

MASTER

**TOGAF based EA maturity assessment
instrument design and validation**

Lei, D.

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Eindhoven, July 2010

TOGAF based EA maturity assessment
instrument design and validation

By
D.(Dan) Lei

in partial fulfillment of the requirements for the degree of

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Supervisors:

Gorp, Dr. P.M.E. Van, TU/e, Information Systems

Angelov, Dr. S., TU/e, Information Systems

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I. Preface and acknowledgments

I am not used to look backwards. Once I do so, a deep sign rushes to my mind, reminding me my favorite poem, the road not taken.

Two years ago my study life diverged into two roads. I took the one less travelled by. Now I am approaching to the end of this trip with the completeness of the thesis project. The process of this thesis project is a snapshot of my master study life, with passion and depression, achievement and loss. Knowledge is a great reward for this trip, but not the biggest. The times during these two years educated me a life-long wisdom, the power of support.

I appreciate the support from so many people in my student life, especially in the master thesis project period. First I would like to thank Pieter Van Gorp, my mentor and first supervisor in the last two years. I am happy to be his student. Discussions with him not only eased the problems which I encountered in the project but also inspired me with excellent ideas. His enthusiasm further stimulates me to greater efforts. I also would like to thank my second supervisor Samuil Angelov. His feedback is instant, sharp and constructive. The advice had a great contribution to my thesis.

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Special thanks go to my family and friends. My parents have always been supporting me in my life. Their unlimited trust encourages me to grow richer all the time. The tremendous support from my boyfriend Lassi motivates me to go through the hardest moment of my thesis project, sharing my laughs and tears. I want to give my final great thanks to my friends. They carefully listen to my story about pains and gains in the study life, supporting every decision that I made.

Thanks to so many great people, I am able to embark on this journey and continue. I took the one less travelled by, and that has made all the difference.

Dan Lei

雷丹

July, 2010

II. Abstract

The Open Group Architecture Framework (TOGAF) is one of the most popular frameworks in Enterprise Architecture (EA). Many organizations are on the way of applying TOGAF. They want to evaluate to what extent they have done it. A practical assessment instrument is needed in the industry. Maturity assessment is a method which has been widely used to identify the gap between business vision and business capabilities. Unfortunately no sufficient assessment instrument has been developed for TOGAF based EA evaluation. This study tries to address the issue by developing a maturity assessment instrument to evaluate TOGAF based EA work. The assessment contains maturity assessment questionnaire and documentation assessment questionnaire. Interviews were conducted to validate the assessment instrument.

III. Management Summary

Introduction

Enterprise Architecture is widely applied in organizations to address information complexity and business alignment issues. The increasingly significant role of Enterprise Architecture attracts the attention from organizations to evaluate the processes and outcomes of their Enterprise Architecture work. Several Enterprise Architecture maturity models have been proposed for evaluating the maturity levels of Enterprise Architecture work. The structures of majority models are based upon the Capability Maturity Model from the Software Engineering Institute in Carnegie Mellon University. However, none of the available models provide practical guidelines in assessing any particular Enterprise Architecture frameworks. Furthermore, The Open Group Architecture Framework (TOGAF) as one of the mainstream EA framework has been widely applied in EA practice. No single maturity assessment instrument has been designed tailoring to this particular framework. The ICT Architecture research group in Eindhoven University of Technology (TU/e) has developed an efficient EA maturity assessment model. This TU/e ICTA model will be an important input in this study.

Purpose

This study intends to develop a practical maturity assessment instrument tailored to TOGAF framework. The following research topics are addressed in the study.

- The horizontal assessment: Enterprise Architecture product and process elements maturity assessment based on TOGAF framework
- The vertical assessment: Documentation maturity assessment based on TOGAF context

The first topic aims to assess maturity situation of TOGAF based EA work from an abstract level. The second topic will zoom into details to evaluate the maturity of documentation in TOGAF context. Documentation is a key element in enterprise architecture project. Unfortunately not all documents in reality are in high quality. Therefore it is necessary to select documentation as the target element for detailed maturity assessment. Another motivation to focus on documentation in the vertical level maturity assessment on TOGAF based EA projects is the key position of documentation in TOGAF ADM. Documents are served as inputs and outputs in all ADM phases. By assessing the maturity level of “circulated blood” of ADM, one can have an efficient assessment on to what extent the organization apply TOGAF ADM.

Methods

The research is initiated by the research topics. A literature review is conducted to find the existing literature within study scope to further assist the instrument development. The design of maturity assessment instrument is then followed. Detailed processes will be present in the following part. Finally the instrument is validated through some interviews. The general approach on a high level is present in figure 1.



Figure 1. Research approach on a high level

To address the research topics, the instrument development is divided into two parts, TOGAF based Enterprise Architecture maturity assessment instrument development for the horizontal assessment and TOGAF based documentation maturity assessment instrument development for the vertical assessment. Both of them follow the same design approach. The assessment questionnaire is developed based on the selected key information from TOGAF and modified TU/e ICTA maturity model.

Product

The EA maturity assessment instrument is developed for 15 selected elements (present in table 1). Key information from each element are discussed in the study and used in the questionnaire development.

Table 1. TOGAF based maturity assessment instrument elements

Categories	TOGAF elements	TU/e ICTA model elements	Maturity assessment elements
Product	N/A	Product-related tools	Product-related tools
	N/A	Modeling languages	Modeling languages
	N/A	Patterns	Patterns
	Reference models	RA and RM	Reference models
	ADM	Architecture frameworks	ADM
	N/A	Standards	Standards
	N/A	Templates	Templates
	Architecture repository	Product knowledge repository	Architecture repository
	Manners in applying ADM	Policies	Policies
	Architecture deliverables	Architecture documentation	Architecture documentation
Process	Architecture governance / Risk management	Project management / Risk management	Project management / Risk management
	Migration planning	Support / Configuration Management	Migration planning
	Compliance assessment	Support / Process and product quality assurance	Compliance assessment
	Architecture vision	Support / Decision analysis and resolution	Architecture vision
	Requirements management	N/A	Requirements management

17 key documents are identified as the key document elements to be assessed in the documentation maturity assessment instrument development. Every element is assessed with two questions in both questionnaires. One question reviews the general situation of the element and another one focuses on a specific feature of the element. Three answer options are designed to classify the situation for further discussion and improvement.

Conclusion

The product of this study, TOGAF based EA maturity assessment instrument reaches the research goal of developing a practical tool to assess the maturity situation of TOGAF based Enterprise Architecture work. The soundness and effectiveness of both horizontal and vertical questionnaires have been validated in three interviews. The instrument is proved to be efficient to spot weak points of the Enterprise Architecture work in less than one hour. Affordability and convenience of this maturity assessment instrument enable organizations to evaluate and monitor their TOGAF based EA work easily.

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1. Introduction

In the last twenty years, the development of Enterprise Architecture (EA) has received considerable attention. It has emerged and grown to be an efficient tool for an organization to address system complexity and business alignment issues. Case studies (Ross et al., 2006) demonstrates the significance of EA in business transformation driven by new Information Technology (IT) capabilities in eighteen firms and the important relationship between EA and business strategy in eight firms, by Massachusetts Institute of Technology (MIT) Sloan School's Center for Information Systems Research (CISR) and International Institute for Management Development (IMD) from 1995 to 2005. Given the increasing role of EA in achieving business goals, the extensive interests of managers in measuring and evaluating both EA processes and outcomes are not surprising (Martinsonsa et al., 1999). Maturity assessment is such an important method to identify the gap between business vision and business capabilities and monitor the level of EA practice. Maturity assessment is not a new science, and has been used as a standard business tool for several decades. In the IT domain, many organizations have successfully used maturity assessment techniques, both to establish the level of maturity of the function and to derive some value add from establishing the gaps. In most cases, it is common to benchmark against both best practices and industry competitors (Banger, 2008).

Maturity models have grown across a multitude of domains since the concept of measuring maturity was introduced with the Capability Maturity Model (CMM) from the Software Engineering Institute (SEI) in Carnegie Mellon University (Paulk et al., 1993). Except CMM, more than 150 maturity models have been developed to measure the maturity on a pre-defined scale (Bruin et al., 2005). Several EA related maturity models were developed by referring to the maturity model concept. One of the well-known models is the Enterprise Architecture Maturity Model developed by the National Association of State Chief Information Officers of United States (NASCIO) (GAO, 2003). Unfortunately, this maturity model has little practical guidance in assessing the maturity level. The effectiveness of an Enterprise Architecture program rather than the evaluation of architectural development level for further improvement are focused on in NASCIO's model. Other models also failed to provide practical tool to evaluate the Enterprise Architecture work. As a result, no comprehensive evaluation means have been developed to classify EA practice in terms of maturity assessment. Therefore, studies of practical maturity assessment instrument are needed. Furthermore, The Open Group Architecture Framework (TOGAF) has a wide practice in the industry. With more organizations following the guideline of TOGAF in building their Enterprise Architecture, they are getting more interested in knowing to what extent they apply TOGAF. A maturity assessment will be essential in tackling the issue. Unfortunately, such desires from the industry have not been well fulfilled because no sufficient tailor-made TOGAF based Enterprise Architecture maturity assessment instrument has been developed.

This study tries to address the issues which have been discussed above. The goal of the study is to develop and validate a maturity assessment instrument to evaluate TOGAF based EA practice. The unique part of this study is its practicability. A set of handy maturity assessment questionnaires will be present for organizations to be employed in practice. Clear guidelines and straightforward questions will enable organization to conduct the maturity assessment for their TOGAF based enterprise architecture work easily. The maturity assessment contains two parts. The first part is an overall assessment on selected elements in TOGAF context, to get a horizontally general overview of the EA maturity situation. The second part will dive deep to one element to score the assessment in details. TOGAF defined architecture documentation is chose for the vertical examination. The assessment questionnaires will be developed in both parts of the assessment.

The structure for this thesis text is as follows. Section 2 describes the information from literature review to clarify the current research situation. The research statement will be presented in section 3. From section 4 to 6, the study methodology is constructed and the instrument is developed. The result of validation is discussed in section 7. Finally, section 8 offers evaluations and suggestions for future work.

2. Literature review

2.1. Enterprise Architecture and maturity models literature

Definition of Enterprise Architecture

The concept of enterprise architecture does not have a universally accepted definition in neither the research nor the industry context. Although at a very abstract level, Enterprise Architecture can be described as a set of blueprints is to a building for an organization's operations and systems (GAO, 2003), in reality the concept is much more complicated. The definition from IEEE Standard 1471-2000 (IEEE Computer Society, 2000) is widely agreed among scholars: architecture is the fundamental organization of a system embodied in its components, their relationships to each other, and to the environment, and the principle guiding its design and evolution. The function of architecture is emphasized as the principle to connect different components. Hence, EA is considered as the platform or the interface which links different functional units together. Another definition of Enterprise Architecture will be a capability to integrate technical components in order to meet business needs (Iyer & Gottlieb, 2004). This description will be adopted as the definition of Enterprise Architecture in this study to match the importance of "component-structured" architecture orientation.

Enterprise Architecture maturity models

Needs from managers in measuring and evaluating EA practice has motivated scholars to develop various EA maturity models. Most models are based on the generic 5-level maturity model proposed by CMM. They can be further categorized as the staged 5-level models and the continuous 5-level models. The staged 5-level models distinguish five levels of maturity. For each level a number of focus areas are defined. These target areas have to be reached satisfactorily for the organization to achieve that particular level (Steenbergen et al., 2007). A model (GAO, 2003) developed by The US Government Accountability Office is an example of staged 5-level model. The continuous 5-level models also distinguish five general maturity levels and a number of focus areas. Examples of the continuous model can be found in Enterprise Architecture Maturity Model (NASCIO, 2003). The difference between continuous 5-level model and staged 5-level model is that the focus areas are not attributed to a level, but within each focus area the 5 levels are distinguished (Steenbergen et al., 2007). Another difference between two models is the basis of comparison. The staged models provide a single rating that summarizes appraisal results and allows comparisons among organizations. The continuous models enable comparisons across and among organizations on a process area by process area basis or by comparing results through the use of equivalent staging (CMMI Product Team, 2001). The application of these two popular models is mainly in architectural processes assessment.

TU/e ICTA Enterprise Architecture Maturity Model

An Enterprise Architecture maturity model has been proposed by researchers from Eindhoven University of Technology (TU/e) ICT Architectures (ICTA) group (This model will be entitled as

TU/e ICTA EA Maturity Model in this study) (Dijkman et al., 2010). This is a continuous 3-level EA maturity model. The concept of elements is developed to be corresponding with “process areas” in the continuous models to better serve the “component-structured” architecture. Elements are categorized in three groups, “product elements”, “process elements” and “(human) resource elements”. The elements in TU/e ICTA EA Maturity Model are presented in Table 1.

It is detected in the pilot interviews that the highest level which majority organizations have achieved today is level 3. Therefore a 3-level maturity model instead of a 5-level one is proposed. Level 1 is referred to as an ad-hoc manner and the situation that a particular element is used only when the need is felt by one or a few project members typically. Level 2 is the inconsistent application of elements. The agreement on application is only reached in the projects level. Level 3 is referred to as the standardized application of elements at an organizational level and used in the same way in each project. Some resource elements are naturally not applicable at the lower levels of maturity.

Table 1. Elements in TU/e ICTA EA Maturity Model (Dijkman et al., 2010)

Categories	Elements	
Product	Product-related tools	
	Modeling languages	
	Patterns	
	Reference architecture(RA) and Reference model(RM)	
	Architecture frameworks	
	Standards	
	Templates	
	Architecture repository	
	Policies	
	Architecture documentation	
	Process	Project management / Risk management
		Support / Configuration Management
		Support / Process and product quality assurance
		Support / Decision analysis and resolution
Engineering / verification and validation		
Engineering / technical solution		
Product knowledge management		
Use of process-related tools		
Use of model transformations		
Communication		
Resource		Tasks
	Functions/roles	
	Responsibility and authorization	
	Competences	
	Development and training	
	Workforce planning	
	Reward structure	
	Team structure/Organizational structure	
	Feedback and coaching	
	Use of resource-related tools	

2.2. EA frameworks and The Open Group Architecture Framework literature

The history of Enterprise Architecture frameworks

The year 2007 marks the twenty year anniversary of Enterprise Architecture. By then a number of EA methodologies have come and gone. Today four dominate EA methodologies survive in the field: The Zachman Framework for Enterprise Architectures, TOGAF, The Federal Enterprise Architecture (FEA) and Meta Framework (now as Gartner Framework) (Sessions, 2007). Zachman Framework is the pioneer EA framework. He developed the multiple perspective approach by observing roles in different industries. He also originally described his approach as an *information systems architectural framework* and soon renamed to be an *enterprise-architecture framework*. Zachman framework has a big influence to many following EA framework. One of the well-known frameworks is Technical Architecture Framework for Information Management (TAFIM) by the Department of Defense of U.S. government. And TAFIM is adopted to be the original version of TOGAF. FEA is a unique framework. It can be viewed as a methodology for creating an Enterprise Architecture (Itälä & Han, 2009). Version 1.1 of this framework was released in 1999 by General Accounting Office (GAO) of U.S. government. Meta Group was a famous IT research and advisory organization. Meta Framework has evolved to Gartner Framework with the acquisition from Gartner. Compared with other EA framework, Gartner Framework is more like an EA practice (Itälä & Han, 2009).

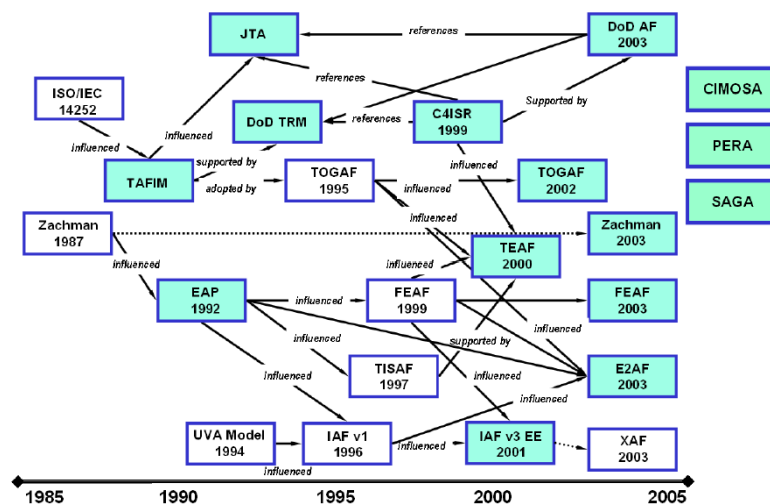


Figure 1. Evolution of EA frameworks (Itälä & Han, 2009)

The Open Group Architecture Framework

TOGAF is a framework and guideline for developing an Enterprise Architecture. The original development of TOGAF Version 1 in 1995 was based on the TAFIM. Ever since, TOGAF has been developed and continuously evolved by representatives of some of the world's leading IT customer and vendor organizations, working in The Open Group's Architecture Forum¹. It intends to provide a

¹ See <http://www.opengroup.org/architecture/>

practical, freely available, industry standardized method of designing Enterprise Architecture, leveraging all relevant assets in the process (Open Group, 2009). Currently two versions of TOGAF are most applied ones.

- TOGAF Version 8² ("Enterprise Edition") was first published in December 2002 and republished in updated form as TOGAF 8.1 in December 2003, which was updated in November 2006 as TOGAF 8.1.1.
- TOGAF Version 9³ is the latest version, published in February 2009.

TOGAF is a widely applied in industry. A recent report (Forrester Research, 2009) revealed that TOGAF Version 9 would pass over the Zachman framework to be the preferred EA framework for practitioners. Practicality and free usability also contribute to the popularity of TOGAF (Raynard, 2008). Research showed that TOGAF provides the users detailed methods as well as supporting tools for improving and developing Enterprise Architecture by conceptualizing through practice in Open Group's Architecture Forum. It is denoted that TOGAF is free for anyone to utilize in their various architecture framework needs.

In this study we shall only discuss TOGAF Version 9 as it is the trend of the industry. The goal of TOGAF is to provide a framework for the design, evaluation and building of architectures for enterprises. TOGAF version 9 divides its content into three parts, TOGAF Capability Framework, TOGAF Architecture Development Method (ADM) & Content Framework, TOGAF Enterprise Continuum & Tools. It maps between the Business Vision and Drivers(TO-BE) to the Business Capabilities(AS-IS). Figure 2 illustrates the overview of TOGAF Version 9 content.

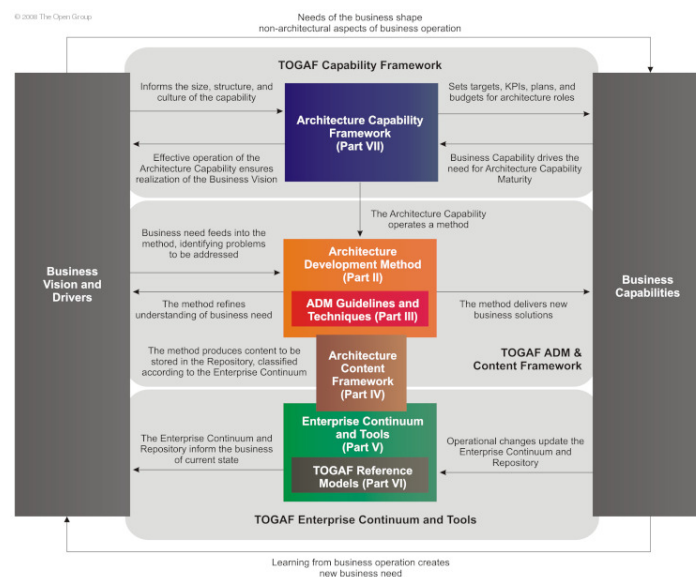


Figure 2. TOGAF overview (Open Group, 2009)

² See <http://www.opengroup.org/architecture/togaf8-doc/arch/>

³ See <http://www.opengroup.org/architecture/togaf9-doc/arch/>

- TOGAF ADM is a generic method which specifies an iterative approach for architecture development. It is the key of TOGAF.
- The content framework provides a structural model for architectural content. It enables the major work products (produced by ADM) created by architect to be consistently defined, structured, and presented.
- Architecture capability framework provides a number of guidelines to establish an architecture function.
- The enterprise continuum is a virtual repository of all architecture assets including models, patterns and architecture descriptions.
- Finally TOGAF provides a set of resources, guidelines, templates to assist in the use of TOGAF.

Open Group (2009) clarifies that the division of TOGAF into independent parts has a certain purpose. It intends to focus on each specific area and discuss the details so that it is especially addressed in isolation. But in this research, TOGAF is taken as one piece framework and restructured into process and product elements.

TOGAF Architecture Development Method

ADM is the core of TOGAF. ADM is the core of TOGAF. It provides a tested and repeatable process for developing architectures (Open Group, 2009). The ADM includes establishing an architecture framework, developing architecture content, transitioning, and governing the realization of architectures. The execution of ADM will produce a number of outputs, including process flows, architectural requirements, project plans, and project compliance assessments. Figure 3 shows the basic structure of the ADM. The principles and the tailored framework are created in the preliminary phase and architecture vision phase. Those principles and the tailored framework also define the scope and commitment of EA work. Different as-is and to-be situations are defined in the business architecture, the information system architecture and the technology architecture phases, respectively, by performing gap analysis. Opportunities and solutions phase covers the work package and transition architecture. The implementation and migration plans are developed in the migration planning phase. The quality of implementation is assessed in the implementation governance phase. Architecture update and new request for architecture work issues are performed in the architecture change management phase and the requirement management.

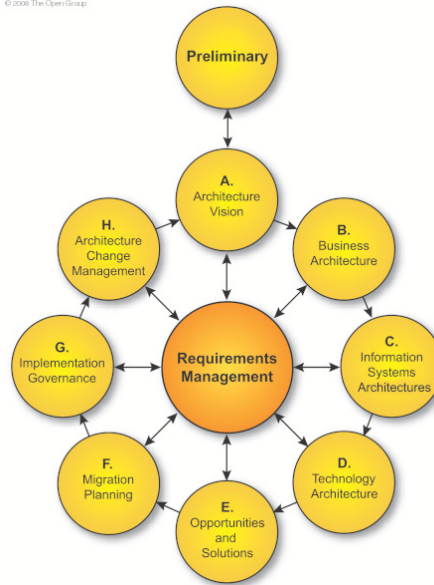


Figure 3. Architecture Development Cycle (Open Group, 2009)

2.3. Documentation maturity assessment literature

Documentation is a key element in enterprise architecture project. On one hand, it helps architects to build and maintain architecture. On the other hand, it plays an important role in assisting outsiders to understand the overall of the architecture quickly. Hence, soundness of documentation will directly affect the quality of enterprise architecture.

