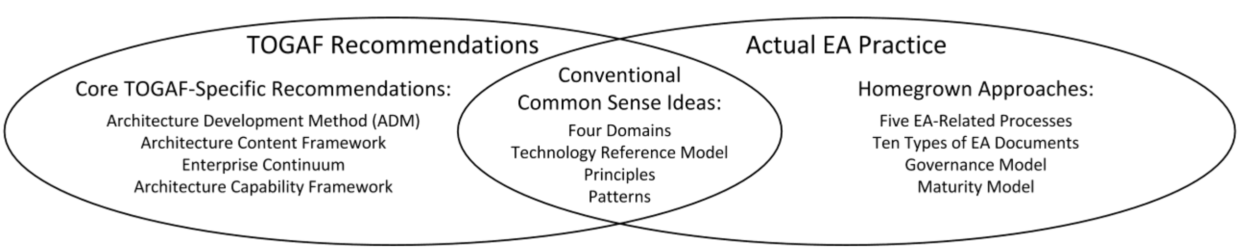

Figure 4. Overlap Between TOGAF Recommendations and the Actual TOGAF-Based EA Practice

Consequently, TOGAF had a negligible influence on the university's EA practice since *none* of the TOGAF-specific recommendations proved useful. Although TOGAF describes itself as "a detailed method and a set of supporting tools" (TOGAF, 2011, p. 3) that provide "a best practice framework for adding value" (TOGAF, 2011, p. 7), my findings question these statements since TOGAF at the university proved useless as a methodology and largely useless as a set of tools except for a small number of non-TOGAF-specific tools that addressed only secondary aspects of EA practice.

6 Can We Generalize These Findings?

In Section 5, I compare Central Australian University's actual EA methodology with TOGAF's recommendations, analyze what influence TOGAF had on the university's EA practice, and, thereby, answer the second part of the research question. To summarize, I conclude that the university's EA practice overlapped with TOGAF's prescriptions only in its conventional ideas (see Figure 4) since the university considered most of the key TOGAF prescriptions to be impractical and, thus, did not adopt them (see Table 4). I now discuss whether one can generalize the resulting conclusions beyond this particular case.

At the first glance, the most intuitive short answer is that one cannot generalize the conclusions beyond this case. After all, one may be able to generalize the findings from a single case only to weak propositions (Yin, 2003). The organization may be in some sense "untypical" and represent a deviation from a widely established norm. The case selection procedure might have accidentally come across a highly peculiar or unique case.

However, more deeply analyzing the findings suggests that the opposite answer is more likely to be true. Moreover, the principal conclusion on the practical inapplicability of TOGAF's key prescriptions seems to be perfectly logical, and I could have predicted it even before conducting my empirical analysis of the data due to a number of highly alarming facts about TOGAF.

First, TOGAF has a dubious historical origin. As TOGAF (2011, p. 3) states: "The original development of TOGAF Version 1 in 1995 was based on the Technical Architecture Framework for Information Management (TAFIM). However, TAFIM was rejected as ineffective. As Perks and Beveridge (2003, p. 79) state: "TAFIM most certainly required a large investment of both time and money", "the elapsed time required to produce the architecture makes it close to obsolete before completion", "the end result is normally incomprehensible to a business-oriented audience and is harder to trace to the business strategy", and "due to some of these flaws, the TAFIM was abruptly cancelled". Therefore, I do not know how TOGAF can represent best practice if its direct predecessor that advocated essentially the same ideas proved ineffective.

Second, TOGAF has no documented examples of its successful practical implementation. For instance, in comprehensively reviewing 1,075 EA publications (Kotusev, 2017), I did not identify even a single real-life example that demonstrates the actual usefulness of TOGAF recommendations. Moreover, even The Open Group cannot provide these examples at the request of its own members as Anderson et al., 2009 (p. 64) note: "One area in which we were hoping that Open Group membership might have helped us was in the provision of case studies and worked examples, but none were forthcoming". They go on to say: "There is a pressing need for some detailed worked examples and use cases. Although these were requested, they were not forthcoming from TOGAF trainers or The Open Group". Therefore, researchers seemingly take the beliefs of high TOGAF utility for granted, and one cannot trace them to any real underlying evidence.

Third, EA practitioners have already reported negative experiences with TOGAF. For example, EA practitioners report that "after an intensive phase of familiarization and an initial workshop, where TOGAF was presented to the involved stakeholders, we decided: thanks, too complicated for us" (Buckl et al., 2009a) and "Our views on TOGAF inevitably changed as the project progressed. Working sequentially through the TOGAF [ADM] cycle ceased to make sense" (Anderson et al., 2009, p. 48). Therefore, my findings about the practical inapplicability of TOGAF's core prescriptions are actually not new.

Fourth, I found it hard to find TOGAF consultants and gurus who have clearly explained how to adapt and use it in practice. During my comprehensive EA literature review (Kotusev, 2017), I found only shadowy attempts to explain how exactly organizations should adapt and use TOGAF. For example, an EA consultant explains that "there's very few people who use the whole ADM but typically people will align their architecture practice at their level of maturity with the relevant aspects of the ADM" (Alwadain, Fielt, Korthaus, & Rosemann, 2014, p. 220). A rather well-known TOGAF guru provides the following explanation:

> *Organizations start with an open framework like the TOGAF framework, but as it gets customized and tailored, it adapts to an organization's culture to become their own "personalized" enterprise architecture model. As enterprise architecture matures in an organization, the TOGAF framework is still inside and powering their enterprise architecture but no longer very visible.* (Viswanathan, 2015, p. 16)

Therefore, the practical usage of TOGAF has never been explained in a clear and straightforward manner.

Fifth, despite the existence of industry surveys that show that many companies use TOGAF (Cameron & McMillan, 2013; Obitz & Babu, 2009), this declarative "usage" does not imply any particular consequences and does not define the resulting EA practice in any real sense. For instance, in conducting a case study of an organization's EA practice after it adapted TOGAF, Smith et al. (2012) found that the organization did not follow TOGAF's main prescriptions, including the ADM and ACF, even though it "used" TOGAF exactly like in the studied case of Central Australian University (see Table 4). Therefore, industry surveys do not prove TOGAF's value since there is little to no correlation between an organization's declaring that it uses TOGAF and the actual prescriptions it follows.

Sixth, since TOGAF has no documented real-life examples, all the beliefs regarding its practical value seemingly build on the claims from The Open Group itself. For example, Alm and Wißotzki (2013, p. 114) argue that "the applicability [of TOGAF] to large enterprises is beyond question, as The Open Group's own website lists some familiar names (The Open Group, 2016a)". However, since these declarations lack independent and objective evidence-based validation, one cannot consider The Open Group's anecdotal claims about the value of its own promoted product as valid or reliable scientific evidence.

