UNIVERSITY OF TWENTE.

Integrating value modeling into ArchiMate

MASTER THESIS HAO DING

Enschede, 2015

Author **Hao Ding**

Programme:	MSc Business Information Technology
Institute:	University of Twente Faculty of Electrical Engineering, Mathematics and Computer Science Enschede, the Netherlands
Student number:	S1349716
E-mail:	h.ding-1@student.utwente.nl
Date:	2015

Graduation Committee

Dr. Maria-Eugenia Iacob

Department	Industrial Engineering and Business Information Systems
E-mail	m.e.iacob@utwente.nl

UNIVERSITY OF TWENTE.

Dr. ir. Marten van Sinderen

Department	Department of Computer Science
E-mail	m.j.vansinderen@utwente.nl

UNIVERSITY OF TWENTE.

A.I. Adina Aldea

Department	BIZZDesign
E-mail	a.aldea@bizzdesign.nl

UNIVERSITY OF TWENTE.

Management Summary

This research focuses on defining an efficient and effective approach to construct a value model with ArchiMate. A value model described the value creation process, which include the proposition, participants, commodities, activities and business networks. Clearly defining the value creation process could help managers capture the essential resources, activities involved in the progress, make more accurate cost/benefit estimation. Currently, information technology innovations are rapidly changing the world, more and more business innovations are supported by IT systems. To get support from the IT side, managers need to communicate with IT specialists in order to present their business idea to the IT side and get full support. However, the IT side finds difficulty in capturing the entire value creation logic, from the strategic level to the implementation phase.

The reason is that both sides use different languages. The business side uses business models and related technology to address the business requirements and make new value proposition accordingly. Meanwhile, IT managers and specialists use other modeling techniques to construct the IT infrastructure. The functional difference between these two sides lead to the difficulty of capturing each other's logics.

To solve these conflicts, there is a need to design a coherent and comprehensive modeling approach. The enterprise architecture (EA) represents an architectural landscape of the whole organization, which captures the relationship of business, process and IT as well as the services it delivers to its customers. The attribution of EA makes it an ideal tooling as an intermediary between the business side and IT side. One of the widely accepted EA languages is called ArchiMate. ArchiMate provides a graphical representation of enterprise architectures, which include the interrelated architectures, the specific viewpoints for selected stakeholders, their motivations. The main research question of this thesis is how to use ArchiMate to model the value creation process.

To solve this problem, we introduce the Value Delivery Modeling Language (VDML), which integrates multiple business modeling techniques. VDML is capable of modeling a business idea from different perspectives, including the value proposition, business activities, capabilities, etc. More importantly, VDML contains multiple meta-models to address these aspects. In this thesis, we construct a value modeling approach with ArchiMate by mapping the concepts in ArchiMate with those in VDML. By comparing the concepts, we construct a series of value related viewpoints with ArchiMate. These viewpoints covers different aspects in the value creation process. To efficiently use these viewpoints, a guideline is provided to show the construction process of a value model.

To validate the methodology, a case study from VDML is used to test the coverage of the viewpoint. After that, we use another case from e3value to test whether this approach can also work with other technologies. At the end of the research, an evaluation session is held in BiZZdesign, experts are invited to give feedbacks.

Acknowledgements

This thesis represents the final research work as a “Business&IT” master student at the University of Twente. Upon delivery, it also means the end of my student career. As a foreign student, I enjoyed the time spent in UT and learned a lot from my Dutch schoolmates.

This research is conducted at the University of Twente under the supervision of Maria-Eugenia Iacob, Marten van Sinderen and Adina Aldea, who are the experts in the field of Enterprise Architecture. During the research, they gave me valuable advice and guide me on applying theories into practice. During the research session, I encountered several difficulties, both from internal and external. I’m glad that finally I overcame these issues and finished the study.

First, I would like to thank Maria-Eugenia Iacob and Marten van Sinderen as my university supervisors. I really appreciate for your patience and kindness on guiding me to finish my master thesis. Your experiences and views gave me room to improve my ideas.

Next, I would like to thank Adina Aldea as my supervisor at BiZZdesign. I’m grateful for your kind help along the way of writing the thesis. Especially for the great help in the evaluation session. The experts from BiZZdesign gave me valuable feedbacks regarding my research.

At last, I would like to thank my family for their understanding and help during this period of time. Furthermore, I would like to thank all my friends, as well as the experts from BiZZdesign, for their help.

As the author, I hope you will enjoy reading this thesis. In case you have any questions, please do not hesitate to contact me.