Unfortunately not all documents in reality are in high quality (Huang & Tilley, 2003). Research on software system documentation showed that this is partly due to the fact that documentation is usually generated in an ad hoc manner. Little objective guidance can be followed to trace documentation quality or to improve the documentation creation process. This situation leads to the result that documentation is difficult to predict, challenging to assess, and that usually falls short of its potential.

Another motivation to focus on documentation in the detailed level maturity assessment on TOGAF based EA projects is the key position of documentation in TOGAF ADM. Documents are served as inputs and outputs in all ADM phases. As we discussed above, ADM is the key component of any TOGAF based EA projects. Therefore by assessing the maturity level of “circulated blood” of ADM, one can have an efficient assessment on to what extent the organization apply TOGAF ADM.

Unfortunately little documentation maturity assessment literature in Enterprise Architecture field has been found. Enterprise Architecture area is still a young academic subject. Not all corners in this field have been well explored. But we are able to find some documentation maturity assessment literature in software engineering field. From the historical point of view, architecture documentation is a derivative from software engineering documentation in its history of development. Compared with documentation maturity assessment in EA, documentation maturity assessment in software

engineering is a more matured field with many studies. Although the architecture documentation originates from the software engineering documentation, it covers a bigger scope than software engineering documentation due to the capacity of Enterprise Architecture. Architecture documentation is created in corresponding to all the domains in Enterprise Architecture, such as the business domain architecture documentation and the data domain architecture documentation. Another difference between the architecture documentation and the software engineering documentation is the level of details. The architecture documentation has more general description of the requirements and routine, whereas the software engineering documentation explains how to program a particular routine. Therefore the code is commonly presented in the software engineering documentation instead of the architecture documentation.

Documentation is the written record of what the software is supposed to do, what it does, how it does and how to use it (Visconti & Cook, 1993). It is also described as any artifact intended to communicate information on the software system (Forward & Lethbridge, 2002). Sound documentation should follow seven fundamental principles: (1) Write from the point of view of the reader; (2) Avoid unnecessary repetition; (3) Avoid ambiguity; (4) Use a standard organization; (5) Record rationale; (6) Keep documentation current but not too current; and (7) Review documentation for fitness of purpose (Clements et al., 2003).

Research shows that effectively documenting an architecture is as important as crafting it (Clements et al., 2003). Because if the architecture is not understood (or worse, misunderstood), it cannot meet its goals as the unifying vision for system and software development. Empirical studies have also agreed that documentation is a critical component in Enterprise Architecture development and maintenance phases (Visconti & Cook, 1998; Huang & Tilley, 2003).

The Documentation Process Maturity Model presented by Visconti & Cook (1993) is a description of process maturity, capability and practices which enables an organization to generate high quality documentation. The structure of the model is based upon the SEI's Software Process Maturity and Capability Maturity models with 4 maturity levels and represents an ideal process and the assessment to determine where the organization stands relative to the model. Another Documentation Maturity Model is proposed by Huang & Tilley (2003). It is particularly targeted on assessing the quality of software system documentation in two aspects of documentation quality: the process and the product. The process component of this model is a five-level staged maturity model inspired by the Reverse Engineering Environment Framework (REEF). The product component of the model is centered on a set of key product attributes (KPAs) (Tilley, 1998).

Those two models are quite different from each other. The Documentation Process Maturity Model (showed in Table 2) focuses only on the process part. It designs the key practices, indicators and challenges for each level of documentation process. Documentation Maturity Model (showed in Table

3), which also based on CMM, assessed from the software engineering perspective on both the products (measured by KPAs) and the processes (measured by five levels). Unfortunately both of the models do not include any practical assessment instruments.

Table 2. Documentation Process Maturity Model Summary Table (Visconti & Cook, 1998)

	Ad-hoc	Inconsistent	Defined	Controlled
Key words	Chaos Variability	Standards Check-off list Inconsistency	Product assessment Process definition	Process assessment Measurement, Control Feedback Improvement
Succinct Description	Documentation not a high priority	Documentation recognized as important and must be done	Documentation recognized as important and must be done well	Documentation recognized as important and must be done well consistently
Key Process Areas	Ad-hoc process Not important	Inconsistent application of standards	Documentation quality assessment Process definition	Process quality assessment and measures
Key Practices	Documentation not used	Check-off list Variable content	SQA-like team for documentation Consistent use of documentation tools	Minimum process measures Data collection and analysis Extensive use of documentation tools and integration with CASE tools
Key Indicators	Documentation missing or out of date	Standards established	SQA-like practices Consistent use of documentation tools	Data analysis and improvement mechanisms
Key Challenges	Establish documentation standards	Exercise quality control over content Specify process	Establish process measure Incorporate control over process	Automate data collection and analysis Continual striving for optimization

Table 3. DMM KPAs and Maturity Levels (Huang & Tilley, 2003)

KPA	Maturity Level					
		1	2	3	4	5
Format	Text	Inline & Informal	Inline & Standardized	Hyperlinked	Contextual	Personalized
	Graphics	Static & Informal	Static & Standardized	Animated	Interactive	Editable
Efficiency		Manual	Semi-automatic & Static	Semi-automatic & Dynamic	Automatic & Static	Automatic & Dynamic
Granularity		Source code	Design patterns	Software architecture	Requirements	Product lines

3. Problem statement and research methodology

Most of the EA maturity models focus on assessing the maturity levels of architectural processes. Product elements in EA have been left out of research attention. Therefore an EA maturity assessment on both elements will have a valuable contribution to the field. It is also remarkable that all the different maturity models are theoretically oriented in the sense that they are difficult to be applied in empirical studies. It is surprising that no paper has presented any practical instruments (e.g., interview questionnaires) for assessing EA projects in practice. Furthermore, although TOGAF has been widely applied in EA practice, no single maturity assessment tailored to this particular framework exists, not to mention empirical studies on TOGAF maturity assessment.

This situation raised an interesting question: Is it possible to develop an instrument to assess the maturity of TOGAF based EA projects?

3.1. Research topics

This study wants to address the following research topics.

- The horizontal assessment: Enterprise Architecture product and process elements maturity assessment based on TOGAF framework
- The vertical assessment: Documentation maturity assessment based on TOGAF context

The first topic will assess maturity situation of TOGAF based EA work from an abstract level. The second topic will zoom into details to evaluate the maturity of documentation in TOGAF context. TOGAF is a framework rather than a real project. It does not provide sufficient information in resource elements. Hence the resource element maturity assessment will not be covered in this study.

3.2. General study approach

The methodology in this study will follow a four steps research approach. Figure 4 represents the research approach on a high level. The research is initiated by the research topics. A literature review is conducted to find the existing literature within study scope to further assist the instrument development. The design of maturity assessment instrument is then followed. Detailed processes will be present in the following part. Finally the instrument is validated through some interviews.



Figure 4. Research approach on a high level

3.3. The horizontal research approach

This assessment is the part one of TOGAF based EA work maturity assessment. It takes place in three steps. First, the architecture elements information will be extracted from TOGAF framework. In this step key TOGAF elements will be presented as one intermediate output. In the second step, the TOGAF elements information shall be integrated into TU/e ICTA EA maturity model to generate the maturity assessment questionnaire for TOGAF based EA projects as a second output. In the third steps, the assessment questionnaire is validated and refined through interviews to issue the final maturity assessment instrument for TOGAF based EA work. An overview of the maturity assessment on TOGAF is present in Figure 5.

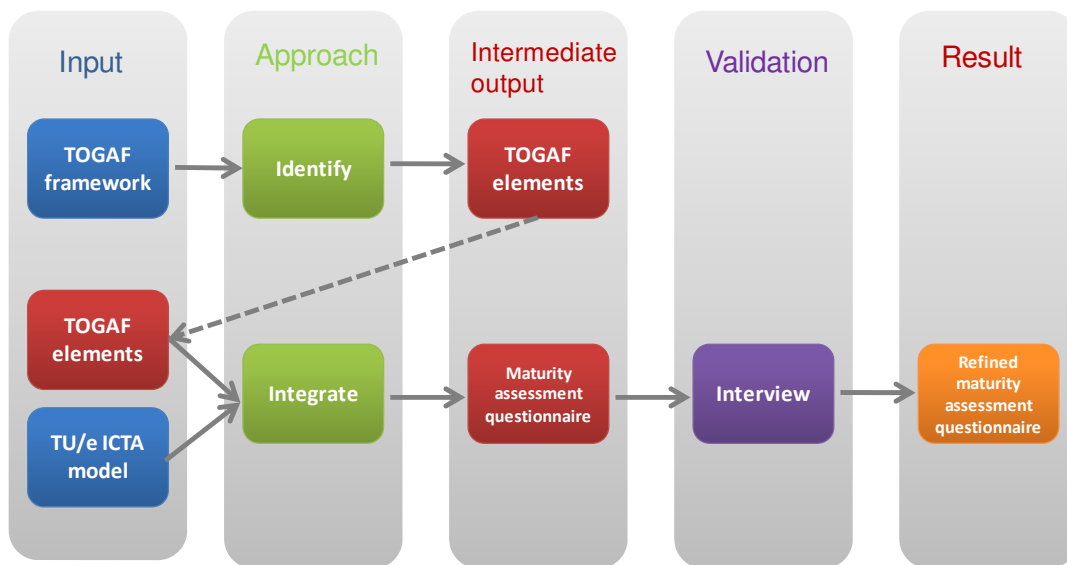


Figure 5. TOGAF based EA maturity assessment research approach

3.4. The vertical research approach

In the second part of the TOGAF based EA maturity assessment, documentation is selected to elaborate the maturity assessment into a detailed level. There are four steps in this approach. First, detailed information of TOGAF documentation will be selected and summarized from TOGAF. A TOGAF documentation summary will be generated as an intermediate output. At the same time, a documentation maturity model will be established based on TU/e ICTA EA maturity model as the second step. In the next step, the documentation maturity assessment questionnaire for TOGAF based EA will be developed with inputs of information from TOGAF documentation and corresponding documentation maturity model. In the last step, the intermediate questionnaire will be used in the interviews for validation and refined documentation assessment questionnaire will be generated as the result of documentation maturity assessment instrument on TOGAF based EA work. An overview of TOGAF based EA documentation maturity assessment is present in Figure 6.

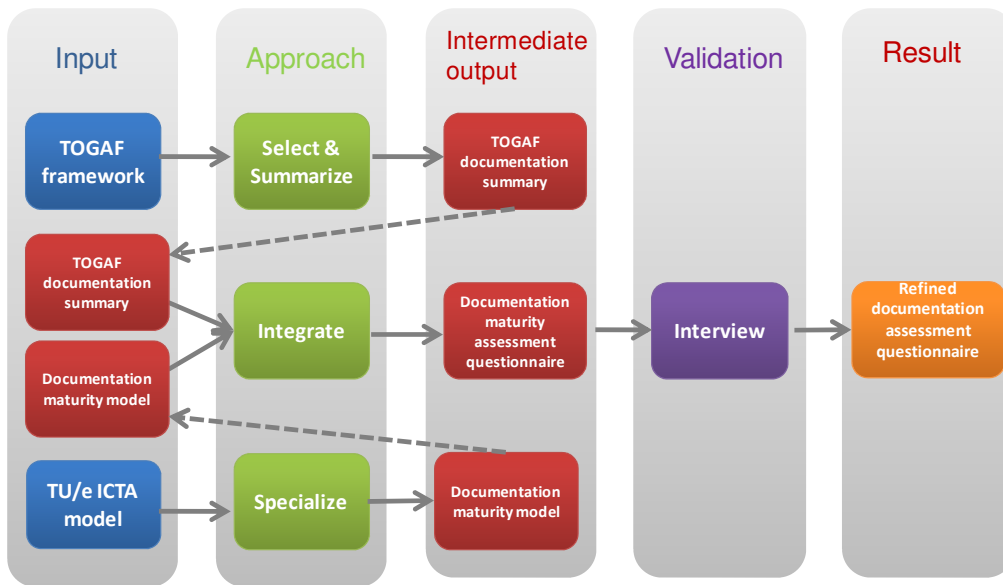


Figure 6. TOGAF based EA documentation maturity assessment research approach

4. Instrument development I: the horizontal assessment

4.1. Elements selection

The elements used in the maturity assessment instrument development come from integration of the elements in TU/e ICTA EA maturity model and the elements in TOGAF. Table 4 compares the differences in those elements.

Table 4. Maturity assessment element comparison

Categories	TOGAF elements	TU/e ICTA model elements	Maturity assessment elements
Product	N/A	Product-related tools	Product-related tools
	N/A	Modeling languages	Modeling languages
	N/A	Patterns	Patterns
	Reference models	RA and RM	Reference models
	ADM	Architecture frameworks	ADM
	N/A	Standards	Standards
	N/A	Templates	Templates
	Architecture repository	Product knowledge repository	Architecture repository
	Manners in applying ADM	Policies	Policies
	Architecture deliverables	Architecture documentation	Architecture documentation
Process	Architecture governance / Risk management	Project management / Risk management	Project management / Risk management
	Migration planning	Support / Configuration Management	Migration planning
	Compliance assessment	Support / Process and product quality assurance	Compliance assessment
	Architecture vision	Support / Decision analysis and resolution	Architecture vision
	N/A	Engineering / verification and validation	N/A
	N/A	Engineering / technical solution	N/A
	N/A	Product knowledge management	N/A
	N/A	Use of process-related tools	N/A
	N/A	Use of model transformations	N/A
	N/A	Communication	N/A
Requirements management	N/A	Requirements management	
Resource	N/A	Tasks, functions, responsibility and authorization, competences, Development and training, workforce planning, reward structure, organizational structure, feedback and coaching, use of resource-related tools	N/A

Fifteen key elements are selected for the maturity assessment instrument, including ten product elements and five process elements. Most of the product elements derive from TU/e ICTA model. Product elements in TU/e ICTA model fit in logical classification. Minor change occurs in the

architecture frameworks element. In the maturity assessment element, it is replaced by ADM since TOGAF itself is reference architecture. In contrast, the process elements are partly my own contribution since I identified the key elements from TOGAF. Process elements in the TU/e ICTA EA maturity model capture the key features in the whole processes of EA development, which does not fit the ADM process orientated approach in TOGAF. As this study stresses the TOGAF based EA maturity assessment innovation, the TOGAF approach should be prioritized in the integration of two inputs. Since TOGAF is a technical framework for Enterprise Architecture, no corresponding resource elements are found in TOGAF. As a consequence, the resource elements are not included in the TOGAF based EA maturity assessment elements.

4.2. Model development

The maturity model of TOGAF based EA work is a model derived from the TU/e ICTA model with selected elements. The model is shown in table 5. Three levels of maturity is classified based on TU/e ICTA maturity model (Dijkman et al., 2010). Level 1 is referred to as an ad-hoc manner and the situation that a particular element is used only when the need is felt by one or a few project members. Level 2 is the inconsistent application of elements. The agreement on application is only reached in the projects level. Level 3 is referred to as the standardized application of elements at an organizational level and used in the same way in each project.

Table 5. TOGAF based EA maturity model

Categories	Elements	Level 1	Level 2	Level 3
Product	Product-related tools	Ad-hoc	Inconsistent	Standardization
	Modeling languages	Ad-hoc	Inconsistent	Standardization
	Patterns	Ad-hoc	Inconsistent	Standardization
	Reference models	Ad-hoc	Inconsistent	Standardization
	ADM	Ad-hoc	Inconsistent	Standardization
	Standards	Ad-hoc	Inconsistent	Standardization
	Templates	Ad-hoc	Inconsistent	Standardization
	Architecture repository	Ad-hoc	Inconsistent	Standardization
	Policies	Ad-hoc	Inconsistent	Standardization
	Architecture documentation	Ad-hoc	Inconsistent	Standardization
Process	Project management / Risk management	Ad-hoc	Inconsistent	Standardization
	Migration planning	Ad-hoc	Inconsistent	Standardization
	Compliance assessment	Ad-hoc	Inconsistent	Standardization
	Architecture vision	Ad-hoc	Inconsistent	Standardization
	Requirements management	Ad-hoc	Inconsistent	Standardization

4.3. Elements analysis and questionnaire design

As TOGAF becomes more and more popular, increasingly amount of Enterprise Architecture projects follow TOGAF framework to build their enterprise architectures. But it is difficult to assess to what extent those projects apply TOGAF due to lacking of a practical assessment tool. This section intends to analyze the selected elements and design the assessment questions for the elements.

4.3.1 Product elements

4.3.1.1 Product-related tools

Product-related tool is an important instrument for architects to realize any Enterprise Architecture project. In the last few years, various EA tools have been developed in practice. Although TOGAF itself does not require or recommend any specific tool, many tools have specific functions or add-in to support TOGAF framework. A list of TOGAF 8 tool support product is presented in Table 6. All product listed in the table were registered in TOGAF Version 8. It will be beneficial for architects to use those TOGAF-favored tools to develop their enterprise architecture. Hence the selection of tool with the TOGAF supporting function will be an assessment point.

Table 6. TOGAF 8 Tool Support Product⁴

Company	Product
alfabet AG	planningIT 3.1 and later
Armstrong Process Group, Inc	APG TOGAF 2007 Process Library (ATPL) 1.0
Avolution	ABACUS 3.x
BIZZdesign Holding	Architect 2
IDS Scheer AG	ARIS Platform V7.1 or later
Orbus Software	iServer 2009 V5 SP1
Telelogic	System Architect V11
The Salamander Organization Limited	MooD Transformation Technology 2006, 2007, 2008, 2008se

In the tool standardization issue, TOGAF questions if it is necessary for an organization to seek a single "one size fits all" tool for EA development. It is argued that a single mandated tool will hinder the reasons of principle (e.g., impede competitive commercial innovation or the development of advanced tool capability) and not accommodate a variety of architecture development "maturity levels" and specific needs across an enterprise. It further states that successful enterprise architecture teams are often those who harmonize their architecture tools with their architecture maturity level, team/organizational capabilities, and objectives or focus (Open Group, 2009). Therefore from TOGAF's point of view, standardization of tool is less critical in the EA development than synchronizing multi-tool suite to achieve different objectives in different architecture domains.

⁴ See http://www.opengroup.org/togaf/cert/select_prod.tpl?CALLER=select_prod.tpl&tools=Y

However, the statement from TOGAF on tool standardization issue is contradictory to the main idea of TU/e ICTA model. The increment of measurement levels in the TU/e ICTA model represents the ascending trend of standardization of elements application in the EA work. The conflicting propositions lead to the situation that this tool standardization issue cannot become a checkpoint for TOGAF based EA maturity assessment in this study yet. But the tool standardization issue can be a critical assessment point on the condition that more substantiated information is collected in the future to favor one side.

TOGAF proposes a set of evaluation criteria for selecting architecture tools. The criteria factors are features and functions, intuitiveness and ease-of-use, organizational compatibility, tool capacity and scalability constraints, architecture of the tool, full lifecycle support, interoperability, financial considerations, and vendor factors. TOGAF recommends architects to use TOGAF Tool Criteria in tool selection procedure. Hence the use of TOGAF Tool Criteria will be another assessment point.

There are two considerations in product-related tools element and the evaluation questions are presented at Table 7.

Table 7. Evaluation questions about product-related tools

Element 1. Product-related tools		
Level	Q1: Do you take TOGAF supporting function into account when selecting the EA tools?	
1	Some individual architects may use tool that supports TOGAF.	
2	Tool selection is agreed on the project basis. Some projects take TOGAF supporting function into account when selecting the tools.	
3	TOGAF supporting function is taken into account when selecting the EA tools and all the tools which are in EA projects support TOGAF.	
Level	Q2: To what extent do you use TOGAF Tool Criteria to select tool?	
1	There is no standard on which tool should be selected. Tools are selected on personal basis. Some architects use TOGAF Tool Criteria to select tools.	
2	Tools are selected on project basis. Some projects use TOGAF Tool Criteria to select tools.	
3	Selection of tools is agreed on enterprise level and every project use TOGAF Tool Criteria when selecting tools. Even when multi-tools suites are selected, they are synchronized to achieve objectives in different architecture domains.	

4.3.1.2 Modeling language

Modeling languages are essential instruments for the description and communication of architectures. Modeling languages and tools have evolved more or less “hand in hand”. In some cases methodologies and frameworks have grown around and are supplied together with architecture

support tools. In other cases, tool vendors have strived to endow their tools with new functionality in order to support frameworks or other modeling notations (Steen et al., 2005).

On one hand, TOGAF neither develops a modeling language nor appoints any specific modeling languages for TOGAF implementation, which makes the questions on assessing any particular modeling language not possible. The assessment then will be a general assessment on the usage of modeling language from the perspective of TU/e ICTA model. On the other hand, TOGAF recommends some modeling language to be used in some predefined extension modules. The extension modules are supported by TOGAF content metamodel to explore more in-depth considerations for particular architecture concerns. The information of recommended modeling language by TOGAF in the predefined extension modules is summarized in Table 8. This information enables the assessment on the use of those recommended modeling languages in TOGAF extension modules.

Table 8. TOGAF recommended modeling language summary (Open Group, 2009)

Content Metamodel Extension modules	Functions	Recommended modeling languages
Process Modeling Extensions	Extension to support process modeling.	<ul style="list-style-type: none"> • Business Process Modeling Notation (BPMN) specification • Software Process Engineering Metamodel (SPEM) specification
Infrastructure Consolidation Extensions	Extension to support consolidation of application and technology across locations.	<ul style="list-style-type: none"> • Unified Modeling Language (UML) • Systems Modeling Language (SysML) • IT Portfolio Management Facility (ITPMF)
Motivation Extensions	Extension to support linkage of drivers, goals, and objectives to organizations and services.	<ul style="list-style-type: none"> • Business Motivation Model (BMM) specification

Unfortunately TOGAF only lists the name of the recommended modeling languages but does not provide detailed information (e.g., which part of UML should be used). This situation may be deduced that TOGAF is not matured in the modeling languages elements. Hence, the assessment questions on modeling language will largely follows the evaluation perception of TU/e ICTA model. The modeling language evaluation questions are presented at Table 9.

Table 9. Evaluation questions about modeling language

Element 2. Modeling Language		
Level	Q3: To what extent do you agree to use certain modeling language?	
1	No common modeling language exists in the enterprise. Use of a language is based on the choice of individual architect.	
2	An agreement is reached within a project on a set of modeling languages.	
3	A set of enterprise-wide modeling languages are agreed upon and used in all enterprise projects.	
Level	Q4: To what extent do you use recommended modeling languages in TOGAF Process Modeling Extensions, Infrastructure Consolidation Extensions, and Motivation Extensions if applicable?	
1	We don't know/use the recommended modeling languages in those areas.	
2	Some extension areas use recommended modeling languages.	
3	All the extension areas use recommended modeling languages.	

