

True Value of the Open Group (TOGAF) ArchiMate Language: Change Management

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Abstract: Enterprise Architecture (EA) is not a simple endeavor. It requires the use of a well-orchestrated collection of ontologies, frameworks, processes, and methodologies all combined to help align information technology (IT) investments with business goals. The emphasis therefore should be on the process of constructing an enterprise architecture that aligns with business goals and not working through these complex ontologies and frameworks. The use of enterprise standard architecture languages and tools can greatly lessen the stress constructing the enterprise architecture. This article first introduces the ArchiMate language and the connection with The Open Group Architecture Framework (TOGAF). Second, the article discusses the free ARCHI tool and the proprietary Avolution ABACUS ArchiMate tool. Third, this article reviews and analyzes the various categories of potential uses of tools following the ArchiMate language. Finally, a discussion of each category of use is summarized along with the overall value of the TOGAF ArchiMate language when used with available tools. Although past studies indicate TOGAF ArchiMate language is used primarily for requirement management, this research concludes that primary uses center upon assessing the impacts change.

Keywords: Enterprise Architecture, Change Management, Strategy, Innovation.

I. INTRODUCTION

TOGAF is an enterprise architecture framework that allows stakeholders and enterprise architects to design, develop, evaluate, and construct flexible enterprise architectures that are aligned with business needs and objectives (Minoli, 2008). TOGAF is said to be the *defacto global standard* for construct of enterprise architectures (The Open Group, n.d.a). TOGAF enables enterprise architects the ability for description, analysis, and visualization of relationships from domain to domain within business organizations. TOGAF helps achieve this in a very unambiguous way due to the use of the TOGAF standard along with its ArchiMate language. The TOGAF ArchiMate language is the focus of this research. The hypothesis for this research is that the TOGAF ArchiMate language is not just used for requirements management. The study question then becomes, what are the true uses of the TOGAF ArchiMate language? This research studies past works which state that the TOGAF ArchiMate language is primarily useful in requirements management. Next, this research analyzes multiple research studies that have used TOGAF ArchiMate and performs an analysis of these to yield a better set of categories of use of TOGAF ArchiMate. Finally, this research concludes that the primary uses of TOGAF ArchiMate center upon assessing the impacts change between the as-is and the to-be. Thus, this is where TOGAF should focus it future work for improving ArchiMate.

II. PAST WORKS

Engelsman, Jonkers, and Quartel (2010) wrote a very lengthy document concerning their thoughts on the primary use of TOGAF ArchiMate. They covered the areas of: requirements chains, architecting requirements, requirements concepts, examples for requirements, and a brief section on tools and techniques. The core thrust of their findings and thesis was that TOGAF ArchiMate was most useful as a requirements management tool. Very little effort was put into outlining the value of evaluating the impacts of change.

Teka et.al. (2012) noted that TOGAF ArchiMate language lacked support mechanism for adequately analyzing goal and requirement change impacts. To overcome this deficiency, they used additional external methods to fill the gap of TOGAF ArchiMate by creating meta-model extensions focusing on semantics for goal influence relationships. This

allowed them to work to more effectively assess the impacts of change. Thus, Teka, et. al. (2012) noted that although the TOGAF ArchiMate language was advertised to be a great requirements management tool, with few changes, ArchiMate could (more importantly) be used to analyze the impacts of change.

III. METHODOLOGY

As stated previously, the hypothesis for this research is the TOGAF ArchiMate language is not just used for requirements management. The study question is: what are the true uses of the TOGAF ArchiMate language? The methodology used in this research was to analyze past works then investigate other more current analytical studies which have utilized the TOGAF ArchiMate language. Once the collection of current analytical studies is assembled, this research utilizes a qualitative analysis methodology to develop the set of categories of use of the TOGAF ArchiMate language.