Hao Ding

13.01.2016

TABLE OF CONTENTS

LIST OF TABLES

Table Page

LIST OF FIGURES

CHAPTER I

1.1 Introduction

Although information technology innovations are rapidly changing the world each day, the innovation itself does not contain any objective value before it is used in a certain commercialized purpose. Enterprises which have experience of adopting similar technologies can easily allocate new resources into the organization. However, to those companies which intend to create new valuable deliveries by implementing new technologies, may encounter difficulties on how to combine resources with new technology and how to make profits from the new production. A business model can be applied to solve this problem. It is used to illustrate the value creation and realization in a network perspective. Such a network is often characterized as a value chain (Laffey and Gandy, 2009). Pateli and Giaglis (2004) claim that such a business model can illustrate the interactions between firms. These interactions include the exchange of products and services. In case of the new technology have no obvious business model available, managers then need to find an appropriate model based on their own expertise in order to capture the potential value. Under these circumstances, the knowledge limitations on both new technology and modelling method could lead to the situation that new technologies show less value to the enterprise than expected, or the resources cost of new business misaligned with the company strategy. Although the term business model has been widely investigated, many works only focus on the study of a single firm (Pateli and Giaglis, 2004; Osterwalder et al, 2005). This means the business model cannot describe the impacts of interactions between enterprises to the value creation. Furthermore, continuously bring in new IT systems may cause compatibility problems and lead to the situation that enterprises have to deal with more legacy systems.

To solve these conflicts, there is a need to design a coherent and comprehensive modeling approach, where firms are analyzed at two different levels: the firm level and the network level. At the firm level, an enterprise architecture represents an architectural landscape of the whole organization, which captures the relationship of business, process and IT as well as the services it delivers to its customers. In this thesis, the definition given by Lankhorst is used, who combines the definition of enterprise defined by The Open Group and give the definition of enterprise architecture as: "A coherent whole of principles, methods, and models that are used in the design and realization of an enterprise organizational structure, business processes, information systems, and infrastructure." (Lankhorst, 2013). At the network level, Gordijn and Akkermans (2003) proposed a value modeling methodology which is able to model how enterprises consume, create and distribute commodities in a network perspective. This methodology is known as E3value model, which is first known as an electronic business model (Gordijn et al., 2000b). However, there still lacks a way of analyzing an enterprise in both levels within one method. Hereby, aligning the concept of value modeling with enterprise architecture could contribute the efficiency and effectiveness when creating innovations.

Some previous researches have been done relate to the study of mapping the concepts between the domains of business model and enterprise architecture (Janssen, et al., 2005) (Kinderen, et al., 2012) (Kinderen, et al., 2014) (Iacob et al., 2014). The main contributions can be concluded as:

- A traceable way of merging business requirements from business models to an enterprise architecture model and vice visa;
- A more powerful and accurate way of calculating costs in the value exchanges.

To better understand the concepts, some background information is given in the next section.

1.2 Background

In this section, we present the most important topics in this thesis, which are the EA frameworks, business models and alignment. The information provides valuable insights relating to the problem statement.

Enterprise Architecture

An enterprise architecture describes the components of an organization their interactions with each other. So far, many frameworks have been defined and each of them provides a way of constructing an enterprise architecture; such as Zachman framework, Architecture of Integrated Information Systems (ARIS), Federal Enterprise Architecture Framework (FEAF), Model Driven Architecture (MDA) and The Open Group Architecture Framework (TOGAF). Iacob et al., (2012) claim that a comprehensive EA approach should include:

- A framework, which divides an architecture into different domains, as well as the relationships between these domains.
- A language, which is used to describe an architecture by using a certain kind of representation method, e.g. graphics.
- A process is needed to explain the way of working. More specifically, a step-wise prescriptive method for developing architectural descriptions.