4.3.1.3 Patterns

Architectural patterns (Open Group, 2009) (also referred to as architectural styles) are “well-established solutions to architectural problems”. In TOGAF, patterns are considered to be a way of putting building blocks into context; for example, to describe a re-usable solution to a problem. Building blocks are what you use; patterns can tell you how you use them, when, why, and what trade-offs you have to make in doing so (Open Group, 2009). TOGAF referred to book *Pattern-oriented Software Architecture: A system of patterns* (Buschmann et al., 1996) to differentiate three types of patterns. Different from the book, TOGAF focuses more on the functions of patterns in providing re-usable models and methods for the architecting of enterprise information systems.

- The Architecture Pattern is a basic structure of system development with predefined guidelines and rules.
- The Design Pattern is a predefined structure or component for system development which solves a general design problem within a particular context.
- The Idiom is a special pattern. It indicates the specific way of implementing particular aspects of components or the relationship between them in a lower level.

Although TOGAF has defines the types of patterns, TOGAF Version 9 has not yet integrated the usage of patterns into TOGAF application. Therefore the maturity assessment on patterns falls to the measurement perspective from TU/e ICTA model. But as indicated in TOGAF context, it sees patterns as an emerging important resource, TOGAF proposes in Version 9 a tentative format of

content of patterns (presented in Table 10) to be tested and attempts to offer more rigorous information on patterns in future versions of TOGAF. Hence the usage of TOGAF content of patterns can be used in the assessment point.

Table 10. TOGAF content of a pattern (Open Group, 2009)

Name	Content
Name	A meaningful and memorable way to refer to the pattern, typically a single word or short.
Problem	A description of the problem indicating the intent in applying the pattern.
Forces	A description of the relevant forces and constraints, and how they interact/conflict with each other and with the intended goals and objectives.
Solution	A description, using text and/or graphics, of how to achieve the intended goals and objectives.
Resulting Context	The post-conditions after the pattern have been applied. Implementing the solution normally requires trade-offs among competing forces.
Examples	One or more sample applications of the pattern which illustrate each of the other elements
Rationale	An explanation/justification of the pattern as a whole, or of individual components within it, indicating how the pattern actually works, and why - how it resolves the forces to achieve the desired goals and objectives, and why this is "good".
Related Patterns	The relationships between this pattern and others.
Known Uses	Known applications of the pattern within existing systems, verifying that the pattern does indeed describe a proven solution to a recurring problem.

The patterns maturity assessment questions are presented at Table 11.

Table 11. Evaluation questions about patterns

Element 3. Patterns		
Level	Q5: To what extent do you agree to use patterns?	
1	Usage of patterns is based on the architect's experience and a small scale patterns are used.	
2	Usage of patterns is based on the architects' experience. Larger scale patterns that may affect the whole project are used. Any storage of patterns is done in an unstructured manner.	
3	Patterns are used consistently across projects in the enterprise. They are stored in a repository with clear guidelines followed in the enterprise.	<input type="checkbox"/>
Level	Q6: To what extent do you use TOGAF proposed content of pattern?	
1	Some individual architects may know and use TOGAF proposed content of pattern.	
2	Some projects use TOGAF proposed content of pattern.	
3	Whole enterprise use TOGAF proposed content of pattern and take it as a standard.	

4.3.1.4 Reference models

A reference model is an abstract framework for understanding significant relationships among the entities of an environment, and for the development of consistent standards or specifications supporting that environment (Open Group, 2009). TOGAF Technical Reference Model (TRM) is considered as foundation architecture focuses on the Application Platform space. TRM model can be decomposed into three major entities (Application Software, Application Platform, and Communications Infrastructure) which are connected by two interfaces (Application Platform Interface and Communications Infrastructure Interface). Figure 7 shows TRM from high level view. As TRM has a significant role in providing widely accepted core taxonomies and the corresponding visual representations. It is essential to measure to what extent TRM is applied in TOGAF based EA work.

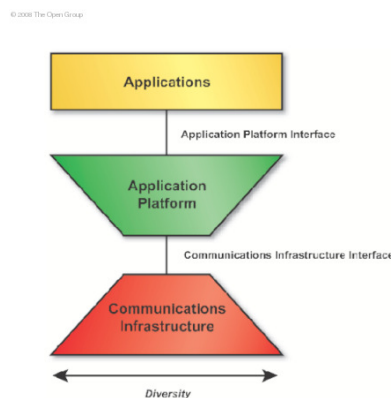


Figure 7. Technical Reference Model - High-Level View (Open Group, 2009)

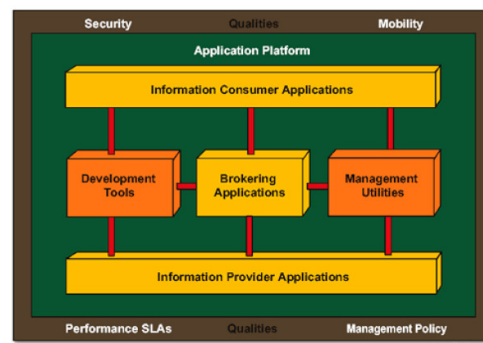


Figure 8. III-RM - High-Level View (Open Group, 2009)

Another reference model in TOGAF is Integrated Information Infrastructure Reference Model (III-RM). It is a reference model that focuses on the Application Software area and Common Systems Architecture in Enterprise Continuum terms. The III-RM is a subset of the TOGAF TRM in terms of its overall scope, but it also expands certain parts of the TRM - in particular, the business applications and infrastructure applications parts (Open Group, 2009). The high-level view of III-RM is illustrated in Figure 8. It is fundamentally an Application Architecture reference model - a model of the application components and application services software essential for an integrated information infrastructure.

III-RM as a sub model of TRM is also important in addressing some of the key challenges facing the enterprise architect today, particularly business applications and infrastructure applications parts. Therefore it is necessary to assess the usage of both TOGAF TRM and III-RM when evaluating the maturity level of reference models elements in TOGAF based EA work. Questions in evaluating reference models are presented on Table 12.

Table 12. Evaluation questions about reference models

Element 4. Reference models		
Level	Q7: To what extent do you use TRM and III-RM?	
1	Not used./Architects use TRM or III-RM individually.	
2	Some projects use TRM and III-RM based on their experience and agreement	
3	Usage of TRM and III-RM is an enterprise policy. All EA projects use them.	
Level	Q8: In which of the following entities do you use TRM (Application Software, Application atform, and Communications Infrastructure)?	
1	Some architects use TRM in the areas which they need.	
2	Some projects use TRM in some of the entities.	
3	TRM is used in all three entities.	

4.3.1.5 ADM

The ADM is decomposed into ten phases. It is not possible to assess the details in each phase. But the structure of ten phases is the same, including objectives, approach, inputs, steps and outputs. Hence it is an easy approach to assess the standardization situation of applying ADM by assessing the situation of applying ADM structure.

Furthermore, one technique is widely used in the ADM, especially in the business architecture, the information system architecture and the technology architecture phases. Gap analysis is used to underline the difference between Baseline Architecture and the Target Architecture in order to validate an architecture that is being developed. Therefore the use of gap analysis is a good indication of the maturity situation of applying ADM. Questions for evaluating ADM are presented on Table 13.

Table 13. Evaluation questions about ADM

Element 5. ADM		
Level	Q9: To what extent do you follow the structure (objectives, approach, inputs, steps and outputs) in each of your ADM phases?	
1	There is no strict structure for architect for refer to in ADM phases. Architects can follow TOGAF ADM structure if they want.	
2	Agreement of following ADM structure is agreed on a project basis.	
3	Use of ADM structure is agreed on enterprise level. All EA projects have to follow ADM structures in all phases.	
Level	Q10: Do you perform gap analysis?	
1	Typically it is not performed. Some architects may do it according to their need.	
2	Some projects perform gap analysis if they need.	
3	Performing gap analysis is agreed on enterprise level. All the projects need to do it.	

4.3.1.6 Standards

TOGAF does not specify any standards in the development of EA work. But it indicated that the classification of standards with guidelines. The first type is legal and regulatory obligations. These standards are mandated by law and therefore an enterprise must comply or face serious consequences. The second type is industry standards. These standards are established by industry bodies and are then selected by the enterprise for adoption. Industry standards offer potential for interoperation and sharing across enterprises, but also fall outside of the control of the enterprise and therefore must be actively monitored. The third group is organizational standards. These standards are set within the organization and are based on business aspiration. Organizational standards require processes to allow for exemptions and standards evolution. Due to this situation, it is not possible to assess the application of any particular standards. We shall then assess the overall application of standards from the standpoint from the TU/e ICTA model.

Although TOGAF does not specify any standards, it establishes a standards information base, which provides a repository area to hold a set of specifications. Standards within the standards information base are categorized according to the building blocks within the TOGAF content metamodel. Each metamodel entity can have standards associated with it. At the top level, standards are classified in line with four TOGAF architecture domains, which are the business standards, the data standards, the application standards and the technology standards (Open Group, 2009). Table 14 shows the standards classification within the standards information base. Therefore use of TOGAF standards information base can be evaluated in the standards element maturity assessment.

Table 14. Standards Classification within the Standards Information Base (Open Group, 2009)

Business standards	<ul style="list-style-type: none">• Standard shared business functions• Standard role and actor definitions• Security and governance standards for business activity
Data standards	<ul style="list-style-type: none">• Standard coding and values for data• Standard structures and formats for data• Standards for origin and ownership of data• Restrictions on replication and access
Applications standards	<ul style="list-style-type: none">• Standard/shared applications supporting specific business functions• Standards for application communication and interoperation• Standards for access, presentation, and style
Technology standards	<ul style="list-style-type: none">• Standard hardware products• Standard software products• Standards for software development

Questions for evaluating standards are presented on Table 15.

Table 15. Evaluation questions about standards

Element 6. Standards		
Level	Q11: To what extent do you use standards?	
1	No standards are used. / Only legal and regulatory obligations are complied.	
2	Projects can decide themselves if they want to use standards. The standards in use are industry standards.	
3	Organizational standards are set within the organization and are based on business requirement.	
Level	Q12: To what extent do you use TOGAF standards information base?	
1	Not used. / Some architects use standards information base individually.	
2	Some projects have and use standards information base.	
3	Standards information base is established in the enterprise wide. All EA projects use it.	

4.3.1.7 Templates

In TOGAF, the reference library provides a repository area to hold the best practice or template materials that can be used in constructing architectures. The predefined templates are part of the storage in the reference library.

TOGAF (Open Group, 2009) reflects that the source of any kind of templates or reference architecture has a significant effect on the execution of projects. Therefore TOGAF is not considering providing any specific templates to avoid potential misdirection. In addition, TOGAF points out that the templates that are originated from within the enterprise and have been tested are likely to have a much better fit to the needs of the organization. Hence, the questions for evaluating standards are presented on Table 16.

Table 16. Evaluation questions about templates

Element 7. Templates		
Level	Q13: To what extent do you create and use template?	
1	Not templates are in use. / Templates are used in an informal way.	
2	Some projects will consider using templates. And when templates are not available, they will consider spending time designing templates.	
3	Templates are created, defined and used on an enterprise level.	
Level	Q14: To what extent do you store your templates in the reference library?	
1	No rules existed on how to store the templates. Some architects save them individually.	
2	Some projects save their templates and best practice in reference library if they want.	
3	It is agreed on the enterprise level that all the templates are stored in the reference library.	

4.3.1.8 Architecture repository

TOGAF provides a structural framework for the architecture repository. With the help of this architecture repository, an enterprise is able to distinguish between different types of architectural assets that exist at different levels of abstraction. It can be categorized into six classes of architectural information, namely, architecture metamodel, architecture capability, architecture landscape, standards information base, reference library, and governance log. Table 17 shows the content information of TOGAF architecture repository. The maturity assessment of standards information base is discussed in the element “standards”.

Table 17. Content of TOGAF Architecture Repository (Open Group, 2009)

Architectural information	Content
Architecture metamodel	It describes the organizationally tailored application of an architecture framework, including a method for architecture development and a metamodel for architecture content
Architecture capability	It defines the parameters, structures, and processes that support governance of the Architecture Repository.
Architecture landscape	It shows an architectural view of the building blocks that are in use within the organization today.
Standards information base	It captures the standards with which new architectures must comply, which may include industry standards, selected products and services from suppliers, or shared services already deployed within the organization.
Reference library	It provides guidelines, templates, patterns, and other forms of reference material that can be leveraged in order to accelerate the creation of new architectures for the enterprise.
Governance log	It provides a record of governance activity across the enterprise.

The assessment of the element architecture repository can lay on the overall application of architecture repository and the detailed assessment on the six areas of the repository. Questions for evaluating product knowledge repository are presented on Table 18.

Table 18. Evaluation questions about architecture repository

Element 8. Architecture repository		
Level	Q15: To what extent do you use architecture repository?	
1	It is not used.	
2	Repository is used per project and information is not shared.	
3	Repository is used in the enterprise wide. Information is shared and reused.	
Level	Q16: To what extent do you establish your repository in the six areas (architecture metamodel, architecture capability, architecture landscape, standards information base, reference library and governance log)?	
1	No area is established.	
2	Some areas are established in some projects.	
3	Complete six areas are established in repository.	

4.3.1.9 Policies

In the context of this study, policies are customized as the manners and rules in applying the ADM. One important manner in applying ADM is to tailor to the need of the organization. ADM is a generic method for architecture development. It is designed to fit with most systems and organizational requirements. But it is often necessary to modify or extend the ADM to cater to the specific needs from organizations. One of the tasks before applying the ADM is to review its components for the applicability, and then tailor them appropriately to the circumstances of individual enterprises. This activity will produce an "enterprise-specific" ADM (Open Group, 2009).

Another important feature of applying the ADM is iterative approach. Iterative approach allows architects to address different aspects of EA issues at different time to make efficient progress. Iterations can be done in four manners, namely, the architecture context iterations, the architecture definition iterations, the transition planning iterations and the architecture governance iterations. The architecture context iterations facilitate initial mobilization of architecture activity by establishing the architecture approach, principles, scope and vision. The architecture definition iterations enable the creation of architecture content by cycling through business, information systems, and technology architecture phases. The transition planning iterations support the creation of formal change roadmaps for a defined architecture. And the architecture governance iterations offer governance of change activity progressing towards defined target architecture (Karvinen, 2009).

The policies element will be assessed from two aspects, the tailor-making and the iterations, in applying the ADM. Questions for evaluating policies are presented on table 19.

Table 19. Evaluation questions about policies

Element 9. Policies		
Level	Q17: To what extent do you tailor TOGAF ADM into your own architecture framework (terminology, process and content)?	
1	There is no agreement on how to tailor ADM. Some architects may tailor ADM partly according to their needs.	
2	Agreement on how to tailor ADM is reached on a project basis.	
3	Tailoring ADM is performed at the preliminary phase on the enterprise level.	
Level	Q18: To what extent do you utilize iterative approach when applying ADM?	
1	There is no agreement on which approach to take.	
2	Agreement on how to utilize iterative approach is agreed on a project basis.	
3	Using iterative approach is agreed on enterprise level.	

4.3.1.10 Architecture documentation

The execution of the ADM produces a number of outputs as a result of their efforts. Those outputs which are consumed and produced across the ADM cycle are referred as deliverables. TOGAF defines deliverable as work product that is contractually specified and in turn formally reviewed, agreed, and signed off by the stakeholders. Most deliverables present in documentation form and will be archived at completion of a project, or transitioned into an architecture repository as a reference model, standard, or snapshot of the architecture landscape at a point in time (Open Group, 2009). In this sense the important deliverables which have been archived are the architecture documentation. Hence we replace deliverable term with documentation in this study.

Baseline of architecture documentation is provided by TOGAF to define the activities required in the ADM. It also acts as a starting point for tailoring within a specific organization. Hence assessing the application of baseline will outline the application of documentation to some extent. Since documentation element has been chosen as to be examined in a more detailed level in the following chapter, a general assessment on documentation creation procedures is essential to be conducted here. Questions for evaluating architecture documentation are presented on Table 20.

Table 20. Evaluation questions about architecture documentation

Element 10. Architecture documentation		
Level	Q19: To what extent do you define the procedures of creating the documentation?	
1	There is no agreement on how to create documentation.	
2	The creation of documentation is discussed and agreed on a project basis.	
3	An enterprise rule is established on how to create and manage the architectural documentation.	
Level	Q20: To what extent do you follow TOGAF's documentation baseline?	
1	They are normally omitted.	
2	Some projects follow TOGAF documentation baseline and roadmap.	
3	The documentation baseline and roadmap are defined in the enterprise wide and comply with the TOGAF requirement.	

4.3.2 Process elements

4.3.2.1 Project management / Risk management

Project management is considered as to plan, monitor and control, to manage supplier agreements, and ultimately to quantitatively manage the projects defined processes (Dijkman et al., 2010). Although TOGAF has no direct project management information, it defines architecture governance as the practice and orientation by which enterprise architectures are managed and controlled at the

organizational level. The architecture governance includes implementing a system of controls over the creation and monitoring of all architectural components and activities. The architecture governance activities enable the compliance of the internal and external standards and regulatory obligations when implementing a system, support effective management within agreed parameters in establishing processes, and ensure accountability to a clearly identified stakeholder community in developing the practices, both inside and outside the organization.

Risks always exist in any architecture/business transformation effort. Therefore it is important to identify, classify, and mitigate these risks before starting so that they can be tracked throughout the transformation effort. TOGAF suggests that two levels of risks should be considered, namely, the initial level of risk - risk categorization prior to determining and implementing mitigating actions and residual level of risk – risk categorization after implementation of mitigating actions (if any). In addition, TOGAF purposed five kinds of activities for risk management. These activities are presented in Table 21. Organizations who apply TOGAF may follow the recommended TOGAF risk management activities in their risk management.

Table 21. TOGAF risk management activities lists (Open Group, 2009)

Activities	Content
Risk classification	Risks are normally classified as time, cost, and scope but they could also include client transformation relationship risks, contractual risks, technological risks, scope and complexity risks, environmental risks, personnel risks, and client acceptance risks.
Risk identification	Normally the methodologies involve procedures for contingency planning, tracking and evaluating levels of risk; reacting to changing risk level factors, as well as processes for documenting, reporting, and communicating risks to stakeholders.
Initial risk assessment	Effect could be assessed using the criteria: <ul style="list-style-type: none"> • Catastrophic infers critical financial loss that could result in bankruptcy of the organization. • Critical infers serious financial loss in more than one line of business leading to a loss in productivity and no return on investment on the IT investment. • Marginal infers a minor financial loss in a line of business and a reduced return on investment on the IT investment. • Negligible infers a minimal impact on a line of business' ability to deliver services and/or products.
Risk mitigation and residual risk assessment	Risk mitigation refers to the identification, planning, and conduct of actions that will reduce the risk to an acceptable level. The mitigation effort could be a simple monitoring and/or acceptance of the risk to a full-blown contingency plan calling for complete redundancy in a Business Continuity Plan.
Risk monitoring	Once the mitigation effort has been identified for each one of the risks, re-assess the effect and frequency and then recalculate the impacts and see whether the mitigation effort has really made an acceptable difference. The mitigation efforts will often be resource-intensive and a major outlay for little or no residual risk should be challenged.

The assessment on project management and risk management element can be represented by assessing the application of TOGAF architecture governance and TOGAF risk management risk activities. Questions for evaluating project management and risk management are presented on Table 22.

Table 22. Evaluation questions about project management/risk management

Element 11. Project management / Risk management		
Level	Q21: To what extent do you practice TOGAF architecture governance?	
1	TOGAF architecture governance is performed in an individual way of a responsible specialist.	
2	TOGAF architecture governance is performed on a project level.	
3	TOGAF architecture governance is performed on an enterprise level and it is defined and tailored from the organization's standard processes.	
Level	Q22: To what extent do you follow TOGAF risk management activities?	
1	TOGAF risk management is performed in an individual way.	
2	TOGAF risk management is performed on a project level.	
3	TOGAF risk management is performed on an enterprise level and it is defined and tailored from the organization's standard processes.	

4.3.2.2 Migration planning

Migration planning is the creation of a viable Implementation and Migration Plan in cooperation with the portfolio and project managers. Several activities in migration planning assess the dependencies, costs, and benefits of the various migration projects. Among all the activities, configuration management are involved in step one *Confirm Management Framework Interactions for Implementation and Migration Plan* and step seven *Establish the Architecture Evolution Cycle and Document Lessons Learned*. In step one, implementation and migration plan should be aligned with the operations management framework and be coordinated with the artifact in the configuration management. Configuration management is also performed to ensure that the Enterprise Continuum and the architectures are coordinated and the architectures accurately reflect current and planned reality in step seven.

In addition, TOGAF provides an artifact for configuration management, the processing diagram. The Processing diagram focuses on deployable units of code/configuration and how these are deployed onto the technology platform. It addresses issues such as which set of application components need to be grouped to form a deployment unit, how one deployment unit connects/interacts with another, and how application configuration and usage patterns generate load or capacity requirements for different technology components (Open Group, 2009). Therefore it is convenient to assess the maturity situation of configuration management by assessing the application of the processing diagram.

Questions for evaluating migration planning are presented on Table 23.

Table 23. Evaluation questions about migration planning

Element 12. Configuration management	
Level	Q23: To what extent do you perform TOGAF ADM migration planning phase?
1	Migration planning is done on an individual level. There is no interaction with other architects.
2	Migration planning is done on a project level.
3	Migration planning is done on an enterprise level. It is planned and coordinated with the whole enterprise architecture.
Level	Q24: To what extent do you use TOGAF processing diagram?
1	Not used. / Individual architect may use them separately.
2	It is used on a project level. Some projects use them if necessary.
3	Using processing diagram is defined and agreed on the enterprise level in accordance with an organization's set of standards.

4.3.2.3 Compliance assessment

Compliance assessment is an important technique in ensuring the EA project compliance with the target architecture. TOGAF has complete information on compliance assessment review and tools. The architecture compliance review is a scrutiny of the compliance of a specific project against established architectural criteria, spirit, and business objectives (Open Group, 2009). TOGAF defines the level of compliance as reference for quality assurance. A formal process for such reviews normally forms the core of an enterprise architecture compliance strategy. The guidelines for compliance review provided by TOGAF are illustrated in Figure 9.