IV. TOGAF ARCHIMATE BACKGROUND

The Open Group (n.d.a) notes that approximately eighty percent of the world's leading organizations use TOGAF as the framework and method of choice. This is undoubtedly due to the open and free policy of TOGAF. Thousands of users have been certified worldwide, as well. TOGAF addresses many critical needs which include:

- Use of a common speak and language
- Non-proprietary and open standard
- Time and investment funding savings
- More efficient use of resources
- Demonstration of return on investment (ROI).

The Open Group (n.d.c) illustrates that there are nine phases within TOGAF. These nine phases consist of: Preliminary Phase, architecture vision (Phase A), business architecture (Phase B), information systems architectures (Phase C), technology architectures (Phase D), opportunities and solutions (Phase E), migration planning (Phase F), implementation governance (Phase G), and architecture change management (Phase H). Each of these phases feed the overall requirements management process throughout the project lifecycle.

Minoli (2008) points out that TOGAF can be used to construct the business architecture, application architecture, data architecture, and technology architecture for an enterprise. Minoli (2008) also notes that TOGAF is made up of three main components which include:

- Architecture Development Model (ADM)
- Enterprise Continuum
- TOGAF Resource Base.

The ADM describes how to develop an enterprise-specific architecture that meets the needs of the business organization and aligns with business strategies. The ADM provides a reliable and proven method for architecture construct, a standard set of architecture views, linkages to practical case studies, and guidelines on tools. ArchiMate is directly connected to the TOGAF as the standard language used for constructing the views needed for the ADM throughout the enterprise architecture continuum.

The Open Group (n.d.b) states that TOGAF is the standard while ArchiMate is the common modeling language for describing the enterprise architecture. ArchiMate is made up of lists, types, and categories of views which organize the architecture in a consistent way. This assists in describing and visualizing the various relationships among business domains within an enterprise. The Open Group (n.d.b) also notes that ArchiMate is supported by multiple vendors and tools but that the ArchiMate language itself is independent of vendor or tool. ArchiMate enables modeling throughout the TOGAF ADM and specifically emphasizes phases B, C, and D within the TOGAF which are the business architecture, information systems architectures, and technology architecture.

Franken (n.d.) presents that ArchiMate is the graphical language used to express enterprise architectures. He notes that ArchiMate uses two extensions which are key to migrating or transitioning from the as-is to the to-be construct. Franken

(n.d.) calls ArchiMate the *change instrument* for this transition plan since it ensures the connection between stakeholders and alignment with business needs. He notes that this occurs from initial conception all the way through to implementation. Thus, ArchiMate is a key part of the TOGAF ADM construction.

V. TOOLS EMPLOYING TOGAF ARCHIMATE LANGUAGE

As noted in the previous section, tools can play a major role in expediting the overall enterprise architecture process. Projects can be constructed using the TOGAF standard and the ArchiMate modeling language and there are tools that can help in this endeavor. Two such examples include the free and open-use ARCHI tool and the proprietary Avolution ABACUS ArchiMate tool. The ARCHI tool is touted as being the free and open source modeling tool of choice (Archi, n.d.). Further, the ARCHI web site states that the tool is used by hundreds of enterprise architects worldwide. Since both TOGAF and ArchiMate are free and open-source, ARCHI goes along well with that concept. The tool is targeted toward all levels of architects and (since it is free) is the low-cost option to enter the enterprise architecture tool market. It is also denoted as a tool that is able to cross multiple platforms and can therefore be used by many organizations or companies. The ARCHI web site states that ARCHI is fully compliant with ArchiMate 2.1 and can be installed on Windows, Mac, or LINUX platforms.

The general operation of ARCHI is much like any graphical modeling tool where elements and relationships are modeled. The dynamic viewpoint module allows users to model the architecture in an initial viewpoint then change to a different viewpoint once the user determines which viewpoint is actually best. ARCHI has a hint generator to help users understand elements and chose the correct element. The visualization module allows the user to see all elements and relationships in a single graph tree format. Each node of the tree can be opened to allow the user to drill-down to the next architecture level. ARCHI also has a sketch view that allows the user to brainstorm. One very neat feature of ARCHI is the Business Model Canvas which allows users to link ArchiMate models to business ideas. Overall, ARCHI is postured as a great free and open-source tool option for ArchiMate modeling in TOGAF.