However, none of these approaches are comprehensive enough when using in the architecture development approach. They are either lack of a comprehensive language support (meta model, modelling technique) to draw the architecture or have an inconsistent procedure model to support the development phase (Leist et al., 2006). In contrast, ArchiMate, a modeling language which is developed by multiple Dutch research institutes and managed by The Open Group, composes of all the criteria a comprehensive EA approach should include. These aspects include: framework, abstract syntax, language semantics, concrete syntax and viewpoints (Iacob et al., 2012). Jonkers et al., (2009) further combines ArchiMate with the TOGAF Architecture Development Method (ADM) (Figure 1), which is also the core of the Open Group Architecture Framework (TOGAF). Each of these two components has its own contribution to this integration. TOGAF provides a broad and open ended architecture discipline and supports many modeling approaches and notations. ArchiMate then conforms to the TOGAF approach to enterprise architecture and provides formal notations to describe different architecture scenarios. Based on this division, ArchiMate provides a commentary on the usage at each phase of the TOGAF Architecture Development Method (ADM). The TOGAF + ArchiMate approach provides a solid way of designing an enterprise architecture from baseline to target line, where the external/internal drivers are clearly addressed, all the functions, services and assets are well connected, followed with gap analysis and migration procedure. However, this approach features the efficiency and effectiveness of business-IT alignment within an enterprise, it does not provide a clear way of demonstrating how new value models can be created, visualized and evaluated where external factors involved.

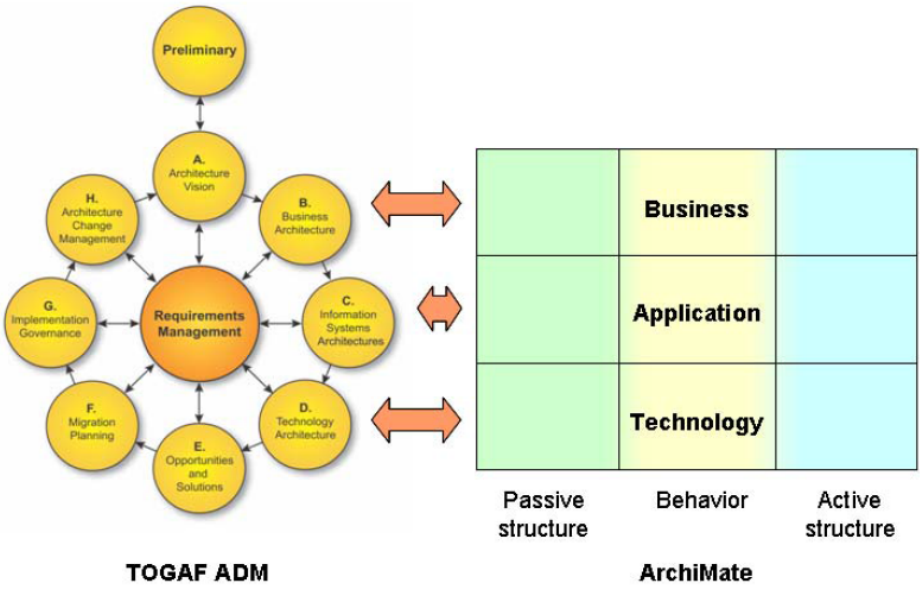


Figure 1: ArchiMate Commentary on the TOGAF ADM (Jonkers et al., 2009)

Business model and value modeling

A business model is a virtual representation of an organization, including all core interrelated financial arrangements designed and developed to achieve a company's strategic goals and objectives presently or in the future (Al-Debei, 2008). Similar to this definition, Chesbrough (2010) also claims that, a business model contains several functions, including value proposition, market segment, the structure of the value chain, revenue mechanisms, cost/profit estimation, competitive strategy and the position of the firm. Many business model frameworks are available for managers to choose, such as the BMO (Osterwalder, 2004), e3value (Gordijn, 2002), RCOV (Demil et al., 2010), the BM concept (Hedman and Kalling, 2003), Value Delivery Modeling Language (VDML) (OMG, 2015) and Entrepreneur's BM (Morris et al., 2005). Some of these models focus on the interactions with information systems, and other models consider more on strategic or enterprise level (Iacob et al., 2012). Through these models, some of them (e.g. The Activity System, RCOV, BM concept, etc.) lack of a formal way to present the model, or there is no meta-model described in these models. Compare to these models, the e3value and VDML have a more formal way to illustrate the value creation and exchange process, since both of them use meta-models and graphical representations to represent the full picture. More importantly, both of the two methodologies are able to demonstrate the economic value in a network perspective

Based on the value-based requirements engineering technique, the e3value model describes the value creation, distribution, and consumption in a network perspective (Gordijn & Akkermans, 2003). According to the e3value ontology, several concepts are defined to represent the value exchanges: (Composite) actor, value object, value exchange, value port, value offering, value interface, value activity and market segment. In order to guarantee the newly created e-commerce is applicable, the e3value model is also able to capture the scenario paths where value objects are exchanged to fulfill the needs of customers by using (end) stimulus.