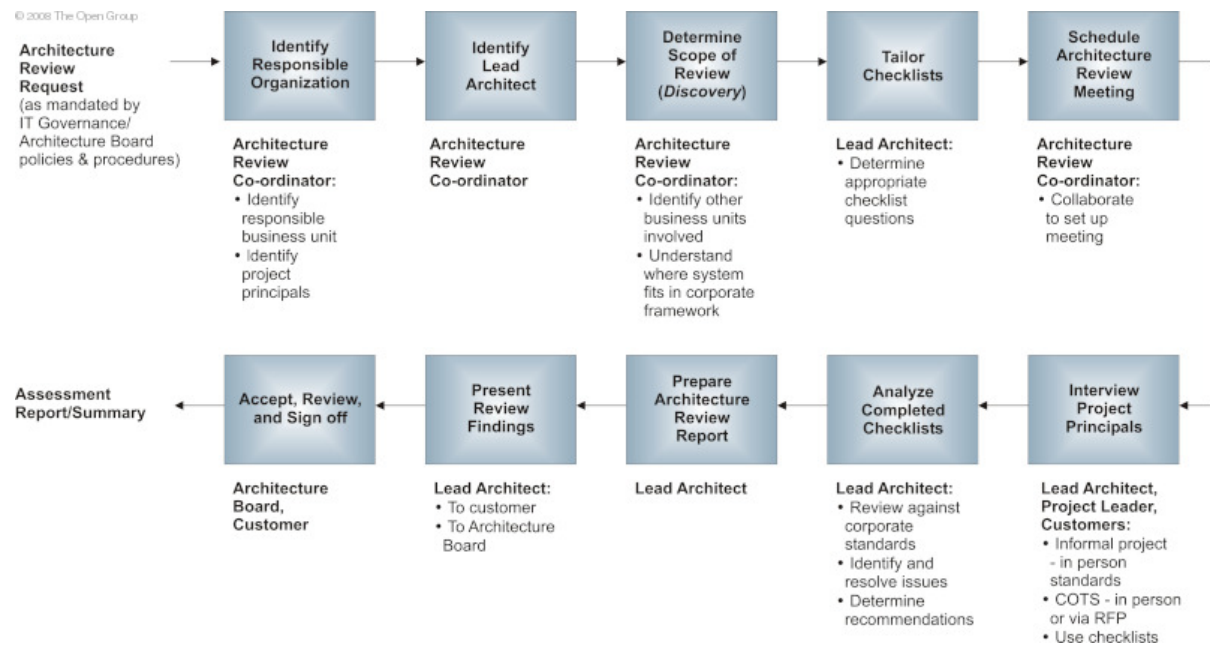


Figure 9. TOGAF Architecture Compliance Review Process (Open Group, 2009)

Furthermore, TOGAF offers a set of checklists with a wide range of typical questions to be used in conducting compliance reviews. Table 24 presents the compliance checklists items. Detailed compliance review questions can be found in TOGAF document⁵. Organizations can select and modify the predefined checklists with their needs.

Table 24. TOGAF Architecture Compliance Review Checklists Items (Open Group, 2009)

Compliance Checklists Items	Details
Applications Checklists	<ul style="list-style-type: none"> • Infrastructure (Enterprise Productivity) Applications • Business Applications • Application Integration Approach
Information Management Checklists	<ul style="list-style-type: none"> • Data Values • Data Definition • Security/Protection • Hosting, Data Types, and Sharing • Common Services • Access Method
Security Checklist	<ul style="list-style-type: none"> • Security Awareness • Identification/Authentication • Authorization • Access Controls • Sensitive Information Protection: • Audit Trails and Audit Logs • External Access Considerations
System Engineering/Overall Architecture Checklists	<ul style="list-style-type: none"> • General • Processors/Servers/Clients • Client • Application Server • Data Server • COTS (where applicable)
Software Services and Middleware Checklist	
Hardware and Operating System Checklist	
System Engineering/Methods & Tools Checklist	
System Management Checklist	

Questions for evaluating migration planning are presented on Table 25.

⁵ See <http://www.opengroup.org/architecture/togaf9-doc/arch/>

Table 25. Evaluation questions about compliance assessment

Element 13. Compliance assessment		
Level	Q25: To what extent do you perform compliance assessment?	
1	Compliance assessment is done in an ad-hoc way on the individual level.	
2	Compliance assessment is planned and executed on the project level.	
3	Compliance assessment is defined and performed on the organizational level in accordance with enterprise architecture requirements.	
Level	Q26: To what extent do you follow compliance assessment checklist recommended by TOGAF?	
1	Not used. / Individual architect may use them separately.	
2	It is used on a project level. Some projects use them if necessary.	
3	Using compliance assessment checklist is defined and agreed on the enterprise level in accordance with enterprise architecture requirements.	

4.3.2.4 Architecture vision

Architecture vision is the first phase in ADM cycle after the preliminary phase. The activities in this phase including defining the scope, identifying the stakeholders, creating the architecture vision document, and obtaining approvals. Architecture vision also ensures that the evolution of the architecture development cycle has proper recognition and endorsement from the corporate management of the enterprise, and the support and commitment of the necessary line management (Open Group, 2009).

Architecture vision phase starts with receipt of a request for architecture work document from the sponsoring organization to the architecture organization. Request from corporate management will be discussed and confirmed to gain full support and endorsement from management side. The scope of architecture is also defined to further clarify the constraints. In addition, the architecture principles which are defined in the preliminary phase will be double checked in accordance with the enterprise principles. As a consequence, an architecture vision document will be created to provide the sponsor with a key tool to sell the benefits of the proposed capability to stakeholders and decision-makers within the enterprise. This architecture vision document describes how the new capability will meet the business goals and strategic objectives and addresses the stakeholder concerns when implemented. Enterprise mission, vision, strategy, and goals will normally be documented as part of some wider enterprise planning activity. Hence architecture vision is concerning with verifying and understanding the documented business strategy and goals, and possibly bridging between the enterprise strategy and goals on one hand, and the strategy and goals implicit within the current architecture reality on the

other hand. It also provides a first-cut, high-level description of the Baseline and Target Architectures for the work in the business, data, application, and technology domains (Open Group, 2009).

The summary of steps within architecture vision phases are listed above (Open Group, 2009):

- Establish the Architecture Project
- Identify Stakeholders, Concerns, and Business Requirements
- Confirm and Elaborate Business Goals, Business Drivers, and Constraints
- Evaluate Business Capabilities
- Assess Readiness for Business Transformation
- Define Scope
- Confirm and Elaborate Architecture Principles, including Business Principles
- Develop Architecture Vision
- Define the Target Architecture Value Propositions and KPIs
- Identify the Business Transformation Risks and Mitigation Activities
- Develop Enterprise Architecture Plans and Statement of Architecture Work; Secure Approval

The key activity in this phase is to create architecture vision document. Therefore this activity will be assessed deliberately. Questions for evaluating migration planning are presented on Table 26.

Table 26. Evaluation questions about architecture vision

Element 14. Architecture vision		
Level	Q27: To what extent do you perform architecture vision activities?	
1	Architecture vision activities are performed in an ad-hoc way on the individual level.	
2	Architecture vision activities are performed on the project level.	
3	Architecture vision activities are performed on the enterprise level and architecture principles are checked in accordance with organizational principles.	
Level	Q28: To what extent do you create the architecture vision?	
1	Not applicable.	
2	It is created on a project level. No agreement is reached on enterprise level on how to conform to each other.	
3	Architecture vision is defined and created on the enterprise level.	

4.3.2.5 Requirements management

Requirements management in the ADM is to define a process whereby requirements for enterprise architecture are identified, stored, and fed into and out of the relevant ADM phases (Open Group, 2009). The center location of requirements management indicates that ADM is continuously driven by

the requirements management process. It is important to mention that requirements management itself is not an independent phase in ADM. It is merely the process for managing requirements throughout the overall ADM. Therefore requirements management is performed in the relevant phase of the ADM, this interactive requirements management activities are described in Table 27.

Table 27. Requirements management steps (Open Group, 2009)

Step	Requirements Management Steps	ADM Phase Steps
1		Identify/document requirements - use business scenarios, or an analogous technique
2	Baseline requirements: <ul style="list-style-type: none"> • Determine priorities arising from current phase of ADM • Confirm stakeholder buy-in to resultant priorities • Record requirements priorities and place in requirements repository 	
3	Monitor baseline requirements	
4		Identify changed requirements: <ul style="list-style-type: none"> • Remove or re-assess priorities • Add requirements and re-assess priorities • Modify existing requirements
5	Identify changed requirements and record priorities: <ul style="list-style-type: none"> • Identify changed requirements and ensure the requirements are prioritized by the architect(s) responsible for the current phase, and by the relevant stakeholders • Record new priorities • Ensure that any conflicts are identified and managed through the phases to a successful conclusion and prioritization • Requirements Impact Assessment for steering the architecture team 	
6		<ul style="list-style-type: none"> • Assess impact of changed requirements on current (active) phase • Assess impact of changed requirements on previous phases • Determine whether to implement change, or defer to later ADM cycle; if decision is to implement, assess timescale for change management implementation • Issue Requirements Impact Statement, Version n+1
7		Implement requirements arising from Phase H
8	Update the requirements repository with information relating to the changes requested, including stakeholder views affected	
9		Implement change in the current phase
10		Assess and revise gap analysis for past phases

Although TOGAF does not mandate or recommend any specific process or tool in requirements management, it presents an effective technique to discover and document business requirements, and to articulate an architecture vision document that responds to those requirements. The technique, business scenarios, is used to help identifying and understanding business needs, and thereby to derive the business requirements that the architecture development has to address. Therefore it is suitable to assess the application of business scenarios when assessing the maturity situation of element requirements management. Questions for evaluating migration planning are presented on Table 28.

Table 28. Evaluation questions about requirements management

Element 15. Requirements management		
Option	Q29: To what extent do you perform requirements management indicated by TOGAF?	
A	Requirements management is performed in an ad-hoc way on the individual level.	
B	Requirements management is performed on the project level.	
C	Performing requirements management is agreed on the enterprise level and is performed in the necessary phases.	
Option	Q30: To what extent do you use business scenarios?	
A	Not used. / It is used in an ad-hoc way on the individual level.	
B	It is used on the project level.	
C	Using of business scenarios is agreed on the enterprise level and defined as a policy.	

5. Instrument development II: the vertical assessment: “documentation”

5.1 Information selection and analysis

5.1.1 Documentation collection

This part intends to provide basic information of TOGAF documentation to make readers being familiar with TOGAF documentation. Table 29 lists the key documentations and their relationship with TOGAF ADM. A similar table is presented by TOGAF⁶. However, the content in that table is not in accordance with the TOGAF ADM information. The reason may be the mistakes made by TOGAF developers when summarizing the documentation information.

Table 29. TOFAD Documentation and relationship with the ADM

No.	Documents	Input to phase	Output from phase
1.	Building Blocks	A, B, C, D, E, F, G, H	F, H
2.	Architecture Contract	G, H	F, G, H
3.	Architecture Definition Document	C, D, E, F, G, H	B, C, D, E, F, G
4.	Architecture Principles	Preliminary, A, B, C, D, E, F, G, H	Preliminary, A, B, C, D H
5.	Architecture Repository	Preliminary, A, B, C, D, E, F, G, H, Requirements Management	Preliminary
6.	Architecture Requirements Specification	C, D, E, F, G, H, Requirements Management	B, C, D, E, F, Requirements Management
7.	Architecture Roadmap	C, D, E, F, G, H	B, C, D, E, F
8.	Architecture Vision	B, C, D, E, F, G, H, Requirements Management	A, B, C, D, E, G
9.	Change Request	A, E, F, H	F, G, H
10.	Compliance Assessment Document	H	G, H
11.	Implementation and Migration Plan	F, G, H	E, F
12.	Implementation Governance Model	G, H	F
13.	Organizational Model for Enterprise Architecture	Preliminary, A, B, C, D, E, F, G, H, Requirements Management	Preliminary
14.	Requirements Impact Assessment	Requirements Management	H, Requirements Management
15.	Statement of Architecture Work	B, C, D, E, F, G, H, Requirements Management	A, B, C, D
16.	Tailored Architecture Framework	Preliminary, A, B, C, D, E, F, G, H, Requirements Management	Preliminary, A
17.	Transition Architecture	F, G, H	E, F, G

⁶ See <http://www.opengroup.org/architecture/togaf9-doc/arch/>

To control the scope of study, only architectural documentation are displayed and discussed in this study. Information related to the non-architectural documentation is not present here. Readers can find information from TOGAF documents if they are interested in.

The following part will briefly elaborate the content of each document.

Building Blocks

A building block is a package of functionality defined to meet the business needs across an organization. Two types of building blocks can be found in TOGAF, architecture building blocks (ABBs) and solution building blocks(SBBs). ABBs relate to the architecture continuum and are defined or selected as a result of the application of the ADM (Open Group, 2009).

Architecture Contract

The traditional architecture contract is an agreement between the sponsor and the architecture function or IS department. However, increasing services are now provided by systems integrators, applications providers, and service providers, co-ordinate through the architecture function or IS department. Therefore the architecture contract is normally established in the joint agreements with all parties involved in the architecture development and delivery (Open Group, 2009).

Architecture Definition Document

The architecture definition document is the deliverable container for the core architectural artifacts created during a project. The architecture definition document examines all relevant states of the architecture, spanning in all architecture domains (Open Group, 2009).

Architecture Principles

Architecture principles are a subset of IT principles that relate to architecture work. They reflect a level of consensus across the enterprise and embody the spirit and thinking of the enterprise architecture. Architecture principles can be further divided into two types of principles. The principles group that governs the architecture process will affect the development, maintenance, and use of the enterprise architecture. Another principles group that governs the implementation of the architecture is guiding the establishment of the first tenets and related guidance for designing and developing information systems (Open Group, 2009).

Architecture Repository

The architecture repository acts as a holding place for all architecture-related projects within the enterprise. The repository facilitates projects to manage all deliverables, locate re-usable assets, and to publish outputs to stakeholders and other interested parties (Open Group, 2009).

Architecture Requirements Specification

The architecture requirements specification provides a set of quantitative statements that outline what an implementation project must do to comply with the architecture (Open Group, 2009).

Architecture Roadmap

The architecture roadmap lists individual increments of change and lays them out on a timeline to show the progression from the baseline architecture to the target architecture (Open Group, 2009).

Architecture Vision

The architecture vision provides a high-level view of the end architecture product. It is normally created early in the project lifecycle. The purpose of the architecture vision is to agree at the outset what the desired outcome should be for the architecture, so that architects can then focus on the critical areas to validate feasibility (Open Group, 2009).

Change Request

Change request is a document developed when the original architecture definition and requirements are not suitable or not sufficient to complete in the implementation of a solution. Deviation from the suggested architectural approach or request scope extensions is recorded in the change request document (Open Group, 2009).

Compliance Assessment Document

Compliance review of implementation projects provides a mechanism to evaluate project progress and ensure that the design and implementation is preceding in-line with the strategic and architectural objectives. The process and result will be documented in the compliance assessment document (Open Group, 2009).

Implementation and Migration Plan

The implementation and migration plan provides a schedule for implementing the solution described by the transition architecture (Open Group, 2009).

Implementation Governance Model

Implementation governance model is a plan for the transition architecture being governed through the implementation. Normally if organizations have established architecture functions, a governance framework is likely to be in place. But specific processes, organizations, roles, responsibilities, and measures are needed sometimes to be defined on a project-by-project basis in the implementation governance model (Open Group, 2009).

Organizational Model for Enterprise Architecture

Organizational model for enterprise architecture is a document which defines of boundaries between different enterprise architecture practitioners and the governance relationships on the roles and responsibilities within the enterprise.

Requirements Impact Assessment

Throughout the ADM, new information is collected relating to architecture. As this information is gathered, new facts may come to light that invalidate existing aspects of the architecture. A requirements impact assessment evaluates the current architecture requirements and specification to identify changes that should be made and the implications of those changes (Open Group, 2009).

Statement of Architecture Work

The Statement of Architecture Work defines the scope and approach that will be used to complete an architecture project. The statement of architecture work is typically the document against which successful execution of the architecture project will be measured and form the basis for a contractual agreement between the supplier and consumer of architecture services (Open Group, 2009).

Tailored Architecture Framework

Although TOGAF provides a standard framework for architecture to be used in a wide variety of organizations, it is necessary to tailor TOGAF into an architecture framework which fits the requirements of organization. The tailored architecture framework will be recorded in tailored architecture framework document (Open Group, 2009).

Transition Architecture

Transition architecture shows the enterprise at incremental states reflecting periods of transition between the baseline and target architectures. Transition architectures are used to allow for individual work packages and projects to be grouped into managed portfolios and programs, illustrating the business value at each stage (Open Group, 2009).

5.1.2 Documentation analysis

Documentation serves as interfaces between different TOGAF ADM phases and combines them as a cycle. Exploration of the changes of documentations in the execution of ADM will assist the understanding the functions of documentation in TOGAF. A thorough examination is conducted for all the key TOGAF documentation. The summary for each document analysis is attached in the Appendix D: TOGAF documentation analysis. On one hand, this appendix reveals the incremental changes and development of documents in different phases. This information will be used in the documentation maturity assessment instrument development as an important input. On the other hand, this appendix can be used independently to serve as a list of document information items for organizations to check the compliance of their TOGAF documents in the details.

It is clear to see from the appendix: TOGAF documentation analysis that the contents of each documents is developed with the more phase performed in TOGAF ADM. Every document is analyzed independently. The corresponding phase to each document is present as well with the input & output marks and information of content changes. If the document is the input of that phase, it will be marked with the green cell. Output is marked as the red cell. Content of the documents in each phase is revealed as well. Changes or new information of the content is marked as orange. The ADM step which initiates the changes is present afterwards. Most of the time, the document will be generated as an output by executing of ADM. Regularly the content of each document is changing due to the action steps in ADM. Sometimes the document is only marked as input or output in some phases. This is due to the reason that TOGAF is still under development and there is some incomplete or inconstant information in the current version.

5.2 Model development

The documentation maturity model aims at assessing the maturity level of documentation in TOGAF based EA work. The documentation maturity model is developed based on the principles of TU/e ICTA EA maturity model. Therefore three levels of maturity are presented in this model to connect this detailed documentation assessment with general maturity assessment on the abstract level. The maturity levels of documentation are classified in Table 30.

The assessment standards of documentation maturity are introduced here. As a sub maturity assessment of general maturity assessment on TOGAF based EA work, three levels are defined in the documentation maturity model to be consistent with the general maturity model.

Level 1 – Ad-hoc: It is the lowest level for all the documentation maturity. The document in this level is either incomplete or has been written and recorded in an arbitrary way with the decision of individual architects. No standardized format or style exists for architects to follow. The quality of the document is highly dependent on the experience and efforts of the architects.

Level 2 – Inconsistent: In this level the documentations are recognized as important and have been complete. However, inconsistent procedures in creating and applying still exist among different project groups. The project team may use an agreed-upon template and standards for documentation application.

Level 3 – Defined: In this level the procedures of documentation creation and application are defined and used in the organizational level. Standardized consistent application is in place. Processes of documentation usage are tailored to the project if needed based on the predefined documentation processes.

Table 30. Documentation maturity model

Documentation	Level 1	Level 2	Level 3
Architecture Contract	Ad-hoc	Inconsistent	Defined
Architecture Definition Document	Ad-hoc	Inconsistent	Defined
Architecture Principles	Ad-hoc	Inconsistent	Defined
Architecture Repository	Ad-hoc	Inconsistent	Defined
Architecture Requirements Specification	Ad-hoc	Inconsistent	Defined
Architecture Roadmap	Ad-hoc	Inconsistent	Defined
Architecture Vision	Ad-hoc	Inconsistent	Defined
Building Blocks	Ad-hoc	Inconsistent	Defined
Change Request	Ad-hoc	Inconsistent	Defined
Compliance Assessment	Ad-hoc	Inconsistent	Defined
Implementation and Migration Plan	Ad-hoc	Inconsistent	Defined
Implementation Governance Model	Ad-hoc	Inconsistent	Defined
Organizational Model for Enterprise Architecture	Ad-hoc	Inconsistent	Defined
Requirements Impact Assessment	Ad-hoc	Inconsistent	Defined
Statement of Architecture Work	Ad-hoc	Inconsistent	Defined
Tailored Architecture Framework	Ad-hoc	Inconsistent	Defined
Transition Architecture	Ad-hoc	Inconsistent	Defined

An illustration for documentation maturity model is present to clarify the indications of different levels. For example, level 1 for Architecture Principles document indicates the following situation happens to the Architecture Principles document. It is not complete or is written and recorded informally or does not exist. Level 2 for Architecture Roadmap shows situation that this document is complete in some projects but applied inconsistently in the whole organization. Level 3 for Transition Architecture document represents the situation that this document is complete in all EA projects in the organization and a consistent and standardized procedure is available on how to create and apply the Transition Architecture document.

5.3 Questionnaire design

The documentation maturity assessment will be performed in two parts, the completeness assessment and the content. Consequently, documentation maturity assessment instrument contains two parts. The first part is a preliminary checklist which is aiming at checking the completeness of EA documentation to investigate the width of the documentation maturity assessment. The second part of the documentation maturity assessment instrument is a questionnaire, aiming at assessing the depth of documentation maturity with concrete questions for the documentation content.

5.3.1 Completeness assessment

The initial step in assessing the documentation maturity level is to identify to what extent the organization complete all the key documentation of TOGAF. Therefore a check-off list is created based on Table 28 to review the completeness of documentation. This check-off list contains 17 documentations which are identified by TOGAF as key documentations in ADM. The questionnaire is answered by *yes/no* questions to determine whether certain documentation is performed. The result of

this completeness assessment will be able to present a brief overview of the documents in TOGAF based EA work. The result is also served as an input for the content assessment. The documentation maturity assessment instrument part one, the completeness assessment checklist, is attached in the Appendix A: Preliminary questionnaire for TOGAF documentation.

5.3.2 Content assessment

The content assessment is a consequent assessment of completeness assessment. This assessment approach is similar to the one of general maturity assessment approach for TOGAF based EA work. The purpose of the assessment questionnaire is to determine that to what extent an organization's enterprise architecture documentations stands relative to TOGAF framework. The assessment instrument questions are derived from the documentation analysis and documentation maturity model. This questionnaire examines the content and processes of each key document in TOGAF based EA projects. Two questions are designed for each document. The maturity level is determined from the questionnaire responses. Due to the page limitation, the assessment questionnaire for TOGAF documentation maturity is attached in the Appendix A: Documentation maturity questions.