The proprietary tool developed by Avolution is called ABACUS ArchiMate (Avolution, 2012b). The most current version of ABACUS on the date of this article is 4.3. ABACUS 4.3 is the tool developed by Avolution to fit the TOGAF standard. Figure 1.0 below shows the overall view of ABACUS 4.3 showing the nine phases of the TOGAF standard.

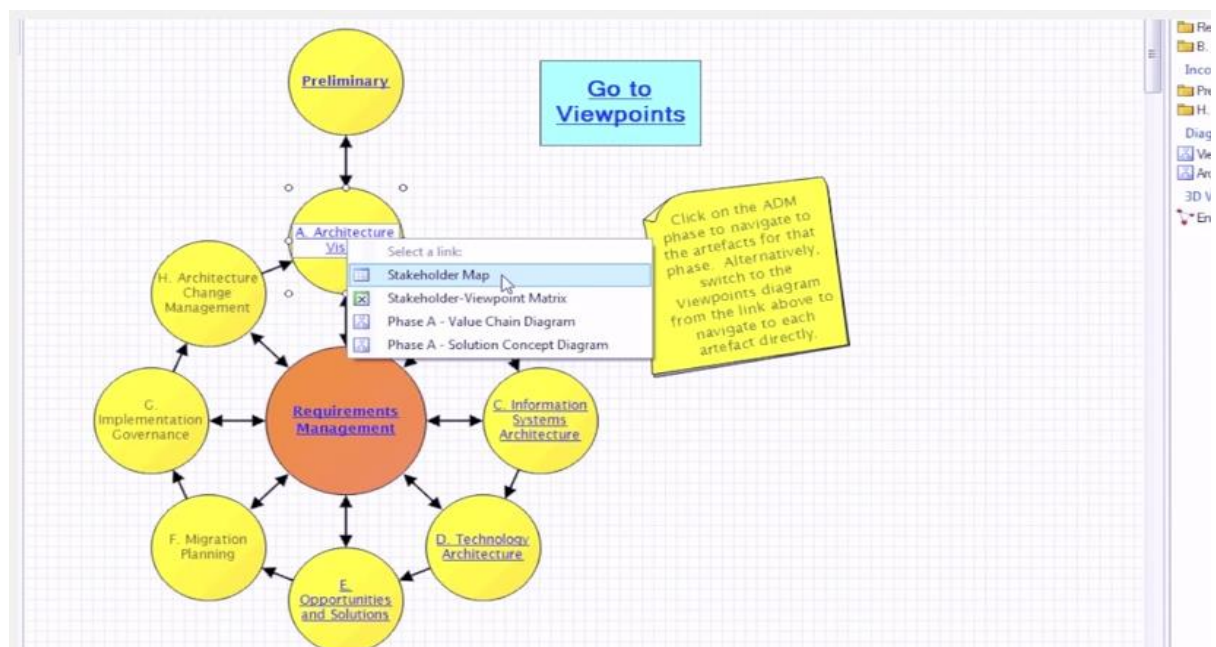


Figure 1.0, TOGAF Module within ABACUS 4.3 (Avolution, 2012b, Adapted for Use)

As can be noted in Figure 1.0, the component phases of the TOGAF model (Phases A through H) can be selected. When the specific phase is selected, it opens a list of available items or views that can be selected and displayed. In Figure 1.0, the example of phase A is opened in to show the items or views available. These include: stakeholder map, viewpoint matrix, value chain diagram, and solution concept diagram. Each of the subsequent TOGAF phases can be opened in this

manner allowing for the construction of many of the needed views. This step by step methodology makes ABACUS 4.3 a very powerful tool for use with the TOGAF standard.

Figure 2.0 below shows the ABACUS ArchiMate tool view that comes standard in ABACUS 4.3. The initial graphic user interface is constructed to show all of the specified components and domains of the ArchiMate language.