The Value Delivery Modeling Language (VDML) is proposed by the Object Management Group, Inc. (OMG) to design and analyze the value creation and exchange in the firm level. Compares to the E3value, it does not only representing the value exchanging process, but also able to support strategic analysis as well as align other business models. It is designed to fulfill several business requirements:

- A robust way to model both tangible and intangible value flows.

- The capacity to model complex collaborations and business networks.
- A flexible and sustainable way to model business activities in environments of high variability.
- Supporting capability optimization and deployment.

Alignment

ArchiMate as an enterprise architecture modeling methodology has become the Open Group standard (Lankhorst, 2009; Iacob et al., 2012). Although ArchiMate allows representing the IT infrastructure of firms in a comprehensive way, it currently lacks of expressivity to model the value exchanges of an enterprise and guidelines to model business processes which support the transactions from a value perspective (Pijpers, 2009; Kinderen, 2014). One way of solving the problem is through model integration (Ettema & Dietz, 2009). Some works are found relate to this subject. Fritscher and Pigneur (2011) used the BMC and ArchiMate to illustrate the importance of aligning business model with enterprise architecture. Through the integration, enterprise is able to identify the priority of the assets. The none core services can then be outsourced and deploy assets to new value propositions with a more accurate cost estimation. This approach only provides global mapping and comparisons while technical details such as concepts and relationships are not addressed.

Related to the study of e3value, Kinderen et al., (2014) apply the ontology alignment techniques and using DEMO as an intermediate between e3value and ArchiMate, show a transformation between the meta-models underlying e3value, DEMO and ArchiMate. The e3value focuses on modeling the value exchanges in a value network, it considers the activities of the enterprise from a value perspective. DEMO is the short for Design and Engineering Methodology for Organizations, it contains a comprehensive set of conceptual modeling techniques, together with a theory-based way of thinking and associated way of working, focused on modeling/analyzing/designing the essential aspects of an organization (Dietz, 2006*).

1.3 Problem statement and research question

Op't Land et al., (2008) claim that trace the value exchange activities of an enterprise is very useful. More specifically, it is suggested to integrate languages such as e3value, DEMO and ArchiMate. However, the integrations done by Kinderen et al., mainly focus on only mapping the concepts of the actor/market segment, value object and value activity to DEMO and then to the ArchiMate. While the other concepts: value interface, value port and value exchange have no related DEMO concepts. These limitations are caused by the missing of meta-model in DEMO, and there lacks of a systemic approach to define the principles of model transformations (Baudry et al., 2010).

The previous mapping works use other methodologies as intermediate to perform the model transformation. Since the intermediate has its own meta-model which is different from e3value model and ArchiMate, inevitably it will lead to an incomplete mapping between these two models. Besides, rather than integrate the two models to express and trace the creation and realization of value objects, a comprehensive approach of how to allow ArchiMate modeling the value contents by itself is still missing. The reason is that, to better understand the business goals, the business side and IT side have to use the same language when discussing the value creation and realization process. It is obligatory for the managers and IT specialists understanding how value is being created based on enterprise resources, and how profits are generated during the exchange process. The thesis tries to solve the problem of demonstrating and analyzing the value creation and realization processes in an organization with ArchiMate. Hereby, we bring out our main research question in this thesis:

How to create modeling support for value modeling in (EA) Archimate?

Three sub-questions are addressed to support the answer of the main question:

Sub 1. What is the meaning of value to an enterprise?

To answer the first sub question, a systematic literature review will be performed to define the concept of value means to a company. Then compare this concept with the one defined in ArchiMate.

Sub 2. How the value exchange modeling method can be integrated into the ArchiMate meta-model?

The second sub question relates to explain the mapping rules between the two models. As a value modeling language, VDML shows a new and formal way of representing value creation process. In this thesis, we intend to align ArchiMate with VDML. In order to do so, we need to find a valid approach through literature review.

Sub 2.1. What are the aspects which the integration does not address while it should be included in a comprehensive value modeling approach?

By aligning VDML and ArchiMate, we intend to see whether the concepts in VDML can become a useful replenishment to ArchiMate, which has not been defined in ArchiMate so far.

Sub 3. How to extend ArchiMate making it able to value modeling?

In ArchiMate, viewpoints are defined to describe how a view can be constructed to show the special interest of a stakeholder. Since the ArchiMate lacks a way of modeling the value model with external environments, create new viewpoints could be an option to solve this problem.