6. Validation and refinement

6.1 Validation

This section describes the validation procedure for TOGAF based EA maturity assessment instrument. To further improve the model and questionnaire, interviews are conducted with the draft version of assessment questionnaire. The interviewees are given the questionnaire in the interviews as the guideline of the interviews. Each situation is discussed and additional questions are asked after each pre-defined questions to clarify and confirm the real situation. The interviewer fills in the result in the questionnaire during the interview and sends the result copy back to the interviewers and confirmation and reference.

6.1.1 Interview procedure

In the validation period of this study, an interview invitation was sent to potential organizations to kindly request for interviews. Three organizations showed interests in the cooperation. Interviews and were conducted with three representatives from those organizations involving 6 projects from different industries.

The first interview was conducted with a consulting firm who is specialized in process-driven architecture. The interview lasted 70 minutes. The second interview was conducted with the IT systems and development department in wholesale banking organization. They cooperated with their vendors to develop their IT system. The interview lasted 40 minutes. The third interview was conducted with a consulting and systems integration company. The interview lasted 60 minutes.

6.1.2 Discussion and feedback

In general the interviewees were very positive about the maturity assessment instrument. They consider the instrument is sound and valid in assessing the maturity situation of TOGAF based EA work. The elements are well categorized to cover different aspects of EA work. The questions reflect the critical issues of particular elements. Furthermore, the necessity of documentation maturity assessment was confirmed in the interviews as well. Interviewees regard TOGAF as a documentation driven framework so they agree that it is needed to have in-depth measurement on this particular element to further strengthen the evaluation of TOGAF based EA maturity situation. A motivating message is revealed through the interviews. Interviewees reflected the same situation discussed in the problem statement that although a strong need grows in the industry for a pragmatic enterprise architecture maturity assessment instrument, no sufficient study has been done from academic side to meet the demand. This promising message substantiates the significance of this study and value of the assessment instrument.

Another circumstance emerged in the interviews. Not all the interviewed organizations adopt TOGAF completely. Industrial difference largely contributes to this condition. Consulting companies claim

that they need to act according to the requirements of their clients. In some cases it is not required by the clients to adopt TOGAF completely. The explanation from the industrial side is that the result is more important than the manner. Therefore taking advantages of several frameworks is more important for them than following certain Enterprise Architecture frameworks completely. As a consequence, a doubt rises in the study that to what extent it is necessary to have a TOGAF specific maturity assessment instrument. Nevertheless, this TOGAF based EA maturity assessment instrument can still help organizations to identify their weaknesses in the application of TOGAF and leave the options for organizations to decide if they want to improve the situation or not.

Feedbacks on improving the instrument have also been collected and divided into two groups, feedback on the content and other feedback. The following section will discuss those issues.

6.1.2.1 Feedback on the content

The complete result and interpretation of the interviews is present in the Appendix E: Result and interpretation of the interviews. Several comments will be highlighted here.

Some interviewees responds that they have difficulties to understand some terms in the assessment because they are too “TOGAF specific”. Two terms regarding to this concerns are element 8 in the abstract maturity assessment: *Architecture repository* and artifact in question 24: *TOGAF processing diagram*. This circumstance reflects the situation that not all the interviewees understand and use TOGAF perfectly. A possible solution for it can be the interactive explanation by the interviewer when conducting the interview. The interviewer can also present the glossary for interviewees to be familiar with TOGAF in a short period.

It is also interesting to notice in the documentation maturity assessment that one document has not been performed by any organizations at all while some documents have been fully completed. The compliance assessment document is the one who did not get any affirmative answer. This position discloses that many organizations are very weak in compliance assessment work. Some organizations are even not aware of TOGAF compliance assessment content at all. Once the spot has been recognized, it is up to the organization to make further effort to improve it. Compared with obvious weak spot, some completed documents are also identified in the interviews. Building blocks and implementation and migration plan are both marked as the existing documents in all the interviewed organizations. It can be interpreted that most of the organizations treated those works with a higher priority.

6.1.2.2 Miscellaneous feedback

One potential threat emerged during the interviews is the interpretation of terminology of “maturity assessment”. Some interviewees may score a highly level unconsciously due to the psychological hint of the word “maturity assessment”. Therefore we think to replace “maturity assessment” with term

“benchmarking”. Although currently there is no sufficient data to establish the benchmarking, it is suggested that in the future work the questionnaires can be used as an instrument in the TOGAF based EA benchmarking projects with a larger database.

Another possible threat can be the indication of levels. It is possible that answers from the interviewees are affected subconsciously by the denotation of levels. Therefore it is suggested in the next part to replace notation *level* with notation *option*.

In the earlier interview, one interviewee suggests adding a small introduction to state the content of the questionnaires. This proposal has been adopted and used in the latter interviews.

6.2 Refinement

After the discussion and feedback analysis, several refinements to the original instrument will be presented here.

As discussed above, it is necessary to have a brief questionnaire introduction to let interviewee be familiar with the structure of the instrument. Therefore the overview of questionnaire is added at the beginning of the questionnaires and present in Figure 10.

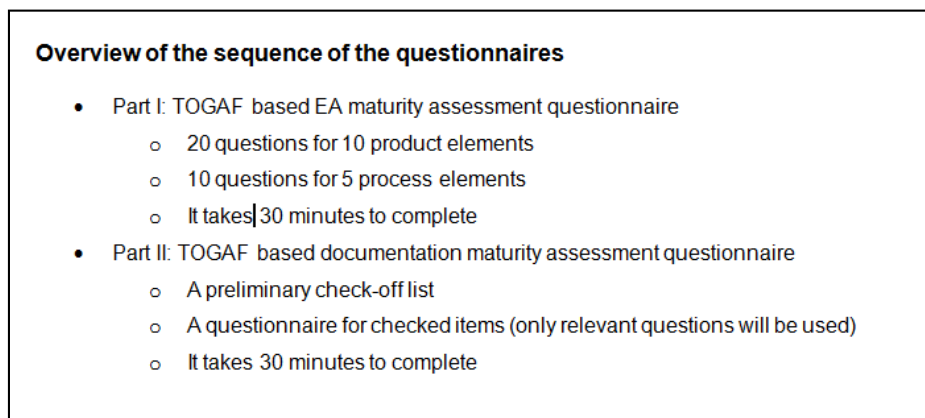


Figure 10. Overview of the questionnaires

Another refinement is the level notation. As discussed above, it is suggested that this particular notation should be removed and replaced with *option* term to indicate the equal positions of the options. Furthermore, replacing number with letters has less indication to the advancement as well. As a consequent, the new layout of the questionnaire is showed in Figure 9.

All the refinement discussed here is integrated in the final version of the instrument and present in the Appendix A: TOGAF based EA maturity assessment instrument.

Element 1. Product-related tools		
Option	Q1: Do you take TOGAF supporting function into account when selecting the EA tools?	
A	Some individual architects may use tool that supports TOGAF.	
B	Tool selection is agreed on the project basis. Some projects take TOGAF supporting function into account when selecting the tools.	
C	TOGAF supporting function is taken into account when selecting the EA tools and all the tools which are in EA projects support TOGAF.	
Option	Q2: To what extent do you use TOGAF Tool Criteria to select tool?	
A	There is no standard on which tool should be selected. Tools are selected on personal basis. Some architects use TOGAF Tool Criteria to select tools.	
B	Tools are selected on project basis. Some projects use TOGAF Tool Criteria to select tools.	
C	Selection of tools is agreed on enterprise level and every project use TOGAF Tool Criteria when selecting tools. Even when multi-tools suites are selected, they are synchronized to achieve objectives in different architecture domains.	

Figure 11. Sample question of changed layout

7. Conclusion, reflection, impact of study and future work

In this chapter the conclusion is drawn, the impact of research to the general academic knowledge is analyzed and the future work is indicated.

7.1 Conclusion

The main goal of this study is to develop an instrument to assess the maturity assessment of TOGAF based Enterprise Architecture work. A set of questionnaires are designed by using the knowledge of TU/e ICTA EA maturity model combined with the information extracted from TOGAF. The questionnaires are further refined and validated through interviews.

TOGAF based EA maturity assessment instrument development

The TOGAF based EA maturity assessment instrument is developed in several steps. In the first step, 15 key elements in from TOGAF and TU/e ICTA EA maturity model are identified. Information related to those 15 elements is examined carefully to be used in the questionnaire development step. Consequently, the TOGAF based EA maturity assessment questionnaire is developed. Every element is assessed with two questions in the questionnaire. One question reviews the general situation of the element and another focuses on a specific case in the element. Three answer options are designed to classify the situation for further discussion and improvement.

TOGAF based documentation maturity assessment instrument development

The development of TOGAF based documentation maturity assessment instrument also follows the similar study pattern to the TOGAF based EA maturity assessment. The first step is to determine the key documents in TOGAF. 17 important TOGAF documents are selected and summarized in the study. The second step is to develop the documentation maturity assessment instrument. A documentation maturity model is developed referring to the TU/e ICTA maturity model. The documentation maturity assessment questionnaires are then designed with a preliminary checklist and consequent questionnaire. To keep the consistency of the questionnaires, a two level questions layout is used in the documentation maturity assessment instrument with three answer options for all identified documents.

Instrument validation

Results from interviews indicate that the instrument is sound and valid in assessing the real situation of TOGAF based Enterprise Architecture work. The questionnaires can help organizations to measure their EA project situation in different elements and further make decision on improvement. Feedback on improving the TOGAF based EA maturity assessment instrument is collected and integrated in the refined version of instrument.

7.2 Reflection

Reflection on the research methodology

This approach has several advantages compared with a complete comprehensive assessment approach. First, the current assessment is less time consuming. It takes less time to complete the assessment questionnaire and easy to classify the result into three options for further decisions. Second, the fine distinction of the elements makes it efficient to spot the weak points of EA work. Similar to this sort of approach (Visconti & Cook, 1998), trade-offs between this approach and a more comprehensive approach always at present. The comprehensive approach would delve more deeply into EA practices. A complete product and process audit will be conducted by trained professionals involving many interviews with project personnel, an extensive self-study report prepared by the organization, and more extensive questionnaires for the interviews. The comprehensive approach would yield a rich report of findings and recommendations. However, the current approach takes the advantage of convenience to obtain information of problem areas for an expensive and exhaustive process that obtains more detailed information, which will be more affordable and convenient for organizations to assess their TOGAF based EA work regularly.

Reflection on the TU/e ICTA maturity model

The TOGAF based EA maturity assessment instrument is developed based on the TU/e ICTA maturity model and TOGAF framework. TU/e ICTA maturity model is a comprehensive maturity model covering three categories of assessment units, the product elements, the process elements and the resource(human) elements. This model has significant influence on the development of TOGAF based EA maturity assessment instrument. It provides the basic structure for the assessment categories and maturity levels. It is clear from the results of interviews that this 3-level maturity model is easier applicable than 5-level maturity model. The categories cover most of the aspects in EA work. However, the standardization issues which is highly ranked in the TU/e ICTA maturity model is not always supported by TOGAF framework and the interviewees. This is due to the reason that the TU/e ICTA EA maturity model is a theoretical model which has to be consistent and precise in the measurement criteria. However, in the real EA work, many non-EA influential factors, such as budget and capability, hinder the final result of EA work.

7.3 Impact of study on the EA body of knowledge

Table 31 compared the difference of the maturity models discussed in this study. The features of maturity models are categorized into several groups to clarify the difference of those models. The contribution of this study to the EA body of knowledge is presented in the table as well.

The model in this study shares the same origin, SEI's CMM, with other maturity models discussed in the literature. Lacking of practical EA maturity assessment tool has been recognized in the beginning of this study. Most of the models are theoretically complete but not reproducible due to lacking of the

publically assessable questionnaires. This study addresses the problem by developing a practical questionnaire to be employed in the maturity assessment. In addition, TOGAF as a wide applicable EA framework has not been well measured in the EA maturity study. We tailor the general EA maturity model into this TOGAF based EA maturity assessment model and develop the corresponding instrument as a vehicle to address such a problem. The “elements-dimension” analysis of TOGAF information contributes to the EA body of knowledge in understanding and researching TOGAF framework from a component structure viewpoint. Furthermore, no EA maturity models address the documentation maturity specially. The detailed focus of TOGAF based EA documentation maturity assessment will be a pioneer study in EA documentation maturity study.

Table 31. Comparison of different maturity models

Model categorization		Name of the maturity models					
		GAO model	NASCIO model	TU/e ICTA model	Huang&Tilley's model	Visconti&Cook's model	Current study
Form	Staged model	x		x	x	x	x
	Continuous model		x				
Specialization	EA specific model	x	x	x			x
	TOGAF specific model						x
	Documentation specific model				x	x	x
Dimension	Product			x	x		x
	Process	x	x	x	x	x	x
	Resource			x			
Characteristics	Reproducible			x			x

7.4 Future work recommendation

Many future works can be developed based on current study. And those future works can further be classified into the content work and the model work. For the content work, Continuing developing the vertical maturity assessment instrument on the other 14 key elements in the maturity assessment model. A comprehensive TOGAF based EA maturity assessment instrument can help the organizations to not only evaluate the overview of EA work but also assess the concrete details for each elements for more precise decision-making and improvement. Another option in the content work is to elaborate the current instrument with more data. Generally an assessment instrument is evolved over many visions with the feedbacks and inputs incorporated in. With massive data available,

the instrument can be adjusted to a benchmarking instrument to better serve the EA industry with a wider application.

Several future work options exist in the model work group as well. As the current model is a staged model, one possibility is to develop this model into a continuous model with more guidelines and instructions of EA development. Another option is to extract and modify the key information of the resource elements and further integrate in the maturity model. The model extension work requires additional cooperation with the organizations who apply TOGAF completely to combine the pragmatic execution information with theoretical examination.

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Appendix A: TOGAF based EA maturity assessment instrument

Overview of the sequence of the questionnaires

- Part I: TOGAF based EA maturity assessment questionnaire
 - 20 questions for 10 product elements
 - 10 questions for 5 process elements
 - It takes 30 minutes to complete
- Part II: TOGAF based documentation maturity assessment questionnaire
 - A preliminary check-off list
 - A questionnaire for checked items (only relevant questions will be used)
 - It takes 30 minutes to complete

Basic Information	
Company name	
Location	
Industry	

Interview Information	Name	Date
Interviewee 1		
Interviewee 2		
Interviewer		

Additional Information

Product questions

Element 1. Product-related tools		
Option	Q1: Do you take TOGAF supporting function into account when selecting the EA tools?	
A	Some individual architects may use tool that supports TOGAF.	
B	Tool selection is agreed on the project basis. Some projects take TOGAF supporting function into account when selecting the tools.	
C	TOGAF supporting function is taken into account when selecting the EA tools and all the tools which are in EA projects support TOGAF.	
Option	Q2: To what extent do you use TOGAF Tool Criteria to select tool?	
A	There is no standard on which tool should be selected. Tools are selected on personal basis. Some architects use TOGAF Tool Criteria to select tools.	
B	Tools are selected on project basis. Some projects use TOGAF Tool Criteria to select tools.	
C	Selection of tools is agreed on enterprise level and every project use TOGAF Tool Criteria when selecting tools. Even when multi-tools suites are selected, they are synchronized to achieve objectives in different architecture domains.	

Element 2. Modeling Language		
Option	Q3: To what extent do you agree to use certain modeling language?	
A	No common modeling language exists in the enterprise. Use of a language is based on the choice of individual architect.	
B	An agreement is reached within a project on a set of modeling languages.	
C	A set of enterprise-wide modeling languages are agreed upon and used in all enterprise projects.	
Option	Q4: To what extent do you use recommended modeling languages in TOGAF Process Modeling Extensions, Infrastructure Consolidation Extensions, and Motivation Extensions if applicable?	
A	We don't know/use the recommended modeling languages in those areas.	
B	Some extension areas use recommended modeling languages.	
C	All the extension areas use recommended modeling languages.	

Element 3. Patterns		
Option	Q5: To what extent do you agree to use patterns?	
A	Usage of patterns is based on the architect's experience and a small scale patterns are used.	
B	Usage of patterns is based on the architects' experience. Larger scale patterns that may affect the whole project are used. Any storage of patterns is done in an unstructured manner.	
C	Patterns are used consistently across projects in the enterprise. They are stored in a repository with clear guidelines followed in the enterprise.	
Option	Q6: To what extent do you use TOGAF proposed content of pattern?	
A	Some individual architects may know and use TOGAF proposed content of pattern.	
B	Some projects use TOGAF proposed content of pattern.	
C	Whole enterprise use TOGAF proposed content of pattern and take it as a standard.	

Element 4. Reference models		
Option	Q7: To what extent do you use TRM and III-RM?	
A	Not used./Architects use TRM or III-RM individually.	
B	Some projects use TRM and III-RM based on their experience and agreement	
C	Usage of TRM and III-RM is an enterprise policy. All EA projects use them.	
Option	Q8: In which of the following entities do you use TRM (Application Software, Application Platform, and Communications Infrastructure)?	
A	Some architects use TRM in the areas which they need.	
B	Some projects use TRM in some of the entities.	
C	TRM is used in all three entities.	

Element 5. ADM		
Option	Q9: To what extent do you follow the structure (objectives, approach, inputs, steps and outputs) in each of your ADM phases?	
A	There is no strict structure for architect for refer to in ADM phases. Architects can follow TOGAF ADM structure if they want.	
B	Agreement of following ADM structure is agreed on a project basis.	
C	Use of ADM structure is agreed on enterprise level. All EA projects have to follow ADM structures in all phases.	
Option	Q10: Do you perform gap analysis?	
A	Typically it is not performed. Some architects may do it according to their need.	
B	Some projects perform gap analysis if they need.	
C	Performing gap analysis is agreed on enterprise level. All the projects need to do it.	

Element 6. Standards		
Option	Q11: To what extent do you use standards?	
A	No standards are used. / Only legal and regulatory obligations are complied.	
B	Projects can decide themselves if they want to use standards. The standards in use are industry standards.	
C	Organizational standards are set within the organization and are based on business requirement.	
Option	Q12: To what extent do you use TOGAF standards information base?	
A	Not used. / Some architects use standards information base individually.	
B	Some projects have and use standards information base.	
C	Standards information base is established in the enterprise wide. All EA projects use it.	

Element 7. Templates		
Option	Q13: To what extent do you create and use template?	
A	Not templates are in use. / Templates are used in an informal way.	
B	Some projects will consider using templates. And when templates are not available, they will consider spending time designing templates.	
C	Templates are created, defined and used on an enterprise level.	
Option	Q14: To what extent do you store your templates in the reference library?	
A	No rules existed on how to store the templates. Some architects save them individually.	
B	Some projects save their templates and best practice in reference library if they want.	
C	It is agreed on the enterprise level that all the templates are stored in the reference library.	

Element 8. Architecture repository		
Option	Q15: To what extent do you use architecture repository?	
A	It is not used.	
B	Repository is used per project and information is not shared.	
C	Repository is used in the enterprise wide. Information is shared and reused.	
Option	Q16: To what extent do you establish your repository in the six areas (architecture metamodel, architecture capability, architecture landscape, standards information base, reference library and governance log)?	
A	No area is established.	
B	Some areas are established in some projects.	
C	Complete six areas are established in repository.	

Element 9. Policies		
Option	Q17: To what extent do you tailor TOGAF ADM into your own architecture framework (terminology, process and content)?	
A	There is no agreement on how to tailor ADM. Some architects may tailor ADM partly according to their needs.	
B	Agreement on how to tailor ADM is reached on a project basis.	
C	Tailoring ADM is performed at the preliminary phase on the enterprise level.	
Option	Q18: To what extent do you utilize iterative approach when applying ADM?	
A	There is no agreement on which approach to take.	
B	Agreement on how to utilize iterative approach is agreed on a project basis.	
C	Using iterative approach is agreed on enterprise level.	

Element 10. Architecture documentation		
Option	Q19: To what extent do you define the procedures of creating the documentation?	
A	There is no agreement on how to create documentation.	
B	The creation of documentation is discussed and agreed on a project basis.	
C	An enterprise rule is established on how to create and manage the architectural documentation.	
Option	Q20: To what extent do you follow TOGAF's documentation baseline?	
A	They are normally omitted.	
B	Some projects follow TOGAF documentation baseline and roadmap.	
C	The documentation baseline and roadmap are defined in the enterprise wide and comply with the TOGAF requirement.	

Process questions

Element 11. Project management / Risk management		
Option	Q21: To what extent do you practice TOGAF architecture governance?	
A	TOGAF architecture governance is performed in an individual way of a responsible specialist.	
B	TOGAF architecture governance is performed on a project level.	
C	TOGAF architecture governance is performed on an enterprise level and it is defined and tailored from the organization's standard processes.	
Option	Q22: To what extent do you follow TOGAF risk management activities?	
A	TOGAF risk management is performed in an individual way.	
B	TOGAF risk management is performed on a project level.	
C	TOGAF risk management is performed on an enterprise level and it is defined and tailored from the organization's standard processes.	

Element 12. Configuration management		
Option	Q23: To what extent do you perform TOGAF ADM migration planning phase?	
A	Migration planning is done on an individual level. There is no interaction with other architects.	
B	Migration planning is done on a project level.	
C	Migration planning is done on an enterprise level. It is planned and coordinated with the whole enterprise architecture.	
Option	Q24: To what extent do you use TOGAF processing diagram?	
A	Not used. / Individual architect may use them separately.	
B	It is used on a project level. Some projects use them if necessary.	
C	Using processing diagram is defined and agreed on the enterprise level in accordance with an organization's set of standards.	

Element 13. Compliance assessment		
Option	Q25: To what extent do you perform compliance assessment?	
A	Compliance assessment is done in an ad-hoc way on the individual level.	
B	Compliance assessment is planned and executed on the project level.	
C	Compliance assessment is defined and performed on the organizational level in accordance with enterprise architecture requirements.	
Option	Q26: To what extent do you follow compliance assessment checklist recommended by TOGAF?	
A	Not used. / Individual architect may use them separately.	
B	It is used on a project level. Some projects use them if necessary.	
C	Using compliance assessment checklist is defined and agreed on the enterprise level in accordance with enterprise architecture requirements.	

Element 14. Architecture vision		
Option	Q27: To what extent do you perform architecture vision activities?	
A	Architecture vision activities are performed in an ad-hoc way on the individual level.	
B	Architecture vision activities are performed on the project level.	
C	Architecture vision activities are performed on the enterprise level and architecture principles are checked in accordance with organizational principles.	
Option	Q28: To what extent do you create the architecture vision?	
A	Not applicable.	
B	It is created on a project level. No agreement is reached on enterprise level on how to conform to each other.	
C	Architecture vision is defined and created on the enterprise level.	