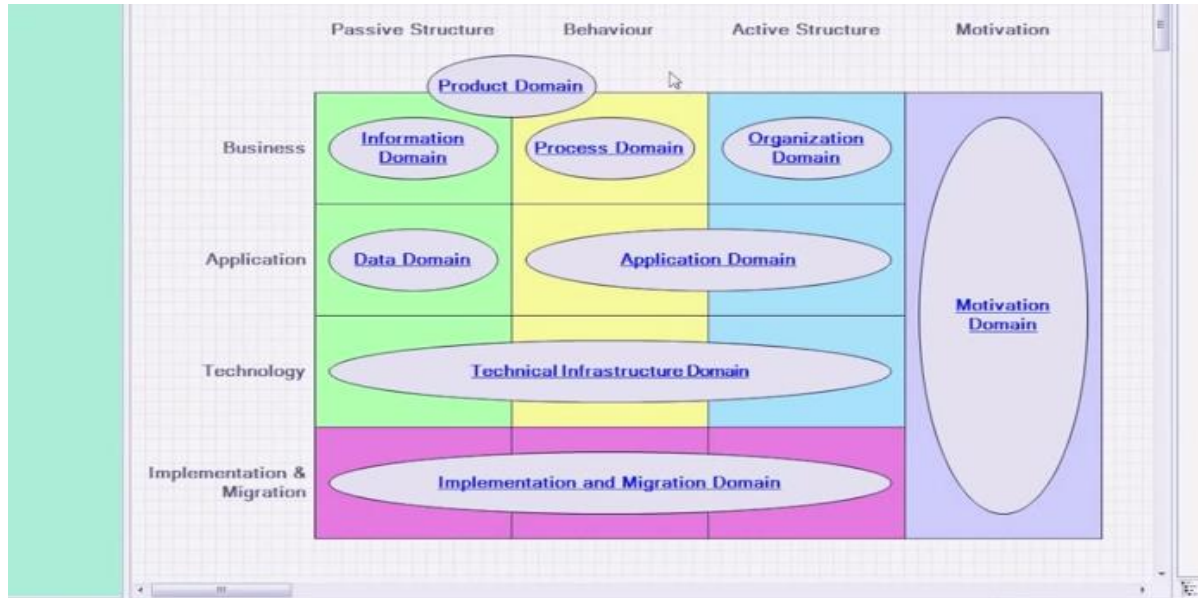


Figure 2.0, ArchiMate 2.0 View in ABACUS 4.3 (Avolution, 2012a, Adapted for Use)

The domains that make up the ArchiMate language include: product domain, information domain, process domain, organization domain, data domain, application domain, technical infrastructure domain, plus the two extensions which are the motivation domain and the implementation and migration domain. The top axis includes the passive structure, behavior, active structure, and motivation categories. The left axis includes the business, application, technology, and implementation and migration levels. Just as before in the TOGAF view in Figure 1.0, Figure 2.0 shows that each component within the ABACUS ArchiMate view can be opened to show the selection of items and views available within each domain. For example, if information domain is selected, a list of items and views that are available is displayed in a list view. This list view is shown below in Figure 3.0. An enterprise architect can complete an architecture construct using ABACUS ArchiMate by working through each of the domains and supplying the necessary items and views.