Finally, one cannot attribute TOGAF's inapplicability in the studied case organization solely to its specificity (e.g., size, industry or maturity). From the size perspective, Central Australian University employs around 500 IT specialists, and, therefore, can be considered as a reasonably average mid-size organization (i.e., somewhere in the middle of the size spectrum between small organizations that employ tens of IT specialists and large organizations that employ thousands of IT specialists). From the industry perspective, The Open Group promotes TOGAF's ADM as "a generic method, intended to be used by enterprises in a wide variety of industry types and geographies" (TOGAF, 2011, p. 61). The Open Group positions TOGAF as a universal framework applicable to all industries including academia and claims that 19 universities worldwide use it (The Open Group, 2016a). Moreover, The Open Group declares that organizations across 26 diverse industries use TOGAF (The Open Group, 2016a) and that academia falls in the top-five most popular industries that use TOGAF (i.e., 1) finance (41 organizations), 2) central government (24 organizations), 3) IT (20 organizations), 4) academia (19 organizations), and 5) local government (19 organizations)). At the same time, neither TOGAF nor any other EA literature suggests any articulate organization-specific or industry-specific methodological differences in EA practice. From the maturity perspective, the existing EA maturity models (DoC, 2007; GAO, 2003, 2010; NASCIO, 2003; OMB, 2007; Ross, 2003) suggest that one cannot attribute this study's conclusions to low maturity in the case study's EA practice. Therefore, we can conclude that the case study's specific nature or low maturity of its EA practice cannot explain my findings.

Moreover, one can observe the same set of alarming facts with other "definitive" EA frameworks as well. For instance, in comprehensively reviewing the EA literature (Kotusev, 2017), I did not identify any examples that demonstrate an organization's successfully practically applying any EA framework; rather, I found much work that harshly criticizes such frameworks and several documented failures instead. For example, DoDAF proved ineffective even in the U.S. Department of Defense (DOD) for which it was created as at least two sources note: "Despite spending almost 4 years and about $318 million, DOD does not have an effective architecture program" (GAO, 2005, p. ii) and "even though DOD has spent more than 10 years and at least $379 million on its business enterprise architecture, its ability to use the architecture to guide and constrain investments has been limited" (GAO, 2013, p. ii). The FEAF-based federal enterprise architecture (FEA) program also failed as Gaver (2010, p. 6) reports: "Enterprise Architecture within the federal government hasn't been working, and far more often than not hasn't delivered useful results. Moreover, significant parts of the federal EA program have been complete and utter failures.". Different authors have concluded that "the frameworks appear theoretical and impossible to implement" (Buckl et al., 2009a, p. 15) or even "worse than useless" (Tucci, 2011, p. 1). Unsurprisingly, Holst and Steensen (2011, p. 19) have argued that "successful EA [practice] is difficult to create based on a large part of the established and commonly accepted mechanistic inspired EA literature". Indeed, the successful EA practice that Tamm, Seddon, Shanks, Reynolds, and Frampton (2015) describe well hardly resembles any of the popular EA methodologies and frameworks that the literature describes. Therefore, *the entire family of EA frameworks has been actually questioned earlier*.

Even worse, all the previous pre-EA architecture-based planning methodologies have also proven ineffective. We can trace the earliest roots of current EA methodologies back to the business systems planning (BSP) methodology that IBM introduced at the end of the 1960s (Kotusev, 2016). In particular, BSP also recommended developing comprehensive architectures in a step-by-step manner that highly resembles TOGAF's and other EA methodologies' prescriptions (BSP, 1975, 1984). After its introduction, BSP engendered an entire family of analogous stepwise architecture-based planning methodologies with different "flavors" including method/1 (Arthur Andersen, 1979, 1987), information engineering (Arthur Young Technology Group, 1987; Finkelstein, 1989; Martin & Finkelstein, 1981), strategic data/information planning (Martin, 1982; Martin & Leben, 1989), and other less widely known methodologies that various consultancies and gurus proposed (Gallo, 1988; Inmon, 1986; Nolan & Mulryan, 1987; Tozer, 1988). Though promoted under different titles (e.g., information architecture, data architecture, and information systems architecture), all these architecture-based methodologies advocated essentially the same step-by-step planning approach as current EA methodologies. However, numerous empirical studies (Beynon-Davies, 1994; Goodhue, Kirsch, Quillard, & Wybo, 1992; Goodhue, Quillard, & Rockart, 1988; Lederer & Sethi, 1988, 1992; Shanks, 1997) have questioned the value of these BSP-based methodologies and even demonstrated their fundamental ineffectiveness. For instance, Goodhue et al. (1992, p. 28) conclude that "the evidence [from nine organizations that tried BSP and similar planning methodologies] presented here strongly supports the need for a fundamental rethinking of IS planning methodologies". Unsurprisingly, all these methodologies faded away long ago and most people do not remember them even though they were once very popular (like TOGAF now). Therefore, all stepwise architecture-based planning methodologies have demonstrated a chronic historical ineffectiveness.

Table 5 summarizes the alarming facts about TOGAF that I discuss above.

Table 5. Alarming Facts About TOGAF

Alarming fact	Explanation
Dubious historical origin	TOGAF descends from TAFIM, but TAFIM previously proved impractical.
Absence of documented examples	The EA literature lacks documented real-life examples that demonstrate the practical implementation of the key TOGAF prescriptions, which even The Open Group cannot provide.
Negative reports of EA practitioners	EA practitioners have already reported previously that TOGAF recommendations are too complex and impractical.
Vague explanations of usage	EA consultants and gurus provide elusive explanations regarding the practical use and value of TOGAF.
Surveys-based usage proofs	Industry surveys do not prove the value of TOGAF recommendations since organizations may not actually follow these recommendations even if they formally declare they use TOGAF.
Claims-based beliefs on the value of TOGAF	One cannot consider The Open Group's non-validated claims about TOGAF's practical value as reliable scientific evidence.
Specificity does not explain inapplicability	The Open Group positions TOGAF as a universal, industry-neutral EA framework that applies to all organizations, including universities.
Other EA frameworks also have the same signs	Other EA frameworks are also heavily criticized, have no demonstrated successful examples, while DoDAF and FEAF have well-documented failures.
Pre-EA methodologies also proved ineffective	All pre-EA stepwise architecture-based planning methodologies (e.g., BSP and Method/1) have proved ineffective and faded away long ago without a trace.

Surprisingly, from analyzing the actual evidence about the world's most popular EA methodology, I found no direct proof of its practical utility whatsoever but instead only a set of troubling signals: 1) a questionable origin, 2) an absence of real-life examples, 3) negative comments from practitioners, 4) vague explanations from commercially motivated consultants, and 5) assumed value based only on The Open Group's claims. In other words, currently, *no* substantiated, scientifically valid reasons to believe that any organization has ever found TOGAF useful in any real sense beyond superficial declarations exist (e.g., that an organization actually followed ADM steps or actually produced ACF deliverables with successful outcomes).

Essentially, while one may find this study's conclusions about TOGAF's practical inapplicability to be surprising, they directly confirm multiple previous indirect "suspicions" regarding TOGAF. The multiple indirect facts that question TOGAF's value (see Table 5) suggest that one can generalize this study's main conclusions to the overall industry situation.