Element 15. Requirements management		
Option	Q29: To what extent do you perform requirements management indicated by TOGAF?	
A	Requirements management is performed in an ad-hoc way on the individual level.	
B	Requirements management is performed on the project level.	
C	Performing requirements management is agreed on the enterprise level and is performed in the necessary phases.	
Option	Q30: To what extent do you use business scenarios?	
A	Not used. / It is used in an ad-hoc way on the individual level.	
B	It is used on the project level.	
C	Using of business scenarios is agreed on the enterprise level and defined as a policy.	

Preliminary questionnaire for TOGAF documentation

Instruction: This check-off list is served the initial setup for the consequent questionnaire. Please mark *yes/no* according to the real situation of your organization.

Please also note that the *yes* option is also applicable when your organization has similar documents to the referred documents or overlapping content with the referred documents.

Do you have the following documentation in your enterprise architecture projects?		Yes	No
1	Building Blocks	<input type="checkbox"/>	<input type="checkbox"/>
2	Architecture Contract	<input type="checkbox"/>	<input type="checkbox"/>
3	Architecture Definition Document	<input type="checkbox"/>	<input type="checkbox"/>
4	Architecture Principles	<input type="checkbox"/>	<input type="checkbox"/>
5	Architecture Repository	<input type="checkbox"/>	<input type="checkbox"/>
6	Architecture Requirements Specification	<input type="checkbox"/>	<input type="checkbox"/>
7	Architecture Roadmap	<input type="checkbox"/>	<input type="checkbox"/>
8	Architecture Vision	<input type="checkbox"/>	<input type="checkbox"/>
9	Change Request	<input type="checkbox"/>	<input type="checkbox"/>
10	Compliance Assessment Document	<input type="checkbox"/>	<input type="checkbox"/>
11	Implementation and Migration Plan	<input type="checkbox"/>	<input type="checkbox"/>
12	Implementation Governance Model	<input type="checkbox"/>	<input type="checkbox"/>
13	Organizational Model for Enterprise Architecture	<input type="checkbox"/>	<input type="checkbox"/>
14	Requirements Impact Assessment	<input type="checkbox"/>	<input type="checkbox"/>
15	Statement of Architecture Work	<input type="checkbox"/>	<input type="checkbox"/>
16	Tailored Architecture Framework	<input type="checkbox"/>	<input type="checkbox"/>
17	Transition Architecture	<input type="checkbox"/>	<input type="checkbox"/>

Documentation maturity questions

Documentation 1. Building Blocks		
Option	Q1: To what extent do you develop view of required building blocks in Business Architecture through the creation of catalogs, matrices, and diagrams of the architecture?	
A	It is not applicable.	
B	It is developed in some projects.	
C	It is developed and complete in all the projects.	
Option	Q2: To what extent do you have and use existing re-usable building blocks?	
A	It is not applicable.	
B	Some building blocks are available and can be re used.	
C	All the building blocks are fully documented and re-used as much as possible.	

Documentation 2. Architecture Contract		
Option	Q3: To what extent do you use the standardized conformance requirements in different architecture contracts?	
A	No standardized conformance requirements exist in architecture contract.	
B	Some architecture projects will use standardized conformance requirements but they are not compulsory.	
C	Standardized conformance requirements existed in all architecture contracts.	
Option	Q4: To what extent do you have same format of content for architecture contract in different projects?	
A	There is no standard format and style that architects must follow.	
B	There is a template of architecture contract and some projects use the template.	
C	Consistent architecture contracts documents are created in the defined procedures.	

Documentation 3. Architecture Definition Document		
Option	Q5: To what extent do you have business, data, application and technology target architecture documented in the architecture definition document?	
A	They are not complete in the architecture definition document.	
B	They are complete with the agreement inside the project.	
C	Standardized procedures to create target architecture are agreed upon in the organizational level.	
Option	Q6: To what extent do you have the standardized architecture definition document?	
A	It exists in the ad-hoc or informal format. There is no standard format and style that architects must follow.	
B	The standard followed may be the developer's own convention. The project team may use an agreed-upon template and standard.	
C	Architecture definition document creation procedures are defined and used. Organizational wide standardized consistent processes are in place.	

Documentation 4. Architecture Principles		
Option	Q7: To what extent do you have same format of content for architecture principles in different projects?	
A	There is no standard format and style that architects must follow.	
B	There is a template of architecture principles and some projects use the template based on the agreement inside the project team.	
C	Consistent architecture principles documentation is created in the defined procedures.	
Option	Q8: To what extent do you re-use the architecture principles?	
A	It is not applicable.	
B	Some architecture principles exist and can be re-used.	
C	All architecture principles are fully documented and re-used as much as possible.	

Documentation 5. Architecture Repository		
Option	Q9: To what extent do you store the standard in the standards information base?	
A	The standards are stored in an ad-hoc and ambiguous manner.	
B	The standards are stored in the inconsistent way within different projects.	
C	Consistent and defined procedures of documenting standards in the standards information base and performed in the organizational level.	
Option	Q10: To what extent do you re-use the architecture repository?	
A	It is not applicable.	
B	Some architecture repository exists and can be re-used.	
C	The architecture repository is fully documented and re-used as much as possible.	

Documentation 6. Architecture Requirements Specification		
Option	Q11: To what extent do you standardize the gap analysis performance?	
A	The standard for gap analysis exists in an ad-hoc manner.	
B	Some projects will perform gap analysis in an agreed-upon manner.	
C	Standardized procedures to perform gap analysis are defined and used in the organizational level.	
Option	Q12: To what extent do you have same format of content for architecture requirements specification in different projects?	
A	There is no standard format and style that architects must follow.	
B	There is a template of architecture requirements specification and some projects use the template.	
C	Consistent architecture requirements specification document is created in the defined procedures.	

Documentation 7. Architecture Roadmap		
Option	Q13: To what extent do you have a time-oriented migration plan in your architecture roadmap?	
A	It is not applicable.	
B	It is developed in some projects.	
C	It is developed and complete in all the projects.	
Option	Q14: To what extent do you follow the same format of content for architecture roadmap in different projects?	
A	There is no standard format and style that architects must follow.	
B	There is a template of architecture requirements specification and some projects use the template.	
C	Consistent architecture requirements specification documentation is created in the defined procedures.	

Documentation 8. Architecture Vision		
Option	Q15: To what extent do you describe the process models in the architecture vision?	
A	It is not applicable.	
B	It is performed in some projects based on their own internal agreement.	
C	Standardized procedures to describe the process models are agreed upon in the organizational level.	
Option	Q16: To what extent do you have the same format of architecture vision in different projects?	
A	There is no standard format and style that architects must follow.	
B	There is a template of architecture vision and some projects use the template.	
C	Consistent architecture vision documentation is created in the defined procedures.	

Documentation 9. Change Request		
Option	Q17: To what extent do you perform impact assessment of the proposed change in your change request?	
A	It is not applicable.	
B	It is performed in some projects based on their own internal agreements.	
C	Standardized procedures to perform impact assessment of the proposed change are defined in the organizational level.	
Option	Q18: To what extent do you document the change request?	
A	The change request is documented in an ad-hoc and ambiguous manner.	
B	The change request is documented in the inconsistent way within different projects.	
C	Consistent and defined procedures of documenting change request are performed in the organizational level.	

Documentation 10. Compliance Assessment Document		
Option	Q19: To what extent do you have and use architecture compliance checklists?	
A	The architecture compliance checklists are used in an arbitrary way with the decision of individual architects.	
B	Use of architecture compliance checklist is agreed upon the project groups.	
C	Consistent and defined procedures of using compliance checklist are performed in the organizational level.	
Option	Q20: To what extent do you have the same format of compliance assessment documentation in different projects?	
A	There is no standard format and style that architects must follow.	
B	There is a template of compliance assessment and some projects use the template.	
C	Consistent compliance assessment documentation is created in the defined procedures.	

Documentation 11. Implementation and Migration Plan		
Option	Q21: To what extent do you have a standardized implementation and migration strategy?	
A	It is not applicable.	
B	It is the internal implementation and migration strategy in the project groups based on their agreement.	
C	Standardized implementation and migration strategy are created and agreed upon in the organizational level.	
Option	Q22: To what extent do you document the implementation and migration plan?	
A	The implementation and migration plan is documented in an ad-hoc and ambiguous manner.	
B	The implementation and migration is documented in the inconsistent way within different projects.	
C	Consistent and defined procedures of documenting implementation and migration plan are performed in the organizational level.	

Documentation 12. Implementation Governance Model		
Option	Q23: To what extent do you have and use governance checkpoints?	
A	The governance checkpoints are used in an arbitrary way with the decision of individual architects.	
B	Use of governance checkpoints is agreed upon the project groups.	
C	Consistent and defined procedures of using governance checkpoints are performed in the organizational level.	
Option	Q24: To what extent do you document the implementation governance model?	
A	The implementation governance model is documented in an ad-hoc and ambiguous manner.	
B	The implementation governance model is documented in the inconsistent way within different projects.	
C	Consistent and defined procedures of documenting implementation governance model are performed in the organizational level.	

Documentation 13. Organizational Model for Enterprise Architecture		
Option	Q25: To what extent do you define the scope of organizations impacted?	
A	It is not applicable.	
B	Some architecture projects define the scope of organization impacted based on internal agreement.	
C	Scope of organization impacted is defined consistently in the organizational level.	
Option	Q26: To what extent do you have the same format of organizational models for enterprise architecture in different projects?	
A	There is no standard format and style that architects must follow.	
B	There is a template of organizational model for enterprise architecture and some projects use the template.	
C	Consistent organizational models for enterprise architecture documents are created in the defined procedures in the organizational level.	

Documentation 14. Requirements Impact Assessment		
Option	Q27: To what extent do you document the results of phase investigations and revised priorities in the requirements impact assessment?	
A	The results of phase investigations and revised priorities are documented in an ad-hoc and ambiguous manner.	
B	The results of phase investigations and revised priorities are documented in the inconsistent way within different projects.	
C	Consistent and defined procedures of documenting implementation governance model are performed in the organizational level.	
Option	Q28: To what extent do you have a standardized requirements impact assessment?	
A	It is not applicable.	
B	Some projects have an agreed-upon requirements impact assessment internally.	
C	Standardized requirements impact assessment are created and agreed upon in the organizational level.	

Documentation 15. Statement of Architecture Work		
Option	Q29: To what extent do you define and document the roles, responsibilities, and deliverables in the statement of architecture work?	
A	It is not applicable.	
B	Some architecture projects define and document the roles, responsibilities, and deliverables based on internal agreement.	
C	The roles, responsibilities, and deliverables in the statement of architecture work are defined consistently in the organizational level.	
Option	Q30: To what extent do you have the same format of statement of architecture work in different projects?	
A	There is no standard format and style that architects must follow.	
B	There is a template of statement of architecture work and some projects use the template.	
C	Consistent statement of architecture work is created in the defined procedures in the organizational level.	

Documentation 16. Tailored Architecture Framework		
Option	Q31: To what extent do you re-use the existing architecture method in the tailored architecture framework?	
A	It is not applicable.	
B	Some existing architecture methods are available and can be re used.	
C	All existing architecture methods are fully documented and re used as much as possible.	
Option	Q32: To what extent do you re use the existing configured and deployed tools in the tailored architecture framework?	
A	It is not applicable.	
B	Some existing configured and deployed tools are available and can be re used.	
C	All the existing configured and deployed tools are fully documented and re used as much as possible.	

Documentation 17. Transition Architecture		
Option	Q33: To what extent do you have the standardized implementation factor assessment document in the transition architecture documentation?	
A	It is not applicable.	
B	Some projects have an agreed-upon implementation factor assessment internally.	
C	Standardized implementation factor assessment are created and agreed upon in the organizational level.	
Option	Q34: To what extent do you have the same format of transition architecture documentation in different projects?	
A	There is no standard format and style that architects must follow.	
B	There is a template of transition architecture and some projects use the template.	
C	Consistent transition architecture documentation is created in the defined procedures in the organizational level.	

Appendix B: TOGAF element information

Elements	Key Information
Product-related tools	<ul style="list-style-type: none"> No requirements for tools, but certain EA tools have functions to support TOGAF.
	<ul style="list-style-type: none"> TOGAF proposes a set of evaluation criteria for selecting architecture tools⁷.
Modeling language	<ul style="list-style-type: none"> TOGAF has no requirement for the modeling languages.
	<ul style="list-style-type: none"> Some modeling languages are recommended in the extension areas⁸.
Patterns	<ul style="list-style-type: none"> Patterns are not integrated yet in TOGAF V.9.
	<ul style="list-style-type: none"> Sample of pattern content is offered in TOGAF⁹.
Reference models	<ul style="list-style-type: none"> TOGAF has a Technical Reference Model (TRM), which is considered as foundation architecture focuses on the application platform¹⁰.
	<ul style="list-style-type: none"> Integrated Information Infrastructure Reference Model (III-RM) is a subset of the TOGAF TRM. It is fundamentally an application architecture reference model¹¹.
ADM	<ul style="list-style-type: none"> The key component in TOGAF framework is ADM. ADM is decomposed into ten phases and each phase is further divided into steps¹².
	<ul style="list-style-type: none"> The structure of every phase includes objectives, approach, inputs, steps and outputs¹³.
Standards	<ul style="list-style-type: none"> TOGAF establishes a Standards Information Base to provide a repository area to hold a set of specifications¹⁴.
	<ul style="list-style-type: none"> Standards are classified in line with the TOGAF in the business, data, application and technology architecture domains, respectively.
Templates	<ul style="list-style-type: none"> In TOGAF, the reference library provides a repository area to hold the template materials¹⁵.
	<ul style="list-style-type: none"> No templates are provided by TOGAF

⁷ See Tools for Architecture Development section at <http://www.opengroup.org/architecture/togaf9-doc/arch/>

⁸ See Content Metamodel Extensions section at <http://www.opengroup.org/architecture/togaf9-doc/arch/>

⁹ See Architecture Patterns Section at <http://www.opengroup.org/architecture/togaf9-doc/arch/>

¹⁰ See Foundation Architecture: Technical Reference Model section at

<http://www.opengroup.org/architecture/togaf9-doc/arch/>

¹¹ See Integrated Information Infrastructure Reference Model section at

<http://www.opengroup.org/architecture/togaf9-doc/arch/>

¹² See Architecture Development Cycle section at <http://www.opengroup.org/architecture/togaf9-doc/arch/>

¹³ See Introduction to the ADM section at <http://www.opengroup.org/architecture/togaf9-doc/arch/>

¹⁴ See Standards Information Base section at <http://www.opengroup.org/architecture/togaf9-doc/arch/>

¹⁵ See Reference Library section at <http://www.opengroup.org/architecture/togaf9-doc/arch/>

Architecture repository	<ul style="list-style-type: none"> • TOGAF provides a structural framework for an architecture repository¹⁶.
	<ul style="list-style-type: none"> • This repository is further decomposed into six classes.
Policies	<ul style="list-style-type: none"> • Tailoring TOGAF ADM according to the need of organization is one of the important manners in applying for ADM.¹⁷
	<ul style="list-style-type: none"> • Utilizing the iterative approach is another key manner in applying ADM¹⁸.
Architecture documentation	<ul style="list-style-type: none"> • Documentation is an important component in TOGAF ADM.
	<ul style="list-style-type: none"> • TOGAF defines a baseline for TOGAF deliverables produces by executing the ADM¹⁹.
Risk management	<ul style="list-style-type: none"> • TOGAF develops an architecture governance method to manage and control EA project.
	<ul style="list-style-type: none"> • TOGAF suggested a series of activities of risk management²⁰.
Migration planning	<ul style="list-style-type: none"> • Configuration management is one of the important activities in Migration planning phase²¹.
	<ul style="list-style-type: none"> • Processing diagram is the artifact for configuration management.
Compliance assessment	<ul style="list-style-type: none"> • TOGAF provides compliance review processes to conduct the compliance assessment²².
	<ul style="list-style-type: none"> • A set of architecture compliance review checklists is developed by TOGAF for compliance assessment.
Architecture vision	<ul style="list-style-type: none"> • Architecture vision phase verifies the architecture principles in accordance with organization principles²³.
	<ul style="list-style-type: none"> • Creating architecture vision document is the most important activities in this phase.
Requirements management	<ul style="list-style-type: none"> • Requirements management is to identify, store and feed the changing requirements in and out relevant ADM phases²⁴.
	<ul style="list-style-type: none"> • Business scenarios are efficient techniques in discovering and documenting business requirements²⁵.

¹⁶ See Architecture Repository section at <http://www.opengroup.org/architecture/togaf9-doc/arch/>

¹⁷ See Applying the ADM at Different Enterprise Levels section at <http://www.opengroup.org/architecture/togaf9-doc/arch/>

¹⁸ See Applying Iteration to the ADM section at <http://www.opengroup.org/architecture/togaf9-doc/arch/>

¹⁹ See Architecture Deliverables section at <http://www.opengroup.org/architecture/togaf9-doc/arch/>

²⁰ See Risk Management section at <http://www.opengroup.org/architecture/togaf9-doc/arch/>

²¹ See Phase F: Migration Planning section at <http://www.opengroup.org/architecture/togaf9-doc/arch/>

²² See Architecture Compliance section at <http://www.opengroup.org/architecture/togaf9-doc/arch/>

²³ See Phase A: Architecture Vision section at <http://www.opengroup.org/architecture/togaf9-doc/arch/>

²⁴ See ADM Architecture Requirements Management section at <http://www.opengroup.org/architecture/togaf9-doc/arch/>

²⁵ See Business Scenarios section at <http://www.opengroup.org/architecture/togaf9-doc/arch/>

Appendix C: Contents for each documentation summary

Name	Content
Architecture Building Blocks	<ul style="list-style-type: none"> • Fundamental functionality and attributes: semantic, unambiguous, including security capability and manageability • Interfaces: chosen set, supplied • Interoperability and relationship with other building blocks • Dependent building blocks with required functionality and named user interfaces • Map to business/organizational entities and policies
Solution Building Blocks	<ul style="list-style-type: none"> • Specific functionality and attributes • Interfaces; the implemented set • Required SBBs used with required functionality and names of the interfaces used • Mapping from the SBBs to the IT topology and operational policies • Specifications of attributes shared across the environment (not to be confused with functionality) such as security, manageability, localizability, scalability • Performance, configurability • Design drivers and constraints, including the physical architecture • Relationships between SBBs and ABBs
Architecture Contract	<ul style="list-style-type: none"> • Introduction and background • The nature of the agreement • Scope of the architecture • Architecture and strategic principles and requirements • Conformance requirements • Architecture development and management process and roles • Target Architecture measures • Defined phases of deliverables • Prioritized joint work plan • Time window(s) • Architecture delivery and business metrics
Architecture Definition Document	<ul style="list-style-type: none"> • Scope • Goals, objectives, and constraints • Architecture principles • Baseline Architecture • Architecture models (for each state to be modeled): <ul style="list-style-type: none"> ○ Business Architecture models ○ Data Architecture models ○ Application Architecture models ○ Technology Architecture models • Rationale and justification for architectural approach • Mapping to Architecture Repository: <ul style="list-style-type: none"> ○ Mapping to Architecture Landscape ○ Mapping to reference models ○ Mapping to standards ○ Re-use assessment • Gap analysis

	<ul style="list-style-type: none"> • Impact assessment
Architecture Principles	<ul style="list-style-type: none"> • Name • Statement • Rationale • Implications
Architecture Repository	<ul style="list-style-type: none"> • Architecture metamodel • The architecture capability • The architecture landscape <ul style="list-style-type: none"> ○ Strategic Architectures ○ Segment Architectures ○ Capability Architectures • Standards information base <ul style="list-style-type: none"> ○ Business Standards ○ Data Standards ○ Application Standards ○ Technology Standards • The reference library <ul style="list-style-type: none"> ○ Standards bodies ○ Product and service vendors ○ Industry communities or forums ○ Corporately defined templates ○ Best practice resulting from project implementation • The governance log <ul style="list-style-type: none"> ○ Decision Log ○ Compliance Assessments ○ Capability Assessments ○ Calendar ○ Project Portfolio ○ Performance Measurement
Architecture Requirements Specification	<ul style="list-style-type: none"> • Success measures • Architecture requirements • Business service contracts • Application service contracts • Implementation guidelines • Implementation specifications • Implementation standards • Interoperability requirements • Constraints • Assumptions
Architecture Roadmap	<ul style="list-style-type: none"> • Project list: <ul style="list-style-type: none"> ○ Name, description, and objectives of each impacted project ○ Prioritized list of impacted projects to implement the proposed architecture • Time-oriented Migration Plan: <ul style="list-style-type: none"> ○ Benefits of migration, determined (including mapping to business requirements) ○ Estimated costs of migration options • Implementation recommendations: <ul style="list-style-type: none"> ○ Criteria measures of effectiveness of projects ○ Risks and issues ○ Solution Building Blocks (SBBs) - description and model

Architecture Vision	<ul style="list-style-type: none"> • Problem description: <ul style="list-style-type: none"> ○ Stakeholders and their concerns ○ List of issues/scenarios to be addressed ○ Detailed objectives • Environment and process models: <ul style="list-style-type: none"> ○ Process description ○ Process steps mapped to environment ○ Process steps mapped to people ○ Information flow • Actors and their roles and responsibilities: <ul style="list-style-type: none"> ○ Human actors and roles ○ Computer actors and roles ○ Requirements • Resulting architecture model: <ul style="list-style-type: none"> ○ Constraints ○ IT principles ○ Architecture supporting the process ○ Requirements mapped to architecture
Change Request	<ul style="list-style-type: none"> • Description of the proposed change • Rationale for the proposed change • Impact assessment of the proposed change, including: <ul style="list-style-type: none"> ○ Reference to specific requirements ○ Stakeholder priority of the requirements to date ○ Phases to be revisited ○ Phase to lead on requirements prioritization ○ Results of phase investigations and revised priorities ○ Recommendations on management of requirements • Repository reference number
Compliance Assessment	<ul style="list-style-type: none"> • Overview of project progress and status • Overview of project architecture/design • Completed architecture checklists: <ul style="list-style-type: none"> ○ Hardware and operating system checklist ○ Software services and middleware checklist ○ Applications checklists ○ Information management checklists ○ Security checklists ○ System management checklists ○ System engineering checklists ○ Methods and tools checklists
Implementation and Migration Plan	<ul style="list-style-type: none"> • Implementation and Migration Strategy: <ul style="list-style-type: none"> ○ Strategic implementation direction ○ Implementation sequencing approach • Interactions with other management frameworks: <ul style="list-style-type: none"> ○ Approach to aligning architecture and business planning ○ Approach to integration of architecture efforts ○ Approach to aligning architecture and portfolio/project management ○ Approach to aligning architecture and operations management • Project charters: <ul style="list-style-type: none"> ○ Capabilities delivered by projects ○ Included work packages ○ Business value ○ Risk, issues, assumptions, dependencies

	<ul style="list-style-type: none"> • Implementation Plan: <ul style="list-style-type: none"> ○ Phase and workstream breakdown of implementation effort ○ Allocation of work packages to phase and workstream ○ Milestones and timing ○ Work breakdown structure ○ Resource requirements and costs
Implementation Governance Model	<ul style="list-style-type: none"> • Governance processes • Governance organization structure • Governance roles and responsibilities • Governance checkpoints and success/failure criteria
Organizational Model for Enterprise Architecture	<ul style="list-style-type: none"> • Scope of organizations impacted • Maturity assessment, gaps, and resolution approach • Roles and responsibilities for architecture team(s) • Constraints on architecture work • Budget requirements • Governance and support strategy
Requirements Impact Assessment	<ul style="list-style-type: none"> • Reference to specific requirements • Stakeholder priority of the requirements to date • Phases to be revisited • Phase to lead on requirements prioritization • Results of phase investigations and revised priorities • Recommendations on management of requirements • Repository reference number
Statement of Architecture Work	<ul style="list-style-type: none"> • Statement of Architecture Work title • Project request and background • Project description and scope • Overview or outline of Architecture Vision • Managerial approach • Change of scope procedures • Roles, responsibilities, and deliverables • Acceptance criteria and procedures • Project plan and schedule • Support of the Enterprise Continuum • Signature approvals
Tailored Architecture Framework	<ul style="list-style-type: none"> • Tailored architecture method • Tailored architecture content (deliverables and artifacts) • Configured and deployed tools • Interfaces with governance models and other frameworks: <ul style="list-style-type: none"> ○ Enterprise Architecture Management Framework ○ Capability Management Framework ○ Portfolio Management Framework ○ Project Management Framework ○ Operations Management Framework
Transition Architecture	<ul style="list-style-type: none"> • Opportunity portfolio: <ul style="list-style-type: none"> ○ Consolidated gaps, solutions, and dependency assessment ○ Opportunity description ○ Benefit assessment ○ Capabilities and capability increments ○ Interoperability and co-existence requirements • Work package portfolio:

	<ul style="list-style-type: none"> ○ Work package description (name, description, objectives, deliverables) ○ Functional requirements ○ Dependencies ○ Relationship to opportunity ○ Relationship to Architecture Definition Document and Architecture Requirements Specification • Milestone and milestone Transition Architectures: <ul style="list-style-type: none"> ○ Definition of transition states ○ Business Architecture for each transition state ○ Data Architecture for each transition state ○ Application Architecture for each transition state ○ Technology Architecture for each transition state • Implementation Factor Assessment and Deduction matrix, including: <ul style="list-style-type: none"> ○ Risks ○ Issues ○ Assumptions ○ Dependencies ○ Actions • Consolidated Gaps, Solutions, and Dependencies matrix, including: <ul style="list-style-type: none"> ○ Architecture domain ○ Gap ○ Potential solutions ○ Dependencies
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Appendix D: TOGAF documentation analysis

Reading instruction:

This appendix includes 17 key TOGAF documents information. The development of the content for each document is present in one table.