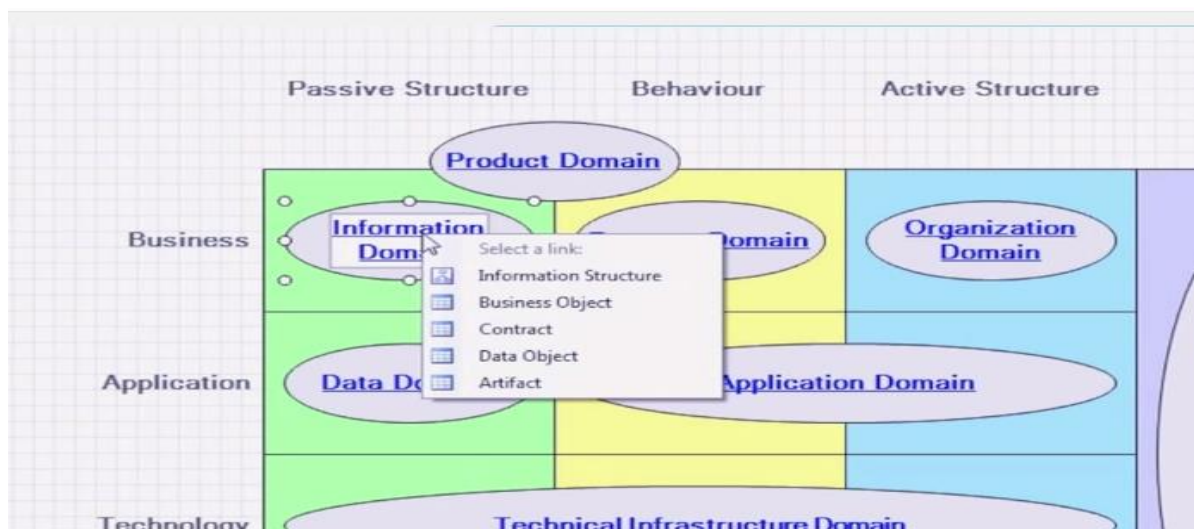


Figure 3.0, ArchiMate Information Domain View (Avolution, 2012a, Adapted for Use)

Much like its free open-source competitor (ARCHI), ABACUS ArchiMate allows for the generation of necessary views which include elements, relationships, and attributes as well as relationship concepts like aggregation, realization, and

composition. Business functions included actors, roles, and functions. Organizations include structure, business actors, business roles, and locations. Applications include components, actors, and interfaces. The technical infrastructure includes such items as infrastructure viewpoint, high level overview, and organization-node-device views. The two extension domains include necessary items and views for motivation and implementation and migration. The motivation domain is made up of many viewpoints that point to stakeholders, drivers, and assessments. Just like ARCHI, the ABACUS ArchiMate tool allows the user to drill-down into lower levels until the very lowest level is completed. One additional feature that ABACUS ArchiMate has is the ability to generate charts, matrices, and catalogs. This feature makes the tool very useful for assessing the differences between as-is and to-be architecture constructs. ABACUS ArchiMate also has a feature that allows the enterprise architect to highlight in red what is changing in the as-is and how the new solution will be integrated in the to-be construct. These features make ABACUS ArchiMate a very valuable tool for use in the TOGAF standard and, as noted in a previous section, the tool expedites the ADM process by specifically emphasizing the development of views for TOGAF phases B, C, and D (business, application, and technology architectures).

VI. USE CASES FOR THE ANALYSIS OF TOGAF ARCHIMATE LANGUAGE

Ahsan, Shah, and Kingston (2010) used the TOGAF ArchiMate language to analyze a hospital case study in the United Kingdom. They stated that ArchiMate was used due to its simplicity and power to expand the architecture as well as ArchiMate defines domains well. The definition of domains enabled analysis of these complex healthcare architectures. The goals of the use of ArchiMate were to organize the healthcare enterprise and facilitate integration of health care units with business architectures. Also, the use of ArchiMate helped the hospital adapt the tools for management and decision making. As one might expect, implementing any changes in a hospital is very challenging due to human and patient involvement. Ahsan, Shah, and Kingston (2010) believed that ArchiMate was needed so that these improvements could be understood and analyzed prior to implementation. This also brought about better alignment of IT investments with business goals. They used ArchiMate to model concepts, relationships, actors, and organizational goals within the various domains. They even developed an extension of ArchiMate called the Hospital Reference Model. In the end, the authors were able to analyze and assess the impacts of changes which brought about more structured implementation.

Aldea, Iacob, Quartel, and Franken (2013) used ArchiMate to evaluate IT investments in very agile and dynamic environments. The purpose of conducting these analyses was to align IT investments with business strategies in order to stay more competitive. They first developed models to link strategy to implementation. Using these models helped them analyze the impacts of strategy change as well as ensuring that vital aspects were not missed. The key questions they answered using ArchiMate were, which strategies should be undertaken and how best can they be implemented? ArchiMate was used to evaluate the impact of strategy changes on the IT architecture. ArchiMate was specifically chosen due to the inclusion of the motivation domain which allowed strategies and goals to be modeled and analyzed.