7 Discussion of Findings

This study's direct empirical findings (see Figure 4) coupled with the available indirect evidence from the existing EA literature (see Table 5) question TOGAF's practical value as a global standard for EA practice. Moreover, the findings suggest that *TOGAF seemingly exists only "on paper" and is likely to represent a typical management fad* (Abrahamson, 1991; Abrahamson & Fairchild, 1999; Kieser, 1997; Miller & Hartwick, 2002; Miller, Hartwick, & Le Breton-Miller, 2004) that consultants widely discuss and aggressively promote even though it contains no useful ideas and organizations cannot successfully implement it.

The evidence from the case study and available literature demonstrates that TOGAF provides impractical prescriptions that organizations cannot follow in their original form. Further, it shows that, when adapted, these prescriptions are purely symbolic in nature since they do not define the resulting EA practice in any real sense (i.e., neither EA-related processes nor their architectural deliverables). Essentially, being "TOGAF based" does not have any particular implications for EA practice. Therefore, despite being widely promoted, TOGAF arguably adds little or no value to the EA discipline. Even if many EA practitioners study TOGAF due to the absence of any alternative comprehensive EA sources (Bloomberg, 2014), it still cannot provide any systematic actionable guidance for an organization to practice EA.

Moreover, TOGAF seemingly has a considerable detrimental and misguiding effect on both EA practitioners and researchers. From a practical perspective, TOGAF states, for example, that "the ADM describes what needs to be done to create an architecture and the content framework describes what the architecture should look like once it is done" (TOGAF, 2011, p. 330). Unsurprisingly, EA practitioners report that "our initial assumptions about TOGAF were that it would be a sort of 'methodology' that we could follow to produce our EA, however this turned out not to be the case" (Anderson et al., 2009, p. 63). From the theoretical perspective, TOGAF provides comprehensive but empirically invalid description of EA practice and, thereby, creates a deceptive illusion of knowledge. For example, Lucke, Krell, and Lechner (2010, pp. 3-4) provide the following justification for using TOGAF's ADM as the basis for their study: "We refrain from defining 'our own process' here and stick with the TOGAF ADM...to identify issues related to the EA process. It is a well-recognized and up-to-date process model compiled from best practices of many practitioners.". However, evidence from both the case study and available EA literature does not allow one to assume that an established EA practice has ever followed the ADM steps let alone that these steps represent "best practices of many practitioners".

7.1 Empirical Contribution

This study demonstrates a set of theoretically significant empirical facts that question several widely accepted theoretical assumptions in the EA discipline and, therefore, "may have more far-reaching theoretical implications than many self-proclaimed theoretical contributions" (Agerfalk, 2014, p. 596).

Firstly, due to TOGAF's popularity, researchers widely assume that one can use it as a general theoretical model of EA practice. For instance, countless authors (Barateiro, Antunes, & Borbinha, 2012; Bischoff, Aier, & Winter, 2014; Buckl, Ernst, Matthes, Ramacher, & Schweda, 2009b; Buckl et al., 2011; Gill, 2015; Hanschke, Ernsting, & Kuchen, 2015; Hauder, Munch, Michel, Utz, & Matthes, 2014; Lucke et al., 2010; Mueller, Schuldt, Sewald, Morisse, & Petrikina, 2013; Nakakawa, van Bommel, & Proper, 2013; Pruijt, Slot, Plessius, Bos, & Brinkkemper, 2012; Rohloff, 2011; Svee & Zdravkovic, 2015; Taleb & Cherkaoui, 2012; van der Merwe, Gerber, & van der Linde, 2013; Vicente, Gama, & da Silva, 2013; Zadeh, Millar, & Lewis, 2012) use TOGAF as a generic conceptual representation of EA practice in their studies. However, my findings show that even EA practices based on TOGAF may essentially not even relate to the TOGAF's original prescriptions (e.g., organizations may not follow the ADM's steps and not produce ACF deliverables). Therefore, one cannot really use TOGAF a general theoretical model of EA practice despite its popularity.

Second, researchers widely assume that one can use the EA frameworks lens to study and analyze EA practices. For instance, many authors (Ambler, 2010; Aziz & Obitz, 2007; Buckl et al., 2009a; Cameron & McMillan, 2013; Dahalin, Razak, Ibrahim, Yusop, & Kasiran, 2010; Gall, 2012; Obitz & Babu, 2009; Schekkerman, 2005; Scholtz, Calitz, & Connolley, 2013) have analyzed EA practices via surveying organizations and asking which EA frameworks they use. Other authors (Bui, 2012; Bui, Markus, & Newell, 2015) have theorized on the properties of EA practices based on the differences between underlying EA frameworks. However, my findings show that the fact that an organization uses a particular EA framework as the basis for its EA practice does not necessarily define the resulting EA practice in any real sense. In other words, my findings suggest that actual EA practices have no correlation with the EA frameworks in which they have their foundation. Therefore, one cannot justifiably use the EA frameworks lens to study EA practices.

Third, researchers widely assume that EA theory and practice require EA frameworks. For instance, in their citation analysis, Simon, Fischbach, and Schoder (2013) show that the entire EA discipline builds on EA frameworks. Moreover, Simon et al. (2013) found that TOGAF (2011) represents the most highly cited EA publication. However, my findings show that the role of EA frameworks may be significantly exaggerated and EA frameworks might even be management fads (Abrahamson, 1991; Abrahamson & Fairchild, 1999; Kieser, 1997; Miller & Hartwick, 2002; Miller et al., 2004). For instance, none of the TOGAF-specific recommendations proved useful in the organization I studied. Moreover, the studied EA practice did not resemble other EA frameworks' recommendations (FEAF, 1999; Schekkerman, 2006; van't Wout et al., 2010; Zachman, 1987). Therefore, the EA discipline seems to significantly exaggerate EA frameworks' role.

Fourth, researchers widely assume that one can conceptualize EA as a comprehensive blueprint of an entire organization structured according to a certain framework (i.e., taxonomy or matrix) that describes its current state, future state, and a transition plan (Armour et al., 1999b; Bernard, 2012; FEA, 2001). However, my findings show that this conceptualization may not reflect the practical reality. For instance, organizations may lack descriptions of their current and future state, may lack a transition plan, may not organize EA documents according to any special logical structures, and their EA may be not comprehensive. Moreover, one cannot conceptualize EA as a single bundle of documents; rather, one needs to conceptualize it as a collection of related but diverse documents that have value independent of one another and have their own unique usage, lifecycle, stakeholders, and purpose. Therefore, the most commonly accepted conceptualization of EA hardly describes EA in all organizations. Moreover, *all* the elements of this conceptualization may be absent in practice.

Fifth, researchers widely assume that one can conceptualize EA practice as a single sequential stepwise process that involves documenting the current state, describing the future state, analyzing the gaps, developing a transition plan, and implementing it. For instance, the vast majority of existing EA methodologies (Armour et al., 1999b; Bernard, 2012; Bittler & Kreizman, 2005; Boar, 1999b; Carbone, 2004; Covington & Jahangir, 2009; FEAF, 1999; Holcman, 2013; IBM, 2006; Longepe, 2003; Niemann, 2006; Schekkerman, 2008; Spewak & Hill, 1992; TAFIM, 1996b; Theuerkorn, 2004; TOGAF, 2011; van't Wout et al., 2010) essentially recommend that an organization documents its current state, describes its desired future state, analyzes the gaps between them, develops a transition plan, and implements it. However, my findings show that organizations may organize EA practices according to a very different high-level logic that does not resemble any of these EA methodologies. Therefore, one cannot conceptualize EA practice as such a single sequential five-step process.