- The first column in the table marks the name of the phases.
- The second column is the input mark. When a cell is marked green, it shows the following rows are the input of that phase. The cross mark resembles that the content on that row is not derived from the input.
- The third column is output mark. When a cell is marked red, it shows the following rows are the output of that phase.
- The fourth column contains the information of content of each document in that phase.
 - If the content is the input of that phase, it will be marked green.
 - If the content is the output of that phase, it will be marked red.
 - If the content is the new or updated (as part of output), it will be marked with yellow.
- The fifth column contains remarks for any information related to corresponding cell in front.
- The sixth column contains related ADM steps to change or create content of document.

Organizational models for enterprise architecture					
Phase	Input	Output	Content	Remark	ADM steps
Preliminary					
			Scope of organizations impacted		
			Maturity assessment, gaps, and resolution approach		
			Roles and responsibilities for architecture team(s)		
			Budget requirements		
			Governance and support strategy		
			Scope of organizations impacted		
			Maturity assessment, gaps, and resolution approach		
			Roles and responsibilities for architecture team(s)		
	x		Constraints on architecture work	new	Determine constraints on enterprise architecture work
	x		Re-use requirements	new	
			Budget requirements		
	x		Requests for change	new	Define requests for change to existing business programs and projects
			Governance and support strategy		
A: Architecture vision					
			Scope of organizations impacted		
			Maturity assessment, gaps, and resolution approach		
			Roles and responsibilities for architecture team(s)		
			Constraints on architecture work		
			Re-use requirements		
			Budget requirements		
			Requests for change		
			Governance and support strategy		

B: Business Architecture				
			Scope of organizations impacted	
			Maturity assessment, gaps, and resolution approach	
			Roles and responsibilities for architecture team(s)	
			Constraints on architecture work	
			Budget requirements	
			Governance and support strategy	
C: Information Systems Architectures				
			Scope of organizations impacted	
			Maturity assessment, gaps, and resolution approach	
			Roles and responsibilities for architecture team(s)	
			Constraints on architecture work	
			Budget requirements	
			Governance and support strategy	
D: Technology Architecture				
			Scope of organizations impacted	
			Maturity assessment, gaps, and resolution approach	
			Roles and responsibilities for architecture team(s)	
			Constraints on architecture work	
			Budget requirements	
			Governance and support strategy	
E: Opportunities & Solutions				
			Scope of organizations impacted	
			Maturity assessment, gaps, and resolution approach	
			Roles and responsibilities for architecture team(s)	
			Constraints on architecture work	

			Budget requirements		
			Governance and support strategy		
F: Migration Planning					
			Scope of organizations impacted		
			Maturity assessment, gaps, and resolution approach		
			Roles and responsibilities for architecture team(s)		
			Constraints on architecture work		
			Budget requirements		
			Governance and support strategy		
G: Implementation Governance					
			Scope of organizations impacted		
			Maturity assessment, gaps, and resolution approach		
			Roles and responsibilities for architecture team(s)		
			Constraints on architecture work		
			Budget requirements		
			Governance and support strategy		
H: Architecture Change Management					
			Scope of organizations impacted		
			Maturity assessment, gaps, and resolution approach		
			Roles and responsibilities for architecture team(s)		
			Constraints on architecture work		
			Budget requirements		
			Governance and support strategy		
Requirements Management					
			Scope of organizations impacted		

			Maturity assessment, gaps, and resolution approach		
			Roles and responsibilities for architecture team(s)		
			Constraints on architecture work		
			Budget requirements		
			Governance and support strategy		

Tailored architecture framework					
Phase	Input	Output	Content	Remark	ADM steps
Preliminary					
			Existing architecture method		
			Existing architecture content (deliverables and artifacts)		
			Existing configured and deployed tools		
	x		Tailored architecture method	new	Select and Tailor Architecture Framework(s)
	x		Tailored architecture content (deliverables and artifacts)	new	Confirm Governance and Support Frameworks
	x		Architecture Principles	new	Identify and Establish Architecture Principles
	x		Configured and deployed tools, including evaluation report if conducted	new	Implement Architecture Tools
A: Architecture Vision					
			Tailored architecture method		
			Tailored architecture content (deliverables and artifacts)		
			Architecture Principles, including business principles, when pre-existing		
			Configured and deployed tools		
			Tailored architecture method		
			Tailored architecture content (deliverables and artifacts)		
			Configured and deployed tools		
B: Business Architecture					
			Tailored architecture method		
			Tailored architecture content (deliverables and artifacts)		
			Configured and deployed tools		

C: Information Systems Architectures					
			Tailored architecture method		
			Tailored architecture content (deliverables and artifacts)		
			Configured and deployed tools		
D: Technology Architecture					
			Tailored architecture method		
			Tailored architecture content (deliverables and artifacts)		
			Configured and deployed tools		
E: Opportunities & Solutions					
			Tailored architecture method		
			Tailored architecture content (deliverables and artifacts)		
			Configured and deployed tools		
F: Migration Planning					
			Tailored architecture method		
			Tailored architecture content (deliverables and artifacts)		
			Configured and deployed tools		
G: Implementation Governance					
			Tailored architecture method		
			Tailored architecture content (deliverables and artifacts)		
			Configured and deployed tools		
H: Architecture Change Management					
			Tailored architecture method		

			Tailored architecture content (deliverables and artifacts)		
			Configured and deployed tools		
Requirements Management					
			Tailored architecture method		
			Tailored architecture content (deliverables and artifacts)		
			Configured and deployed tools		

Architecture Repository					
Phase	Input	Output	Content	Remark	ADM steps
Preliminary					
			Existing Architecture Repository	if available	
	x		Initial Architecture Repository, populated with framework content	new	Confirm Governance and Support Frameworks
A: Architecture Vision					
			Populated Architecture Repository - existing architectural documentation		
	x		Additional content populating the Architecture Repository	new	Develop Architecture Vision
B: Business Architecture					
			Re-usable building blocks		
			Publicly available reference models		
			Organization-specific reference models		
			Organization standards		
C: Information Systems Architectures					
			Re-usable building blocks		
			Organization-specific reference models		
			Organization standards		
D: Technology Architecture					
			Re-usable building blocks		
			Publicly available reference models		
			Organization-specific reference models		
			Organization standards		

E: Opportunities & Solutions					
			Re-usable building blocks		
			Publicly available reference models		
			Organization-specific reference models		
			Organization standards		
F: Migration Planning					
			Re-usable building blocks		
			Publicly available reference models		
			Organization-specific reference models		
			Organization standards		
G: Implementation Governance					
			Re-usable building blocks		
			Publicly available reference models		
			Organization-specific reference models		
			Organization standards		
H: Architecture Change Management					
			Re-usable building blocks		
			Publicly available reference models		
			Organization-specific reference models		
			Organization standards		
Requirements Management					
			A populated Architecture Repository		

Statement of Architecture Work					
Phase	Input	Output	Content	Remark	ADM steps
A: Architecture Vision					
	x		Scope and constraints	new	Identify Stakeholders, Concerns, and Business Requirements
	x		Plan for the architectural work	new	Confirm and Elaborate Business Goals, Business Drivers, and Constraints
	x		Roles and responsibilities	new	Develop Architecture Vision
	x		Risks and mitigating activity	new	Define the Target Architecture Value Propositions and KPIs
	x		Work product performance assessments	new	Identify the Business Transformation Risks and Mitigation Activities
	x		Business case and KPI metrics	new	Develop Enterprise Architecture Plans and Statement of Architecture Work; Secure Approval
B: Business Architecture					
			Approved Statement of Architecture Work		
			Statement of Architecture Work	updated if necessary	Conduct Formal Stakeholder Review
C: Information Systems Architectures					
			Statement of Architecture Work		
			Statement of Architecture Work	updated if necessary	Conduct Formal Stakeholder Review
D: Technology Architecture					
			Statement of Architecture Work		
			Statement of Architecture Work	updated if necessary	Conduct Formal Stakeholder Review

E: Opportunities & Solutions					
			Statement of Architecture Work		
			Statement of Architecture Work	Refined and updated versions	
F: Migration Planning					
			Statement of Architecture Work		
G: Implementation Governance					
			Statement of Architecture Work		
H: Architecture Change Management					
			Statement of Architecture Work		
			Statement of Architecture Work	updated if necessary	
Requirements Management					
			Statement of Architecture Work		

Architecture Principles					
Phase	Input	Output	Content	Remark	ADM steps
Preliminary					
			Existing Architecture Principles	if any	
	x		Architecture Principles	new	Identify and Establish Architecture Principles
A: Architecture Vision					
			Architecture Principles	when pre-existing	
			Architecture Principles	update	Confirm and Elaborate Architecture Principles, including Business Principles
B: Business Architecture					
			Architecture Principles	when pre-existing	
			Architecture Principles	Refined and updated versions	
H: Architecture Change Management					
			Changes to architecture principles	for maintenance changes	

Architecture Vision					
Phase	Input	Output	Content	Remark	ADM steps
A: Architecture Vision					
	x		Refined key high-level stakeholder requirements	new	Identify Stakeholders, Concerns, and Business Requirements
	x		Baseline Business Architecture, Version 0.1	new	
	x		Baseline Technology Architecture, Version 0.1	new	Develop Architecture Vision
	x		Baseline Data Architecture, Version 0.1	new	Identify the Business Transformation Risks and Mitigation Activities
	x		Baseline Application Architecture, Version 0.1	new	
	x		Target Business Architecture, Version 0.1	new	
	x		Target Technology Architecture, Version 0.1	new	
	x		Target Data Architecture, Version 0.1	new	
	x		Target Application Architecture, Version 0.1	new	
B: Business Architecture					
			Refined key high-level stakeholder requirements		
			Baseline Business Architecture, Version 0.1		
			Baseline Technology Architecture, Version 0.1		
			Baseline Data Architecture, Version 0.1		
			Baseline Application Architecture, Version 0.1		
			Target Business Architecture, Version 0.1		
			Target Technology Architecture, Version 0.1		
			Target Data Architecture, Version 0.1		
			Target Application Architecture, Version 0.1		
			Architecture Vision	Refined and updated versions	Develop Target Business Architecture Description
C: Information Systems					

Architectures					
			Architecture Vision		
			Architecture Vision	Refined and updated versions	
D: Technology Architecture					
			Architecture Vision		
			Architecture Vision	Refined and updated versions	
E: Opportunities & Solutions					
			Architecture Vision		
			Architecture Vision, including definition of types and degrees of interoperability	Refined and updated versions	Create Portfolio and Project Charters and Update the Architectures
F: Migration Planning					
			Architecture Vision		
G: Implementation Governance					
			Architecture Vision		
			Architecture Vision, updated post-implementation		
H: Architecture Change Management					
			Architecture Vision		
Requirements Management					
			Architecture Vision		

Building Blocks					
Phase	Input	Output	Content	Remark	ADM steps
A: Architecture Vision					
			existing Architecture Building Blocks		
B: Business Architecture					
			Re-usable building blocks		Select Reference Models, Viewpoints, and Tools
					Develop Baseline Business Architecture Description
					Perform Gap Analysis
					Finalize the Business Architecture
					Create Architecture Definition Document
C: Information Systems Architectures					
			Re-usable building blocks		Identify Required Catalogs of Data Building Blocks
					Develop Baseline Data Architecture Description
					Perform Gap Analysis
					Finalize the Data Architecture
					Identify Required Catalogs of Application Building Blocks
					Develop Baseline Application Architecture Description
					Develop Target Application Architecture Description
					Finalize the Application Architecture
					Create Architecture Definition Document
D: Technology Architecture					
			Re-usable building blocks		Identify Required Catalogs of Technology Building Blocks
					Develop Baseline Technology Architecture Description
					Develop Target Technology Architecture Description

					Perform Gap Analysis
					Finalize the Technology Architecture
					Create Architecture Definition Document
E: Opportunities & Solutions					
			Re-usable building blocks		Analyze the Work Packages with Respect to Business Transformation
F: Migration Planning					
			Re-usable building blocks		
			Re-Usable Architecture Building Blocks		Align Implementation and Migration Plan with the Project Management Framework
					Align Implementation and Migration Plan with the Operations Management Framework
					Determine Operations and Maintenance Costs
					Confirm Enterprise Architecture Evolution
					Plan the Migration Details
G: Implementation Governance					
			Re-usable building blocks		Confirm Scope and Priorities for Deployment with Development Management
					Perform Enterprise Architecture Compliance Reviews
H: Architecture Change Management					
			Re-usable building blocks		

Architecture Contract					
Phase	Input	Output	Content	Remark	ADM steps
F: Migration Planning					
	x		Architecture Contracts (standard) for implementation projects	new	Confirm Organizational Business Value, Return on Investment, and Performance Measurement Parameters
					Detailed Implementation and Migration Plan
G: Implementation Governance					
			Architecture Contract (standard)		
			Architecture Contract (signed), as recommended in the architecture-compliant implemented architectures		Guide Development of Solutions Deployment
H: Architecture Change Management					
			Architecture Contract (signed)		
			Architecture Contract	updated if necessary	

Architecture Definition Document					
Phase	Input	Output	Content	Remark	ADM steps
B: Business Architecture					
	x		Baseline Business Architecture, Version 1.0 (detailed)	Draft	Determine Overall Modeling Process
	x		Target Business Architecture, Version 1.0 (detailed), including:	Draft	Define Roadmap Components
	x		Organization structure - identifying business locations and relating them to organizational units	Draft	Identify Required Service Granularity Level, Boundaries, and Contracts
	x		Business goals and objectives - for the enterprise and each organizational unit	Draft	Identify Types of Requirement to be Collected
	x		Business functions - a detailed, recursive step involving successive decomposition of major functional areas into sub-functions	Draft	Create Architecture Definition Document
	x		Business services - the services that the enterprise and each enterprise unit provides to its customers, both internally and externally	Draft	
	x		Business processes, including measures and deliverables	Draft	
	x		Business roles, including development and modification of skills requirements	Draft	
	x		Business data model	Draft	
	x		Correlation of organization and functions - relate business functions to organizational units in the form of a matrix report	Draft	
	x		Views corresponding to the selected viewpoints addressing key stakeholder concerns	Draft	
C: Information Systems Architectures					
			Baseline Business Architecture, Version 1.0 (detailed)	if appropriate	
			Target Business Architecture, Version 1.0 (detailed)		
			Baseline Data Architecture, Version 0.1		
			Target Data Architecture, Version 0.1		
			Baseline Application Architecture, Version 0.1		
			Target Application Architecture, Version 0.1		

			Baseline Data Architecture, Version 1.0		
			Target Data Architecture, Version 1.0		
			Baseline Application Architecture, Version 1.0		
			Target Application Architecture, Version 1.0		
			Data Architecture views corresponding to the selected viewpoints addressing key stakeholder concerns	refined	Define Roadmap Components
			Application Architecture views corresponding to the selected viewpoints addressing key stakeholder concerns	refined	Create Architecture Definition Document
D: Technology Architecture					
			Baseline Business Architecture, Version 1.0 (detailed)		
			Target Business Architecture Version 1.0 (detailed)		
			Baseline Data Architecture, Version 1.0 (detailed)		
			Target Data Architecture, Version 1.0 (detailed)		
			Baseline Application Architecture, Version 1.0 (detailed)		
			Target Application Architecture, Version 1.0 (detailed)		
			Baseline Technology Architecture, Version 0.1 (vision)		
			Target Technology Architecture, Version 0.1 (vision)		
			Target Technology Architecture, Version 1.0 (detailed), including:		Develop Baseline Technology Architecture Description
			Technology Components and their relationships to information systems		
			Technology platforms and their decomposition, showing the combinations of technology required to realize a particular technology "stack"		Define Roadmap Components
			Environments and locations - a grouping of the required technology into computing environments (e.g., development, production)		Create Architecture Definition Document
			Expected processing load and distribution of load across technology components		
			Physical (network) communications		

			Hardware and network specifications		
			Baseline Technology Architecture, Version 1.0 (detailed)	if appropriate	
			Views corresponding to the selected viewpoints addressing key stakeholder concerns		
E: Opportunities & Solutions					
			Baseline Business Architecture, Version 1.0 (detailed)		
			Target Business Architecture, Version 1.0 (detailed)		
			Baseline Data Architecture, Version 1.0 (detailed)		
			Target Data Architecture, Version 1.0 (detailed)		
			Baseline Application Architecture, Version 1.0 (detailed)		
			Target Application Architecture, Version 1.0 (detailed)		
			Baseline Technology Architecture, Version 1.0 (detailed)		
			Target Technology Architecture, Version 1.0 (detailed)		
	x		Identification of increments	new	Identify Transition Architecture and Capability Increments
	x		Interoperability and co-existence requirements	new	
	x		Inclusion of project list and project charters	new	Create the Transition Architectures
					Conduct Overall Architecture Updates
F: Migration Planning					
			Strategic Migration Plan		
			Baseline Business Architecture, Version 1.0 (detailed)		
			Target Business Architecture, Version 1.0 (detailed)		
			Baseline Data Architecture, Version 1.0 (detailed)		
			Target Data Architecture, Version 1.0 (detailed)		
			Baseline Application Architecture, Version 1.0 (detailed)		
			Target Application Architecture, Version 1.0 (detailed)		
			Baseline Technology Architecture, Version 1.0 (detailed)		
			Target Technology Architecture, Version 1.0 (detailed)		

			Impact analysis - project list and charters		
			Finalized Architecture Definition Document	updated	Align Implementation and Migration Plan with the Project Management Framework
					Confirm Transition Architecture Increments/Phases and Update Architecture Definition Document
					Establish the Architecture Evolution Cycle and Document Lessons Learned
G: Implementation Governance					
			Architecture Definition Document		
			Architecture Definition Document, updated post-implementation		
H: Architecture Change Management					
			Architecture Definition Document		

Architecture Requirements Specification					
Phase	Input	Output	Content	Remark	ADM steps
B: Business Architecture					
	x		Gap analysis results	new	Determine Overall Modeling Process
	x		Technical requirements	new	Identify Types of Requirement to be Collected
	x		Updated business requirements	new	Finalize the Business Architecture
C: Information Systems Architectures					
			Gap analysis results (from Business Architecture)		
			Relevant technical requirements that will apply to Phase C		
			Gap analysis results		Determine Overall Modeling Process
			Relevant technical requirements that will apply to this evolution of the architecture development cycle		Identify Required Catalogs of Data Building Blocks
					Identify Required Diagrams
	x		Constraints on the Technology Architecture about to be designed	new	Identify Types of Requirement to be Collected
			Updated business requirements, if appropriate		Finalize the Data Architecture
					Create Architecture Definition Document
					Identify Required Matrices
					Finalize the Application Architecture
D: Technology Architecture					
			Gap analysis results (from Business, Data, and Application Architectures)		
			Relevant technical requirements from previous phases		
			Gap analysis results		Determine Overall Modeling Process
			Requirements output from Phases B and C		Identify Required Catalogs of Technology Building Blocks

			Updated technology requirements	updated	Identify Required Diagrams
					Identify Types of Requirement to be Collected
					Select Services
					Finalize the Technology Architecture
E: Opportunities & Solutions					
			Gap analysis results (from Business, Data, Application, and Technology Architecture)		
			Architectural requirements		
			IT service management integration requirements		
			Draft Architecture Requirements Specification		Review IT Requirements from a Functional Perspective
					Consolidate and Reconcile Interoperability Requirements
					Create Portfolio and Project Charters and Update the Architectures
F: Migration Planning					
			Architectural requirements		
			Gap analysis results (from Business, Data, Application, and Technology Architecture)		
			IT service management integration requirements		
			Finalized Architecture Requirements Specification		Estimate Resource Requirements, Project Timings, and Availability/Delivery Vehicles
G: Implementation Governance					
			Architectural requirements		Guide Development of Solutions Deployment