Azevedo, Iacob, Almeida, and et.al. (2013) presented a study of the ArchiMate language itself in order to recommend improvements that would allow better evaluation of strategies and subsequent portfolios with respect to how valuable the changes would be in terms of dollar valuation. The authors used ArchiMate to model resources and capabilities which drive portfolios and business strategies. They stated that this needed to be done because of ever-shifting competitive markets where organizations must adapt. Further, the authors cited studies that outlined that the time of sustained competitive advantage is decreasing over time and a better strategy would be to construct successive temporary strategies.

Buckl, Franke, Holschke, and et.al. (2009) used enterprise architecture and the ArchiMate language to analyze a sample business case evaluation. This case focused on the quality aspects of the enterprise in the form of availability and it uses quantitative metrics to assess and evaluate. The scenario used is a complex and interconnected set of systems. Challenges in understanding availability existed due to the interconnected nature of the systems and because it was difficult to assess the impacts of changes on the business architecture. ArchiMate was specifically discussed due to its ability to model the stakeholder perspectives and concerns while connecting to the overall motivations of the business organization. ArchiMate was also able to model the complex and interconnected set of systems.

De Boer, Bonsangue, Groenewegen, and et. al. (2005) evaluated a case that involved a cable TV company that sells subscription services to show the value of ArchiMate in assessing change to the enterprise architecture. They noted that the enterprise is made up of organizational structures, business processes, and the infrastructure. These can change at any time to meet market demands. Each change can have a significant impact and consequences. Thus, the goal was to

maintain integrity of the enterprise by removing ripple-effects that happen due to change. The authors used ArchiMate to assess these changes prior to implementation.

Gaaloul, Guerreiro, and Proper (2014) used an e-Government scenario to highlight the value of analyzing security and access control issues using ArchiMate. Access control is a challenge due to complex dependencies in the system as well as security policies and constraints. The authors used ArchiMate to model actors, roles, services, events, and objects to model the security and access control perspectives. Specifically, they used ArchiMate to model role-based access control and analyze the transactions in the enterprise architecture. This model provided management with metrics and controls to steer service oriented architectures when access control changes are being considered.

Gandry, Feltus, and Dubois (2013) presented a very unique use of ArchiMate where they modeled a lab case to illustrate the need for assessing information security risks and their effects on services delivered. Using the ArchiMate motivations extension, the authors modeled the information security risk management domain. This was done to understand security drivers and the impacts on services within enterprise architecture. This was also done to help management govern the transformations required due to changing business environments. ArchiMate was chosen because of its layered and behavior-based approach.

Hinkelmann, Maise, and Thonssen (2013) presented a case study using ArchiMate to model and evaluated a Swiss company that utilizes databases and data stores dispersed across the country. The authors felt that information could be utilized better by management and therefore set out to get the information more available to managers on a context driven basis. Getting management better information resulted in better IT investment alignment with business goals. ArchiMate was used due to it being a graphical modeling language and because it modeled all necessary components of the architecture. All meta-data and pertinent information and objectives were input and the evaluation was done. This analysis proved that a linkage between enterprise architecture constructs and databases was very beneficial. The integrated view constructed in ArchiMate allowed management to better distribute data stores where needed.

Iacob, Quartel, and Jonkers (2012) presented the case study which involves a scenario where IT portfolios must be combined. The goal of this evaluation was to come up with an optimized IT portfolio mix which would be of greatest value to the business organization. To accomplish this, the authors modeled business value, IT portfolio value, and enterprise architecture performance using ArchiMate. Issues such as value, risk, resources, capabilities, competences, and constraints were all considered. ArchiMate was found to be a good tool for this use and provided great insight to a more optimal mix of IT investments.