Table 6 summarizes the current theoretical assumptions in EA research and explains how my findings question them.

Consequently, my findings question the very foundations of current EA theory, including the role of EA frameworks and widely accepted conceptualizations of EA and EA practice. This conclusion suggests that a significant portion of existing EA research does not concur with the practical reality. For instance, even the recent EA research in leading IS outlets (Lange, Mendling, & Recker, 2016, p. 413) conceptualizes EA as 1) as-is architecture, 2) to-be architecture, 3) transformation roadmap, and 4) principles. However, of these four elements, I could identify only principles in Central Australian University.

At the same time, the EA practice I describe in this study does not correlate with any existing EA methodologies. No theoretical models provide a reasonably accurate methodological description of the EA practice I describe. This fact suggests that real EA practices in organizations might largely not have any relation to the most widely discussed EA methodologies and may be much more diverse than the available theoretical descriptions in the existing EA literature provide. In other words, the current EA literature does not explain how real EA practices might work. For instance, as this case study clearly demonstrates, real-world EA practices can work even when an organization does not develop any elements typically considered as essential for EA in the current EA theory (i.e., current states, future states, and transition plans). Therefore, this study identifies “compelling empirical patterns that cry out for future research and theorizing” (Hambrick, 2007, p. 1350), while the EA practice I describe in this study presents a new, largely unexplored, and revelatory empirical phenomenon that questions whether we really understand what EA practice is, how EA practice works, and even what EA is. In line with earlier calls for reconceptualization (Holst & Steensen, 2011; Janssen, 2012; Korhonen, Lapalme, McDavid, & Gill, 2016), my finding’s also suggests that we might need to reconceptualize the very notion of EA.

Consequently, this study makes a significant empirical contribution to the EA literature by demonstrating important empirical facts that question established theories, can stimulate future research, and may substantially alter the EA discipline (Agerfalk, 2014; Avison & Malaurent, 2014; Hambrick, 2007). Despite being atheoretic, this paper arguably “has a high potential for stimulating research that will impact on information systems theory and/or practice” (Avison & Malaurent, 2014, p. 327).

Table 6. Resulting Empirical Contribution of This Study

Current theoretical assumptions	How findings question assumptions
Due to its popularity, one can use TOGAF a general theoretical model of EA practice.	Despite its popularity, one cannot use TOGAF as a general theoretical model of EA practice because actual TOGAF-based EA practices may not relate to the original TOGAF prescriptions.
One can use the EA frameworks lens to study and analyze EA practices.	One cannot use the EA frameworks lens to study EA practices because actual EA practices seem to have no correlation with the EA frameworks in which they have their foundation.
EA frameworks are fundamental for EA theory and practice.	EA frameworks for the EA discipline may have a significantly exaggerated role because researchers have often found framework-specific recommendations to be impractical.
One can conceptualize EA as a comprehensive blueprint of an entire organization structured according to a certain framework and describing its current state, future state, and a transition plan.	This commonly accepted conceptualization of EA cannot describe EA in all organizations because descriptions of the current and future states of an entire organization may be absent, a transition plan may be absent, EA may be not comprehensive, and EA documents may be not organized according to any special logical structures
One can conceptualize EA practice as a single sequential five-step process.	One cannot conceptualize EA practice as a single sequential five-step process because organizations may organize it according to a very different logic that does not resemble any widely discussed EA methodologies.

7.2 Practical Contribution

This study provides a systematic in-depth description of the EA practice in a large organization from a methodological perspective. This description can help other organizations succeed with EA through demonstrating several important lessons and examples. For instance, this study shows that EA practices may be highly company specific and, even if based on established EA methodologies, may significantly differ from their original prescriptions. Therefore, an organization cannot practically adopt EA simply by following the recommended prescriptions in a straightforward manner—they need to significantly modify it and experiment. Moreover, they may need to “invent” the critical parts of EA practice from scratch even when they use established EA methodologies as a basis.

Further, this study questions TOGAF’s practical value, which many researchers and practitioners consider the de facto standard in EA practice (Brown & Obitz, 2011; Dietz & Hoogervorst, 2011; Gosselt, 2012; Lankhorst et al., 2010; Sarno & Herdiyanti, 2010; Sobczak, 2013). My findings clearly demonstrate that the core TOGAF recommendations may be impractical and that its minor recommendations may have a negligible real impact. Consequently, this study supports the opinions that “TOGAF’s accelerating success is simply because it’s the only game in town” and that “TOGAF has gained traction simply because it’s better than doing nothing” (Bloomberg, 2014, p. 1).

7.3 Limitations of This Study

To my knowledge, this study represents the first deliberate attempt to explore how organizations adapt EA methodologies in organizations. My somewhat "unexpected" findings demonstrate significant potential inconsistencies between EA's common theoretical assumptions and its empirical realities. In particular, this study poses several important questions regarding the value of EA frameworks, practical applicability of popular stepwise EA methodologies, possible industry-specific and organization-specific differences in EA methodologies, and even the nature of EA practice.

Although my findings provide compelling reasons to focus future research efforts on methodological aspects of EA practice, the study itself cannot offer substantiated answers to most of the questions it raises. Neither the organization I studied nor indirect empirical evidence from literature allow one to formulate a clear "ultimate" position regarding the discovered uncertainties in the EA discipline. Therefore, readers should consider this study as the first step towards resolving the existing unambiguity associated with the adaptation of EA methodologies in practice.

7.4 Directions for Future Research

This research demonstrates that researchers have far from sufficiently studied EA practice's current methodological aspects. Specifically, we still do not understand the relationship between popular EA methodologies and actual EA practices "derived" from them. At the same time, one cannot study more general properties of EA practice without understanding the individual documents and processes that constitute its "nuts and bolts" in the same way that one cannot study a microprocessor's properties without understanding individual transistors.

Unfortunately, at the present moment, we do not adequately understand the very basic "nuts and bolts" of EA practice. Therefore, I call for further research on the methodological aspects of EA practice in order to answer all the disturbing questions around EA methodologies, align our theoretical understanding of EA to the practical realities, and construct (rather than assume) a sound evidence-based foundation for future EA research. As Helfat (2007, p. 185) notes:

> *In a field that seeks to understand the real world, it makes little sense to always put theory before facts. We must understand at least the broad outlines of "what" a phenomenon consists of before we try to explain "why" it occurs. That is, we need research directed toward uncovering empirical regularities…. Only then are we in a position to build theory that in turn can serve as the basis for more refined tests and extensions.*

8 Conclusion

In this paper, I study the adaptation of TOGAF, the most prominent EA methodology, in an organization from the "hard" methodological perspective. As part of this study, I describe how the organization organized the TOGAF-based EA practice and analyze in detail how exactly it adapted the TOGAF methodology.