			Gap analysis results (from Business, Data, Application, and Technology Architectures)		
H: Architecture Change Management					
			Gap analysis results (from Business, Data, Application, and Technology Architectures)		Develop Change Requirements to Meet Performance Targets
			Architectural requirements		
Requirements Management					
			Architecture requirements, populating an Architecture Requirements Specification		
			Architecture Requirements Specification	Update if necessary	

Architecture Roadmap					
Phase	Input	Output	Content	Remark	ADM steps
B: Business Architecture					
	x		Business Architecture components of an Architecture Roadmap	new	Define Roadmap Components
C: Information Systems Architectures					
			Business Architecture components of an Architecture Roadmap		
	x		Information systems components of an Architecture Roadmap	new	Define Roadmap Components
D: Technology Architecture					
			Business, Data, and Application Architecture components of an Architecture Roadmap		
	x		Technology Architecture components of an Architecture Roadmap	new	Define Roadmap Components
E: Opportunities & Solutions					
			Consolidated and validated Architecture Roadmap	updated	Confirm Readiness and Risk for Business Transformation
F: Migration Planning					
			Consolidated and validated Architecture Roadmap		
			Finalized Architecture Roadmap		Confirm Transition Architecture Increments/Phases and Update Architecture Definition Document
					Generate the Architecture Implementation Roadmap (Time-Lined) and Migration Plan

G: Implementation Governance					
			Architecture Roadmap		Guide Development of Solutions Deployment
H: Architecture Change Management					
			Architecture Roadmap		

Change Request					
Phase	Input	Output	Content	Remark	ADM steps
A: Architecture Vision					
			Requests for change		Assess Readiness for Business Transformation
					Develop Enterprise Architecture Plans and Statement of Architecture Work; Secure Approval
E: Opportunities & Solutions					
			Change Requests for existing business programs and projects		Determine/Confirm Key Corporate Change Attributes
F: Migration Planning					
			Change Requests for existing business programs and projects		
			Change Requests arising from lessons learned		Confirm Management Framework Interactions for Implementation and Migration Plan
					Establish the Architecture Evolution Cycle and Document Lessons Learned
G: Implementation Governance					
			Change Requests		Guide Development of Solutions Deployment
H: Architecture Change Management					
			Change Request, - technology changes:		Provide Analysis for Architecture Change Management
			New technology reports		
			Asset management cost reduction initiatives		Develop Change Requirements to Meet Performance Targets
			Technology withdrawal reports		
			Standards initiatives		Activate the Process to Implement Change
			Change Request, - business changes:		

			Business developments		
			Business exceptions		
			Business innovations		
			Business technology innovations		
			Strategic change developments		
			Change Request, from lessons learned		

Compliance Assessment					
Phase	Input	Output	Content	Remark	ADM steps
G: Implementation Governance					
			Compliance Assessments		Perform Enterprise Architecture Compliance Reviews
H: Architecture Change Management					
			Compliance Assessments		
			Compliance Assessments	updated if necessary	

Implementation and Migration Plan					
Phase	Input	Output	Content	Remark	ADM steps
E: Opportunities & Solutions					
	x		Implementation and Migration Plan, Version 0.1, including the high-level Implementation and Migration Strategy	new	Review and Consolidate Gap Analysis Results from Phases B to D
					Determine Business Constraints for Implementation
					Determine/Confirm Key Corporate Change Attributes
					Review IT Requirements from a Functional Perspective
					Consolidate and Reconcile Interoperability Requirements
					Refine and Validate Dependencies
					Formulate High-Level Implementation and Migration Strategy
					Identify and Group Major Work Packages
					Identify Transition Architectures
F: Migration Planning					
			Implementation and Migration Plan, Version 0.1, including the high-level Implementation and Migration Strategy		
			Implementation and Migration Plan, Version 1.0		Confirm Management Framework Interactions for Implementation and Migration Plan
					Assign a Business Value to Each Project
					Generate the Architecture Implementation Roadmap (Time-Lined) and Migration Plan
G: Implementation Governance					
			Implementation and Migration Plan		
H: Architecture Change Management					
			Implementation and Migration Plan		

Implementation Governance Model					
Phase	Input	Output	Content	Remark	ADM steps
F: Migration Planning					
	x		Implementation Governance Model	new	
G: Implementation Governance					
			Implementation Governance Model		Perform Enterprise Architecture Compliance Reviews
H: Architecture Change Management					
			Implementation Governance Model		

Requirements Impact Assessment					
Phase	Input	Output	Content	Remark	ADM steps
Requirements Management					
			Requirements Impact Assessment		
			Requirements Impact Assessment		Identify changed requirements and record priorities

Transition Architecture					
Phase	Input	Output	Content	Remark	ADM steps
E: Opportunities & Solutions					
	x		Consolidated Gaps, Solutions, and Dependencies Assessment	new	Assess Transition Capabilities of Corporate and Partner Organizations
	x		Risk Register, Version 1.0	new	
	x		Impact analysis - project list	new	Assess Transition Capabilities of the Enterprise and IT Organization
	x		Dependency Analysis Report	new	
	x		Implementation Factor Assessment and Deduction Matrix	new	Confirm Readiness and Risk for Business Transformation
					Formulate High-Level Implementation and Migration Strategy
					Identify Transition Architectures
					Create the Transition Architectures
F: Migration Planning					
			Consolidated Gaps, Solutions, and Dependencies Assessment		
			Risk Register, Version 1.0		
			Impact analysis - project list		
			Dependency Analysis Report		
			Implementation Factor Assessment and Deduction Matrix		
			Finalized Transition Architecture	updated	Align Implementation and Migration Plan with Business/Capability Planning
					Determine Transition Architecture/Project Increment Timings
					Confirm Transition Architecture Time-Spans
					Update Previously Created Architecture Deliverables

G: Implementation Governance					
			Transition Architecture		
			Transition Architecture, updated post-implementation		
H: Architecture Change Management					
			Transition Architecture		

Appendix E: Result and interpretation of the interviews

Element 1. Product-related tools

Q1: Do you take TOGAF supporting function into account when selecting the EA tools?

Answer : C, C, A

Q2: To what extent do you use TOGAF Tool Criteria to select tool?

Answer: N/A, C, B

Interpretation:

- Some organizations will also take supporting customization functions into account when selecting the EA tools.
- Not so many organizations use TOGAF tool criteria. Most of them use Gartner Tool Kits.

Element 2. Modeling language

Q3: To what extent do you agree to use certain modeling language?

Answer: N/A, B, C

Q4: To what extent do you use recommended modeling languages in TOGAF Process Modeling Extensions, Infrastructure Consolidation Extensions, and Motivation Extensions if applicable?

Answer: B, A, C

Interpretation:

- One organization indicates that they focus on the enterprise architecture level, which makes the answer not available

Element 3. Patterns

Q5: To what extent do you agree to use patterns?

Answer: N/A, B, C

Q6: To what extent do you use TOGAF proposed content of pattern?

Answer: N/A, C, A

Interpretation:

- One organization does not take pattern into consideration because they use reference architecture as a generic pattern.
- Another organization decided to apply patterns, but it hasn't decided in which cases to do so.

Element 4. Reference architectures and reference models

Q7: To what extent do you use TRM and III-RM?

Answer: N/A, B, A

Q8: In which of the following entities do you use TRM (Application Software, Application Platform, and Communications Infrastructure)?

Answer: N/A, B, A

Interpretation:

- Some organizations have their own taxonomy based on their experiences.
- For consulting firms, use of TRM depends on the number of projects from same industry .
- One organization thinks that TRM is irrelevant for their work so they don't apply it.

Element 5. ADM

Q9: To what extent do you follow the structure (objectives, approach, inputs, steps and outputs) in each of your ADM phases?

Answer: C, C(on project level)/A(on organization level), C

Q10: Do you perform gap analysis?

Answer: C, A, A

Interpretation:

- Some organizations use ADM but customize it at the same time.
- In the project level ADM is followed but in the organizational level it is on ad-hoc stage.
- Gap analysis is not performed in some organizations because they have a complete different approach in executing ADM

Element 6. Standards

Q11: To what extent do you use standards?

Answer: B, C, C

Q12: To what extent do you use TOGAF standards information base?

Answer: N/A, C, A

Interpretation:

- One interviewee comments that standard is a bit abstract notion.
- Most of the organizations have their own approach for maintaining the standard and their own standards (it is from Gartner and contains some taxonomy).

Element 7. Templates

Q13: To what extent do you create and use template?

Answer: C, B, C

Q14: To what extent do you store your templates in the reference library?

Answer: N/A, B, C

Interpretation:

- Some organizations have their own internal knowledge base to store the templates.

Element 8. Architecture repository

Q15: To what extent do you use architecture repository?

Answer: B, A, C

Q16: To what extent do you establish your repository in the six areas (architecture metamodel, architecture capability, architecture landscape, standards information base, reference library and governance log)?

Answer: B, A, B

Interpretation:

- Not all the interviewees understand the definition of “architecture repository”.
- From industrial perspective, it is more important to share the knowledge instead of the way the knowledge is stored.

Element 9. Policies

Q17: To what extent do you tailor TOGAF ADM into your own architecture framework (terminology, process and content)?

Answer: C, A, A

Q18: To what extent do you utilize iterative approach when applying ADM?

Answer: B, B, C

Interpretation:

- Sometimes the approach for applying ADM is depended on the request from the clients.

Element 10. Architecture documentation

Q19: To what extent do you define the procedures of creating the documentation?

Answer: C, B, C

Q20: To what extent do you follow TOGAF's documentation baseline?

Answer: B, B, C

Interpretation:

- Some organizations customize the TOGAF documentation baseline into a more pragmatic approach.

Element 11. Project management/Risk management

Q21: To what extent do you practice TOGAF architecture governance?

Answer: C, C, A

Q22: To what extent do you follow TOGAF risk management activities?

Answer: C, C, B

Interpretation:

- Some organizations only do validation in governance work.
- Depending on the industry, the risk management is valued and practiced in very different ways and levels.
- Interviewee comments that it is very difficult for organizations to find risk management guideline from TOGAF.

Element 12 Configuration management

Q23: To what extent do you perform TOGAF ADM migration planning phase?

Answer: C, C, C

Q24: To what extent do you use TOGAF processing diagram?

Answer: A, B, A

Interpretation:

- The definition of “TOGAF processing diagram” is not clear to some interviewees.

Element 13. Compliance assessment

Q25: To what extent do you perform compliance assessment?

Answer: B, A, A

Q26: To what extent do you follow compliance assessment checklist recommended by TOGAF?

Answer: A, N/A, A

Interpretation:

- Compliance assessment in general is a weak point for many organizations, checklist is normally missing.
- Some organizations are even not aware of the compliance assessment techniques provided by TOGAF.

Element 14. Architecture vision

Q27: To what extent do you perform architecture vision activities?

Answer: C, C, B

Q28: To what extent do you create the architecture vision?

Answer: C, C, C

Interpretation:

- This is one part that most of the organizations perform well. However, depends on the projects sometimes the architecture vision is omitted.

Element 15. Requirement management

Q29: To what extent do you perform requirements management indicated by TOGAF?

Answer: A, C, C

Q30: To what extent do you use business scenarios?

Answer: A, B, C

Interpretation:

- Sometimes the requirement management is omitted due to the request from the customers.
- In some projects the business scenarios are used based on the characteristics of the projects.

Result from TOGAF documentation maturity assessment questionnaire

Result of preliminary questionnaires

	Documentation	No. of <i>yes</i>	No. of <i>no</i>
1.	Building Blocks	3	0
2.	Architecture Contract	2	1
3.	Architecture Definition Document	2	1
4.	Architecture Principles	2	1
5.	Architecture Repository	1	2
6.	Architecture Requirements Specification	1	2
7.	Architecture Roadmap	2	1
8.	Architecture Vision	3	0
9.	Change Request	2	1
10.	Compliance Assessment Document	0	3
11.	Implementation and Migration Plan	3	0
12.	Implementation Governance Model	1	2
13.	Organizational Model for Enterprise Architecture	2	1
14.	Requirements Impact Assessment	1	2
15.	Statement of Architecture Work	1	2
16.	Tailored Architecture Framework	2	1
17.	Transition Architecture	1	2

Documentation 1. Building Blocks

Q1: To what extent do you develop view of required building blocks in Business Architecture through the creation of catalogs, matrices, and diagrams of the architecture?

Answer: C, C, B

Q2: To what extent do you have and use existing re-usable building blocks?

Answer: A, C, B

Interpretation:

- Building blocks are widely used in the organizations.
- Depending on the clients, in some cases it is hard to re-use of building blocks. However, organizations try to re-use them if possible.

Documentation 2. Architecture Contract

Q3: To what extent do you use the standardized conformance requirements in different architecture contracts?

Answer: C, B

Q4: To what extent do you have same format of content for architecture contract in different projects?

Answer: C, B

Interpretation:

- Depending on the projects sometimes architecture contract is omitted.

Documentation 3. Architecture Definition Document

Q5: To what extent do you have business, data, application and technology target architecture documented in the architecture definition document?

Answer: C, B

Q6: To what extent do you have the standardized architecture definition document?

Answer: C, C

Documentation 4. Architecture Principles

Q7: To what extent do you have same format of content for architecture principles in different projects?

Answer: C, C

Q8: To what extent do you re-use the architecture principles?

Answer: C, C

Interpretation:

- Some organizations have their own architecture principles based on TOGAF.
- Architecture principles are re used if possible.

Documentation 5. Architecture Repository

Q9: To what extent do you store the standard in the standards information base?

Answer: B

Q10: To what extent do you re-use the architecture repository?

Answer: A

Interpretation:

- It is one of the weak points in many organizations. They are either in the ad-hoc manner or not consistent.

Documentation 6. Architecture Requirements Specification

Q11: To what extent do you standardize the gap analysis performance?

Answer: A

Q12: To what extent do you have same format of content for architecture requirements specification in different projects?

Answer: B

Interpretation:

- Many organizations have not paid attention in this area.

Documentation 7. Architecture Roadmap

Q13: To what extent do you have a time-oriented migration plan in your architecture roadmap?

Answer: C, B

Q14: To what extent do you follow the same format of content for architecture roadmap in different projects?

Answer: C, A

Interpretation:

- For some organizations this part has been well defined, but in other organizations it is not complete.

Documentation 8. Architecture Vision

Q15: To what extent do you describe the process models in the architecture vision?

Answer: C, B, B

Q16: To what extent do you have the same format of architecture vision in different projects?

Answer: C, B, A

Interpretation:

- Depending on the situation of the projects and requirement of the clients, this work has been performed in different levels.

Documentation 9. Change Request

Q17: To what extent do you perform impact assessment of the proposed change in your change request?

Answer: B, B

Q18: To what extent do you document the change request?

Answer: C, B

Interpretation:

- Also depending on the clients, change request is done in different degrees.
- Some organizations have their own change log.

Documentation 10. Compliance Assessment Document

Q19: To what extent do you have and use architecture compliance checklists?

Answer: N/A

Q20: To what extent do you have the same format of compliance assessment documentation in different projects?

Answer: N/A

Interpretation:

- It is clear that compliance assessment is a weak point for many organizations. Therefore there is no corresponding answer from the interviews.

Documentation 11. Implementation and Migration Plan

Q21: To what extent do you have a standardized implementation and migration strategy?

Answer: C, C, C

Q22: To what extent do you document the implementation and migration plan?

Answer: C, C, C

Interpretation:

- This is so far the most advanced level that organizations achieved in TOGAF documentation assessment. All the organizations in the interviews have complete and well-defined implementation and migration plan.
- For some organization it is the most important single document.

Documentation 12. Implementation Governance Model

Q23: To what extent do you have and use governance checkpoints?

Answer: B

Q24: To what extent do you document the implementation governance model?

Answer: B

Documentation 13. Organizational Model for Enterprise Architecture

Q25: To what extent do you define the scope of organizations impacted?

Answer: B, B

Q26: To what extent do you have the same format of organizational models for enterprise architecture in different projects?

Answer: B, B

Interpretation:

- Some organizations have their customized version of organizational model for enterprise architecture.

Documentation 14. Requirements Impact Assessment

Q27: To what extent do you document the results of phase investigations and revised priorities in the requirements impact assessment?

Answer: A

Q28: To what extent do you have a standardized requirements impact assessment?

Answer: A

Interpretation:

- Not so many organizations have well defined requirement impact assessment, or if they have, it is in the ad-hoc manner.
- The result of this assessment can be reflected on the situation of requirement management in TOGAF maturity assessment.

Documentation 15. Statement of Architecture Work

Q29: To what extent do you define and document the roles, responsibilities, and deliverables in the statement of architecture work?

Answer: A

Q30: To what extent do you have the same format of statement of architecture work in different projects?

Answer: A

Interpretation:

- This documentation is badly developed in many organizations due to the requirement of the projects.

Documentation 16. Tailored Architecture Framework

Q31: To what extent do you re-use the existing architecture method in the tailored architecture framework?

Answer: C, A

Q32: To what extent do you re-use the existing configured and deployed tools in the tailored architecture framework?

Answer: C, A

Interpretation:

- Depending on the way of doing TOGAF, some organizations do not have tailored architecture framework.
- However, for some organizations the tailored architecture framework is very important.

Documentation 17. Transition Architecture

Q33: To what extent do you have the standardized implementation factor assessment document in the transition architecture documentation?

Answer: B

Q34: To what extent do you have the same format of transition architecture documentation in different projects?

Answer: C

Interpretation:

- The transition architecture is documented in some organizations but sometimes in a more pragmatic approach.

Appendix F: Abbreviations

ABB	Architecture Building Block
ADM	Architecture Development Method
BPMN	Business Process Modeling Notation
BMM	Business Motivation Model
CISR	Center for Information Systems Research
CMM	Capability Maturity Model
CMMI	Capability Maturity Model Integration
DMM	Documentation Maturity Model
EA	Enterprise Architecture
FEA	The Federal Enterprise Architecture
GAO	Government Accountability Office (U. S.)
GQM	Goal-Question-Metric
MIT	Massachusetts Institute of Technology
ICTA	ICT Architectures
IEEE	The Institute of Electrical and Electronics Engineers
IMD	International Institute for Management Development
III-RM	Integrated Information Infrastructure Reference Model
IT	Information Technology
ITPMF	Information Technology Portfolio Management Facility
KPA	Key Product Attributes
KPI	Key Performance Indicator
RA	Reference Architecture
REEF	Reverse Engineering Environment Framework
RM	Reference Model

SBB	Solution Building Block
SEI	Software Engineering Institute
SPEM	Software Process Engineering Metamodel
SysML	Systems Modeling Language
TAFIM	Technical Architecture Framework for Information Management
TOGAF	The Open Group Architecture Framework
TRM	Technical Reference Model
TU/e	Eindhoven University of Technology
UML	Unified Modeling Language

Appendix G: Glossary

Architectural Patterns	(also referred to as architectural styles) The combination of distinctive features in which architecture is performed or expressed.
Application Platform	The collection of technology components of hardware and software that provide the services used to support applications.
Architecture Capability Framework	Provides a set of reference materials for how to establish such an architecture function
ADM	A step-by-step approach to develop and use enterprise architecture.
Architecture Framework	A foundational structure, or set of structures, which can be used for developing a broad range of different architectures.
Architecture Governance	The practice and orientation by which enterprise architectures and other architectures are managed and controlled at an enterprise-wide level.
Architecture Vision	A phase in the ADM which delivers understanding and definition of the Architecture Vision.
Artifact	An architectural work product that describes architecture from a specific viewpoint.
Baseline	A specification that has been formally reviewed and agreed upon, that thereafter serves as the basis for further development or change and that can be changed only through formal change control procedures or a type of procedure such as configuration management.
Building Block	Represents a (potentially re-usable) component of business, IT, or architectural capability that can be combined with other building blocks to deliver architectures and solutions.
Compliance Assessment	A scrutiny of the compliance of a specific project against established architectural criteria, spirit, and business objectives.
Content framework	Provides a structural model for architectural content that allows the major work products that an architect creates to be consistently defined, structured, and presented.
Configuration Management	A discipline applying technical and administrative direction and surveillance to identify and document the functional and physical characteristics of a configuration item, control changes to those characteristics, and record and report changes to processing and implementation status.
Enterprise Architecture	A capability to integrate technical components to meet business needs.

Enterprise Continuum	A categorization mechanism useful for classifying architecture and solution artifacts, both internal and external to the Architecture Repository, as they evolve from generic Foundation Architectures to Organization-Specific Architectures.
Foundation Architecture	An architecture of generic services and functions that provides a foundation on which more specific architectures and architectural components can be built.
Framework	A structure for content or process that can be used as a tool to structure thinking, ensuring consistency and completeness.
III-RM	A subset of the TOGAF TRM in terms of its overall scope, but it also expands certain parts of the TRM - in particular, the business applications and infrastructure applications parts.
Metamodel	A model that describes how and with what the architecture will be described in a structured way.
Methodology	A defined, repeatable series of steps to address a particular type of problem, which typically centers on a defined process, but may also include definition of content.
Migration Planning	A phase in the ADM which finalize a detailed Implementation and Migration Plan.
Model	A representation of a subject of interest.
Modeling	A technique through construction of models which enables a subject to be represented in a form that enables reasoning, insight, and clarity concerning the essence of the subject matter.
Processing Diagram	An artifact of configuration management focusing on the deployable units of code/configuration and how these are deployed onto the technology platform.
Reference Model	A reference model is an abstract framework for understanding significant relationships among the entities of an environment, and for the development of consistent standards or specifications supporting that environment.
Reference Library	Provides a repository area to hold best practice or template materials that can be used to construct architectures within an enterprise.
Repository	A system that manages all of the data of an enterprise, including data and process models and other enterprise information.
Requirements Management	An activity in ADM to define a process whereby requirements for enterprise architecture are identified, stored, and fed into and out of the relevant ADM phases.

Risk Management The management of risks and issues that may threaten the success of the enterprise architecture practice and its ability to meet its vision, goals, and objectives, and, importantly, its service provision.

Standard Information Base A database of standards that can be used to define the particular services and other components of an Organization-Specific Architecture.

Target Architecture The description of a future state of the architecture being developed for an organization.

TRM A structure which allows components of an information system to be described in a consistent manner (i.e., the way in which you describe the components).