Narman, Johnson, Ekstedt, and et. al.(2009) investigated how manual processes and automated applications can produce data that deteriorates in accuracy over time. The authors used the case of a Swedish utility company to illustrate this deterioration in data accuracy. Since data is used by management to make decisions, the accuracy of that data must be excellent. Poor data and information can impede decision making. Thus, the authors modeled the business processes and behaviors as well as construct an abstract model for data accuracy using ArchiMate. Afterwhich, an evaluation was completed which illustrated the use of ArchiMate and Bayesian Networks to predict the deterioration of data accuracy over time.

Narman, Schonherr, Johnson, and et. al. (2008) presented a case study involving two service oriented architecture (SOA) platforms which were evaluated for quality analysis. Specifically, the ArchiMate model was used to construct only the particular models and diagrams needed to support this type of analysis. The authors felt that EA is an expensive endeavor and only models that prove being worthy of value and promote good decision making should be created. Meta-models were created using ArchiMate language motivations extension for availability, accuracy, confidentiality, and integrity. ArchiMate was selected for use over DODAF, Zachman, and an EA tool called TROUX Architect because the ArchiMate language was more able to be tailored to perform quality analysis. The other models were stated as being more focused on infrastructure and technology. Plus, ArchiMate was found to be industry-neutral whereas the other frameworks and tools were not. The article concluded that ArchiMate was useful for analyzing architectures specifically for quality analysis.

Oussena and Essien (2013) presented a case study of a Student Internship Program (SIP) deployment where the ArchiMate language was used to create the meta-models for business rules and associated metrics. The authors noted that the EA model creating endeavor was a complex task and that there was no generic approach. The complexity was noted as stemming from the complexities of objects, semantics, and relationships. The authors also noted that the main purpose

of EA is to support IT by simulating that the IT investments are aligned with business goals. Thus, their premise is that the model must be accurate and valid for the EA endeavor to be valuable. They selected the ArchiMate language because of its ability to make domain-specific models and because business rules and metrics could be represented in the motivations extension. The metrics they modeled centered upon availability, conformity, dependencies, authentication, effectiveness, and integrity. This research concluded that the ArchiMate language was useful in creating the models and proving that they are aligned with business specifications. Because of this, the models can be accurate and be used to predict the impacts of change in a valid and accurate way.

VII. CONCLUSIONS ON TRUE VALUE

A qualitative analysis of the ArchiMate language use cases presented in the sample set in the previous section reveal that the ArchiMate language was being used for much more than requirements management. By far the largest use of ArchiMate seen in the sample set was to evaluate the impacts of change. The next largest category of use is to model and predict the performance of the architecture to achieve better understanding. Lastly, ArchiMate was used to model the accuracy, validity, and quality of the models or the architecture. The actual categories of use of the ArchiMate language found in this study were:

- Evaluate impacts of strategy change
- Evaluate impacts of IT change on organizational performance
- Evaluate impacts of IT change on availability
- Evaluate impacts of change on integrity of the architecture
- Evaluate impacts of change on access control and security
- Model and predict optimal design mix or architecture
- Model and predict best utilization of resources within architecture
- Determine most optimal mix of IT investments in IT portfolio
- Model and predict data accuracy of architecture over time
- Model and analyze the architecture for quality metrics such as: availability, accuracy, confidentiality, integrity, dependency, conformity, authentication, and effectiveness.

Due to the many uses of the ArchiMate language found in this research, this author concludes that ArchiMate language and available tools are very useful for the overall assessment of enterprise architectures. Although past studies indicate TOGAF ArchiMate language is used primarily for requirement management, this research concludes the primary uses center upon assessing the impacts change between the as-is and the to-be which makes TOGAF ArchiMate an excellent change management tool.

VIII. FUTURE WORK

The motivation extensions may be the most valuable part of the TOGAF ArchiMate language. This is the area where emphasis should be given in the future. Future study should be done that focuses on improving and broadening the motivation extensions for realistic cases of the TOGAF ArchiMate language so that new uses of the language can be expanded upon and achieved. This is the area recommended for TOGAF to spend future cycles to improve the ArchiMate language.

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