This in-depth case study clearly demonstrates that the actual EA practice in the organization I studied, despite being based on TOGAF, did not correlate with its main prescriptions. In analyzing the TOGAF recommendations the organization adopted, I found that the organization did not find a majority of TOGAF prescriptions to be useful, that a small number of useful ideas mentioned in TOGAF are conventional rather than specific to TOGAF, and that the organization established most critical aspects of its EA practice from scratch. Moreover, the EA practice in the organization did not follow even the more general five-step logic (document the current state, describe the future state, analyze the gaps, develop a transition plan, and implement it) and did not use any taxonomies for organizing EA documents as the most widely known EA methodologies recommend (Bernard, 2012; Spewak & Hill, 1992; van't Wout et al., 2010).

From thoroughly analyzing indirect evidence available in the EA literature (Kotusev, 2017), my findings question the value of TOGAF as a standard for EA practice and support the opinion that it is popular only because no better sources on EA exist (Bloomberg, 2014). Moreover, my findings suggest that one can describe TOGAF largely as a "dictionary" of incoherent EA-related notions rather than as a comprehensive EA methodology and that one can even consider it as yet another management fad (Miller et al., 2004) since organizations have found only several scattered ideas from its approximately 700 pages manual to be useful in practice, and even these ideas are not TOGAF specific. Therefore, adapting TOGAF in some cases can be essentially synonymous to ignoring most of its core recommendations and establishing EA practice largely from scratch based on conventional common-sense ideas.

At the same time, the EA practice I found in Central Australian University presents a new and largely unexplored empirical phenomenon that questions whether we really understand what EA practice is, how EA practice works, and even what EA is. Even though this study does not offer any theoretical contribution, it has significant theoretical implications that are “likely to stimulate future research with the potential to alter IS theory and practice” (Agerfalk, 2014, p. 596). Therefore, this study makes a significant empirical contribution to the EA literature by demonstrating important empirical facts that question established theories, can stimulate future research, and may substantially alter the EA discipline (Agerfalk, 2014; Avison & Malaurent, 2014; Hambrick, 2007).

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Appendix A

This appendix contains examples, templates, and schematic structures of main EA documents used at Central Australian University in an alphabetical order: business capability model, conceptual architectures, maxims, one-page diagrams, principles, program of work, roadmaps, solution designs, standards, and the technology reference model. In total, the university created approximately 500 EA documents created. For most types of EA documents, I cannot provide their real examples due to strict confidentiality requirements.

Business Capability Model

The business capability model (BCM) provides a high-level holistic view of the whole university. It shows all the organizational capabilities and subcapabilities and the organizational goals, customers, suppliers, partners, and stakeholders in a simple structured manner. The BCM serves as a heat map for the ICT steering committee and facilitates investment decisions. Figure 5 shows the schematic structure of the business capability model.

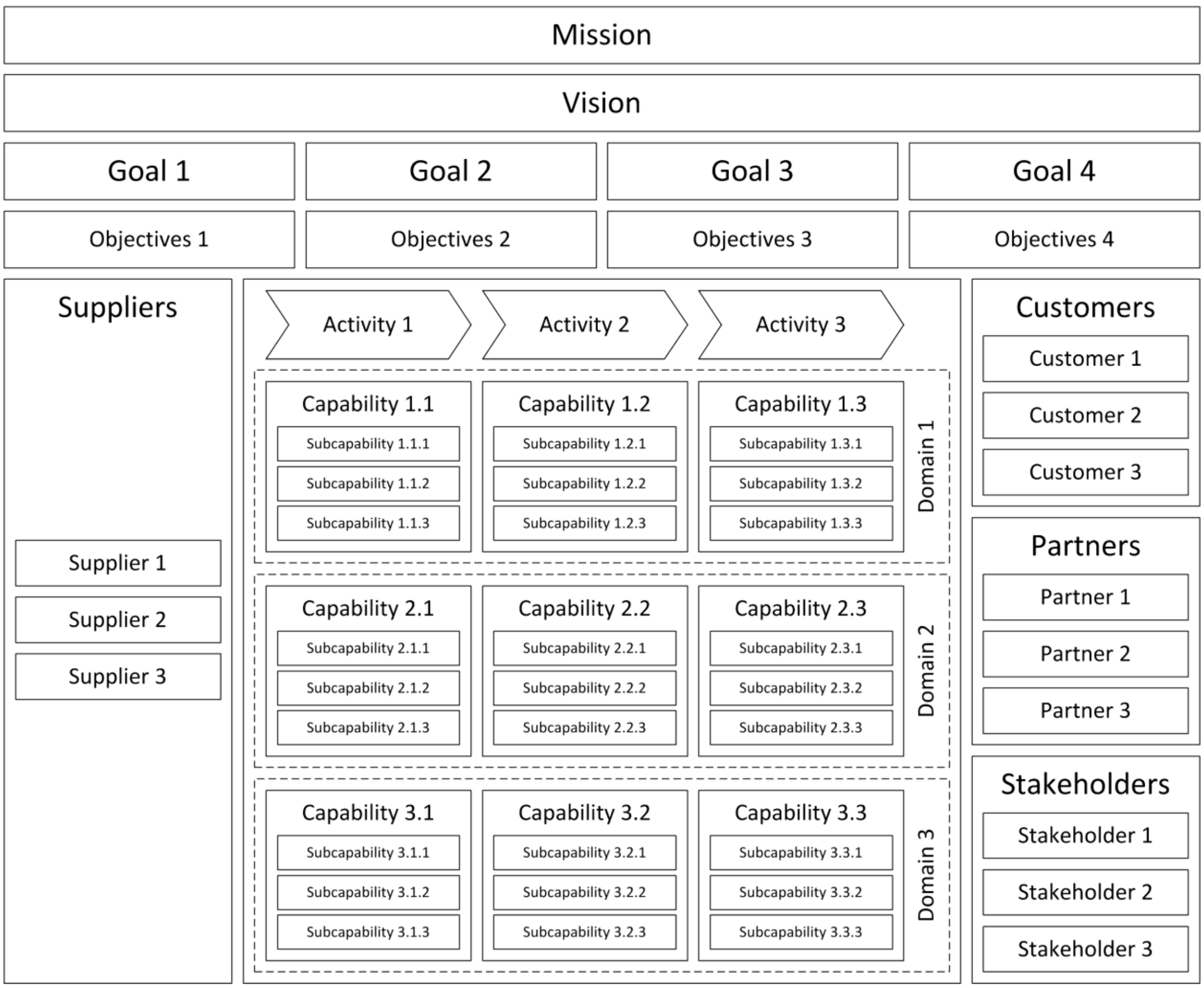

Figure 5. Schematic Structure of the Business Capability Model (BCM)

Conceptual Architectures

Conceptual architectures describe goals, objectives, high-level designs, and major design options for individual IT projects detailed enough to estimate their size, time, and cost. The conceptual architectures is to facilitate the estimation of project costs and timelines in order to enable informed and effective decision-making. Typically, conceptual architectures are 20-40 pages long. Figure 6 shows the structure of the MS Word template for a conceptual architecture.

Project 1 Conceptual Architecture

1. Introduction	1.1. Document map 1.2. Purpose and scope of document	
2. Architectural Guidelines	2.1. Goals 2.2. Key requirements 2.3. Assumptions	2.4. Constraints 2.5. Risks 2.6. Issues
3. Conceptual Architecture	3.1. Architectural highlights 3.2. Key architectural concepts 3.3. Architectural overview	3.4. Current state 3.5. Future state
4. Appendices	4.1. Options analysis 4.2. Architectural decision	

Figure 6. Structure of the MS Word Template for a Conceptual Architecture

Maxims

Maxims are very high-level business and IT principles applicable to all projects. The university defines six business maxims and 14 IT maxims. The maxims facilitate the alignment of all IT projects to the overall organizational philosophy. Table 7 shows real examples of maxims.

Table 7. Real Examples of Maxims

Maxim	Type	Description
Equivalent student / staff / partner experience	Business	The university will provide an equivalent experience for current and prospective students, staff, industry, and professional regardless of their location and culture.
Common business processes	Business	The university will adopt business processes across all points of presence with these processes being transparent and sharing relevant data.
Common use of systems and technology	IT	Implementation of systems and infrastructure used across the university is preferred over the development of similar or duplicated systems that are only provided to a particular area.
Business continuity	IT	Critical systems and data continue to be available in spite of interruptions.

One-page Diagrams

One-page diagrams show the relationship and interaction between various information systems that depict different parts of the organizational IT landscape in their current states and sometimes in their planned future states. In total, the university created approximately 200 one-page diagrams. The one-page diagrams facilitate project planning by solution architects on earlier stages of the project. Figure 7 shows the schematic example of a one-page diagram.

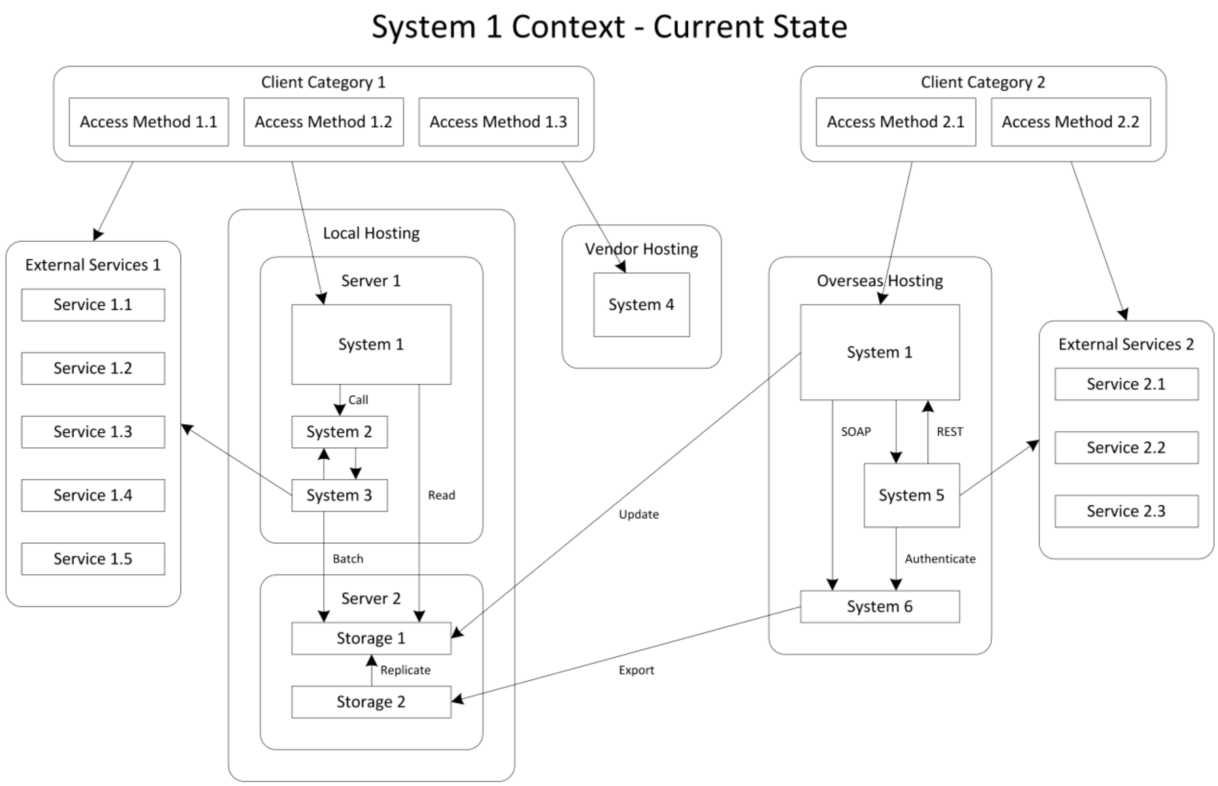

Figure 7. Schematic Example of a One-page Diagram

Principles

Principles are brief reusable implementation-level rules applicable to broad categories of projects. The principles facilitate the technical homogeneity of solution designs that solution architects develop for projects. Table 8 shows real examples of principles.

Table 8. Real Examples of Principles

Principle	Domain	Statement	Rationale	Implications
Services must be used to integrate applications	Integration and data	Integration between applications must be done via services, rather than directly.	Providing service interfaces allows system interactions to be decoupled and abstracted from the actual systems that implement the services.	Additional effort associated with the definition of services during project design, but will lower the cost of maintenance over time.
Production and non-production separation and implementation	Infrastructure	Non-production environments are physically or virtually separated from production environments but are as similar as possible.	Reduces risk by testing changes prior to deploying to production. Separation helps isolation and reduces any further risk on impacting production.	Non production configuration sets to be kept consistent with production. Increased costs associated with deployment of additional environments from a hardware, software and operational perspective.
Secure by default	Security	A system's default setting should not expose users to unnecessary risks and should be as secure as possible.	System may be released with an insecure default configuration that can be exploited by attackers. Unused features may slow down system performance and open doors for intrusion attacks.	All security functionality should be enabled by default, and all optional features which entail any security risk should be disabled by default.

Table 8. Real Examples of Principles

Active directory authentication	Client computing	All authentication for users of client computing services will be against the existing active directory service.	Minimizes management overhead in creating and managing user details in a single source.	If systems require an internal authentication process of some type, they must first synchronize any required user information from active directory in a one way process.

Program of Work

The ICT steering committee prepares the program of work on a yearly basis for the entire university. It contains the list, or mini-roadmap, of all IT projects that the ICT steering committee has chosen to implement and fund in the upcoming year. Figure 8 shows the schematic structure of the program of work.

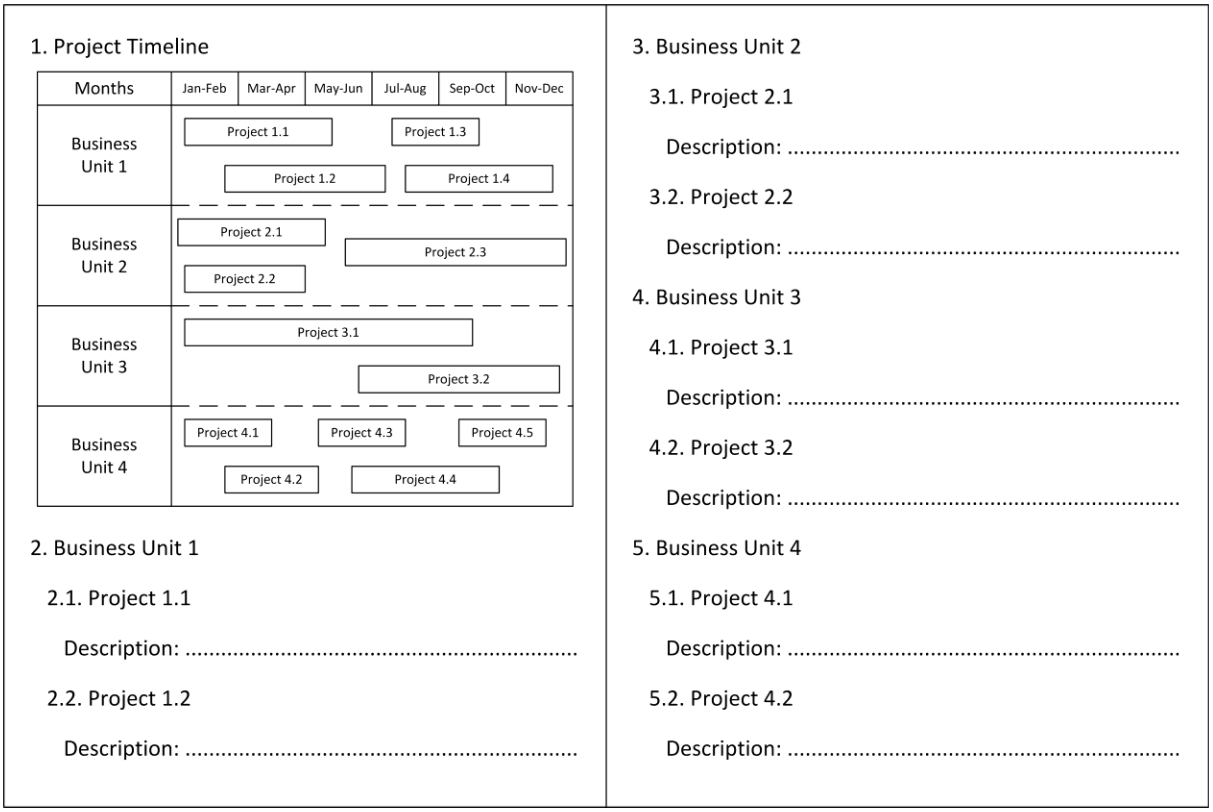

Figure 8. Schematic Structure of the Program of Work

Roadmaps

Each business unit of the university has its own roadmap that shows all the information systems and technologies relevant to it. In total, the university maintains more than 30 different roadmaps. Roadmaps show four different types of systems: 1) implemented systems that the business unit currently uses, 2) systems currently being implemented, 3) planned systems approved for implementation in the future, and 4) systems not yet approved for implementation that the business unit needs. They also show expected beginning and completion dates for planned systems and systems in the implementation stage. The roadmaps facilitate discussions between engagement managers and business customers about their needs for new IT projects. Figure 9 shows the schematic structure of a roadmap.

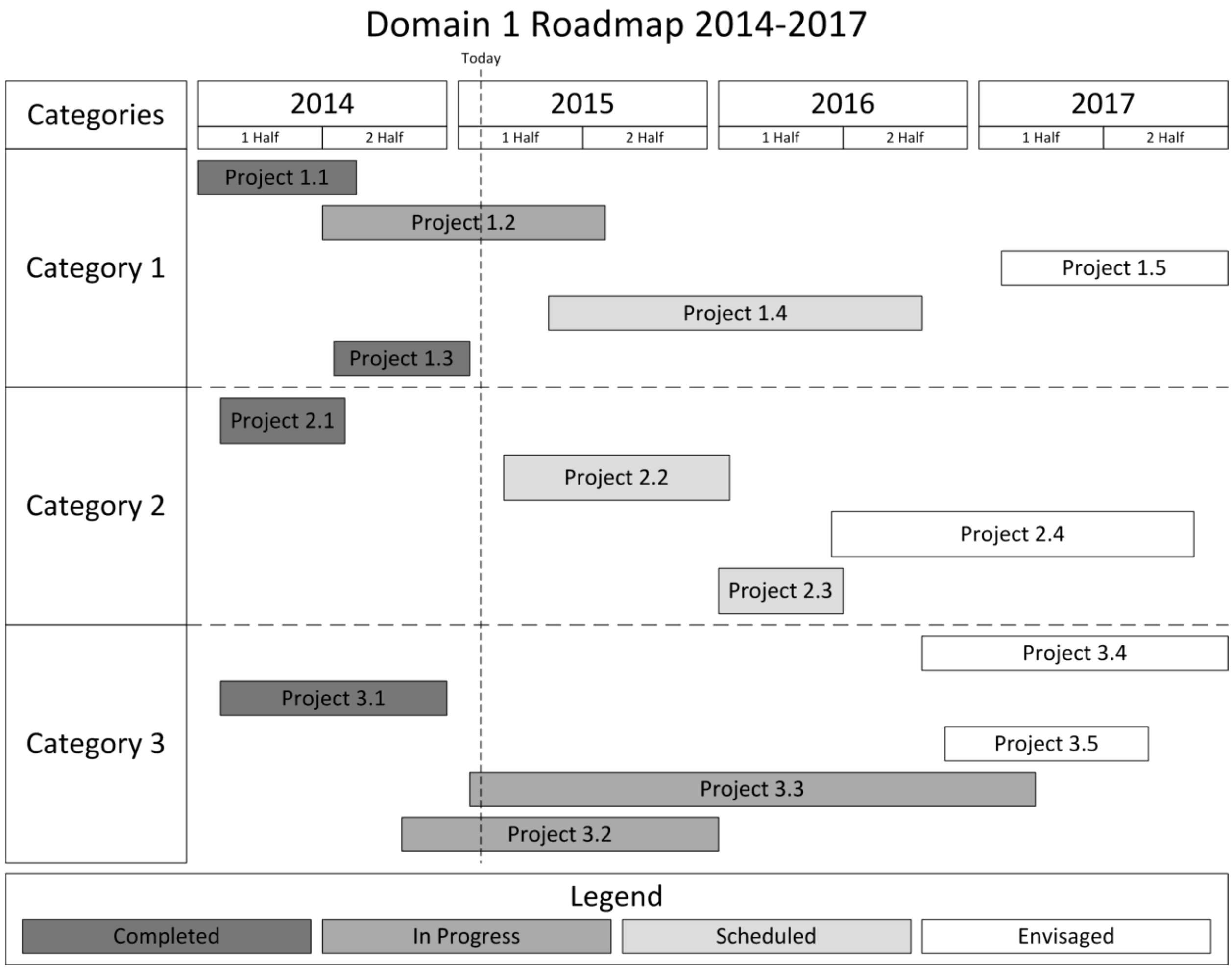

Figure 9. Schematic Structure of a Roadmap

Solution Designs

Solution designs describe detailed designs of individual IT projects actionable for the project teams that implement them. In the two years before I conducted this study (i.e., 2013 and 2015), the university approved approximately 150 solution designs. Solution designs serve as cornerstones and common reference points for project managers, project implementers, and other project participants working on IT projects. Typically, conceptual architectures are 40-80 pages long. Figure 10 shows the structure of the MS Word template for a solution design.

Project 1 Solution Design

1. Document Control	1.1. Document author 1.2. Document revision history 1.3. Authorisation	1.4. Document distribution 1.5. Referenced documents
2. Introduction	2.1. Purpose 2.2. Audience	2.3. Overview 2.4. Glossary
3. Business Problem	3.1. Scope 3.2. Problem overview	
4. Solution Overview	4.1. Application overview 4.2. Products and services 4.3. Data and interfaces overview	4.4. Infrastructure overview 4.5. Security overview
5. Enterprise Architecture Alignment	5.1. Architecture maxims 5.2. Architecture principles 5.3. Architecture standards 5.4. Constraints	5.5. Risks 5.6. Issues 5.7. Key architecture decisions
6. Business Architecture	6.1. End-user experience 6.2. Capability model alignment 6.3. Organisational impact	
7. Data and Integration Architecture	7.1. Key information domains 7.2. Business glossary and key terms 7.3. Data entity/function matrix 7.4. Logical data diagram 7.5. Data security overview 7.6. Data migration	7.7. Data lifecycle 7.8. Logical integration architecture 7.9. Logical component architecture 7.10. Real time interfaces 7.11. Batch interfaces 7.12. Message and file formats
8. Application Architecture	8.1. System components 8.2. Support requirements	8.3. Business continuity and DR 8.4. Application security
9. Technology Architecture	9.1. Logical architecture 9.2. Physical architecture 9.3. Storage 9.4. Network architecture	9.5. Networking infrastructure 9.6. Infrastructure architecture 9.7. Licencing 9.8. Infrastructure security
10. Security	10.1. Information classification 10.2. Threat management 10.3. Security assurance	

Figure 10. Structure of the MS Word Template for a Solution Design

Standards

Standards are reusable low-level technical rules and patterns applicable to narrow and specific situations. Standards facilitate the reuse of standard components, patterns, and building blocks for specific recurring problems in solution designs that solution architects develop for projects. Figure 11 shows the real example of a standard.

Standard #1: Direct Query Via Crystal Reports

Description:
- Use Crystal Reports as the front-end user-facing application through which operational reporting is produced, utilising raw data from the main application.
- Accesses data sources directly rather than via the application housing that data - typically read-only mode.

Applicability:
- Operational reporting.

Rationale:
- Reporting functionality is not built within the vanilla OOTB product, or not satisfactory enough for reporting requirements.
- Reporting requirements are purely for operational data.
- Cost to utilise is low, as Crystal Reports is already an in-house reporting application and can query the application's database.
- Reporting requirements do not include aggregation or integration of data from any other applications or sources.
- Used to replace MS Excel/MS Access based reporting (if and when applicable).

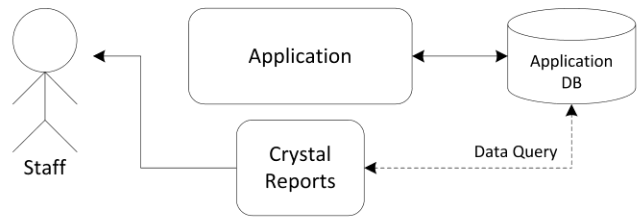

Figure 21. Real Example of a Standard

Technology Reference Model

The technology reference model lists all the available technologies that IT projects should use, which includes programming languages, application servers, operating systems, database management systems, integration buses, and many other technologies. The technology reference model helps solution architects select technology in projects' earlier stages. Figure 12 shows the schematic structure of the technology reference model.

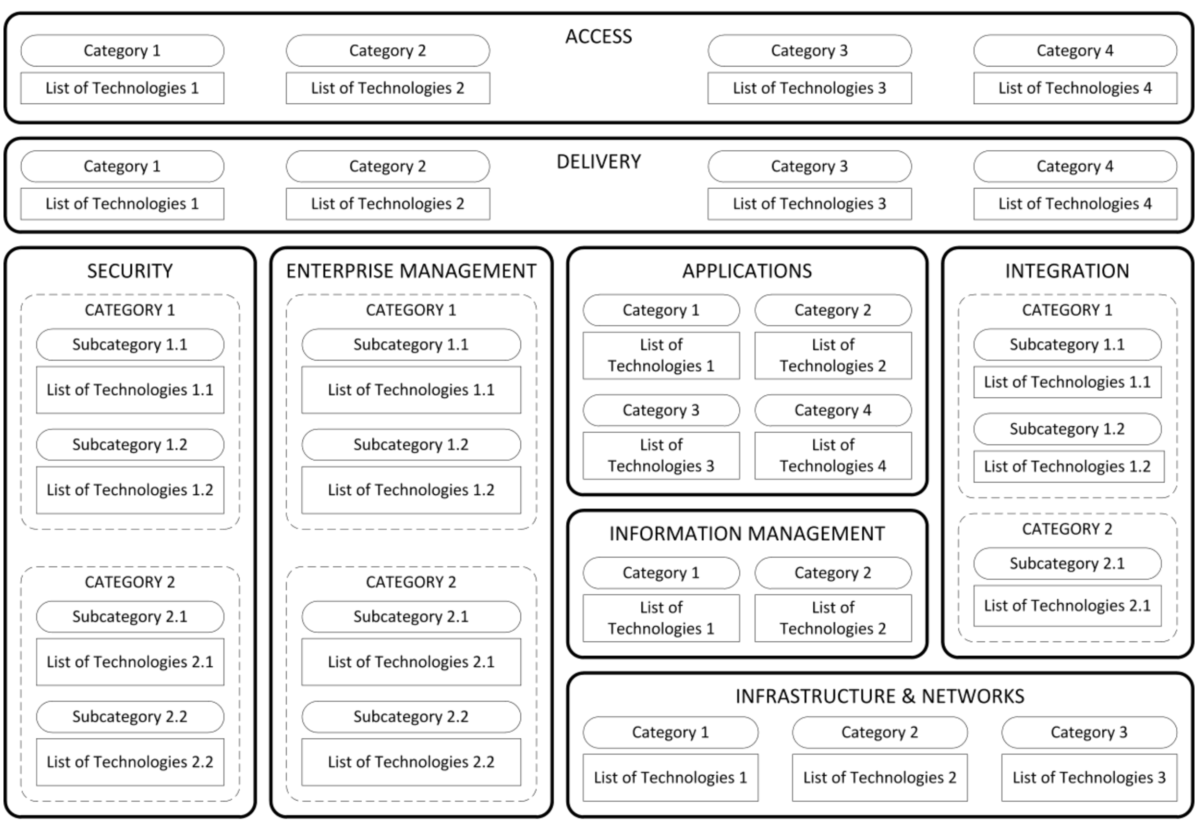

Figure 32. Schematic Structure of the Technology Reference Model (TRM)

About the Author

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