1.4 Research Scope

In order to present a clearer and ease of use value modelling concept, we limit the scope of the model extension to the business layer. Our decision is based on the assumption that most interactions between participating actors in a business collaboration occurring at the level of the business layer. Besides, the E3value model is used as a formal approach of modeling networked value constellations, it is selected to match with ArchiMate and possibly most of the concepts can be aligned in the business layer.

Although the scope limitation will lead to a less complex model transformation mechanism, some concepts which are not covered by E3value will also be discussed so that the extension of ArchiMate can be more comprehensive. Nevertheless, this model transformation can be easily extended in a similar way to cover all other ArchiMate layers.

1.5 Research methodology

This thesis follows the Design Science Research Methodology developed by Peffers et al., (2007). Figure 2 shows the graphical representation of the method. In the introduction, the research problems are listed. Section II introduces the mapping rules and tools which will be used for auto-transformation. Section III illustrates the design of the method and the demonstration of the program. In Section IV we use case study to test the method and section V is used to evaluate the result.

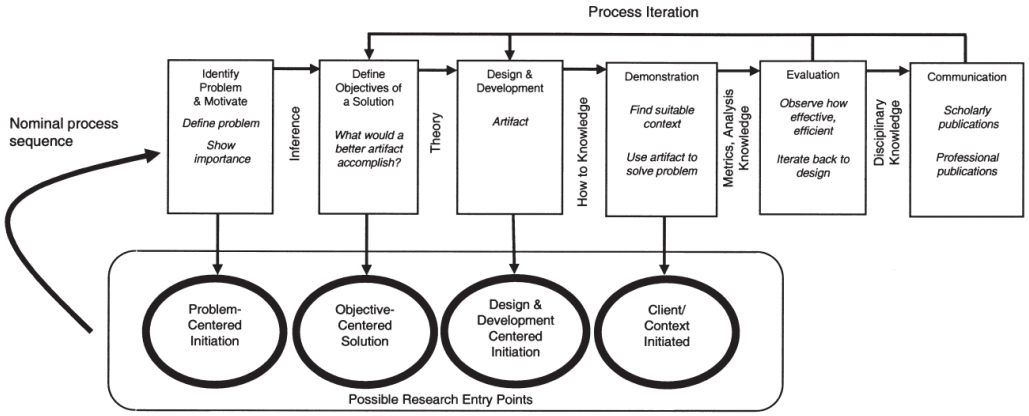


Figure 2: Design Science Research Methodology (Peffers et al., 2007)

A. Identify problem & Motivate

As the first step of the SRM process, it is necessary to define the research problem and state the motivation of doing the research. The research problems defined in chapter 1 will be further explored in the literature review in chapter 2.

B. Define objectives of a solution

The second step defines the potential solutions based on the problem and knowledge of what is possible and feasible. Besides, what are the improvements compare to previous researches (if any) is also claimed in this part.

C. Design & Development

In the D&D phase, an artifact or prototype should be built. It is designed to solve the problems stated in Activity 1 with the objectives as stated in 2. The resources required for this step include theories which can be used to formalize the solution.

D. Demonstration

Demonstrating how one or more problems can be solved with the application. The artifact will be demonstrated by applying the proposed integrated approach to a case. This demonstration is provided in chapter 4.

E. Evaluation

Assess the usability of the artifact on solving the problem and compare the result with the objectives of the solution derived in the design & development phase. The evaluation provides valuable suggestions regarding the improvement of the method.

F. Communication

The last section is concerned with publishing the study to other researchers through different medium, such like journals, reports and scholarly articles.

CHAPTER II: Literature Review

This chapter belongs to phase B in DSRM. To define the solution, a systematic literature review will be performed so feasible knowledge can be found. The structure of this chapter is shown below:

Section 2.1 introduces the framework of literature review, which defines the review processes.
In section 2.2, an introduction will be given to step A, which defines the review objectives.
Section 2.3 defines the keywords in step B and filters articles from databases. In this thesis we use Scopus and Google Scholar as the main bibliographical databases.
Section 2.4-2.5 reports the literature findings based on the keywords. In this section, the concepts relate to value are first defined, which include the essence of value and value creation process. Following with the findings, we further introduce the value concept in ArchiMate and previous works on aligning ArchiMate with business models.
Section 2.6 Summarize the findings and defines the gap of current solutions.

2.1 The Literature Review Framework

The purpose of the literature review is to provide useful background knowledge of the subject in order to support the research questions, objectives and methods. In this thesis, we use the Tranfield et al.'s (2003) three-stage procedure: planning, conducting and third reporting the review. Figure 3 represents the rview procedure.

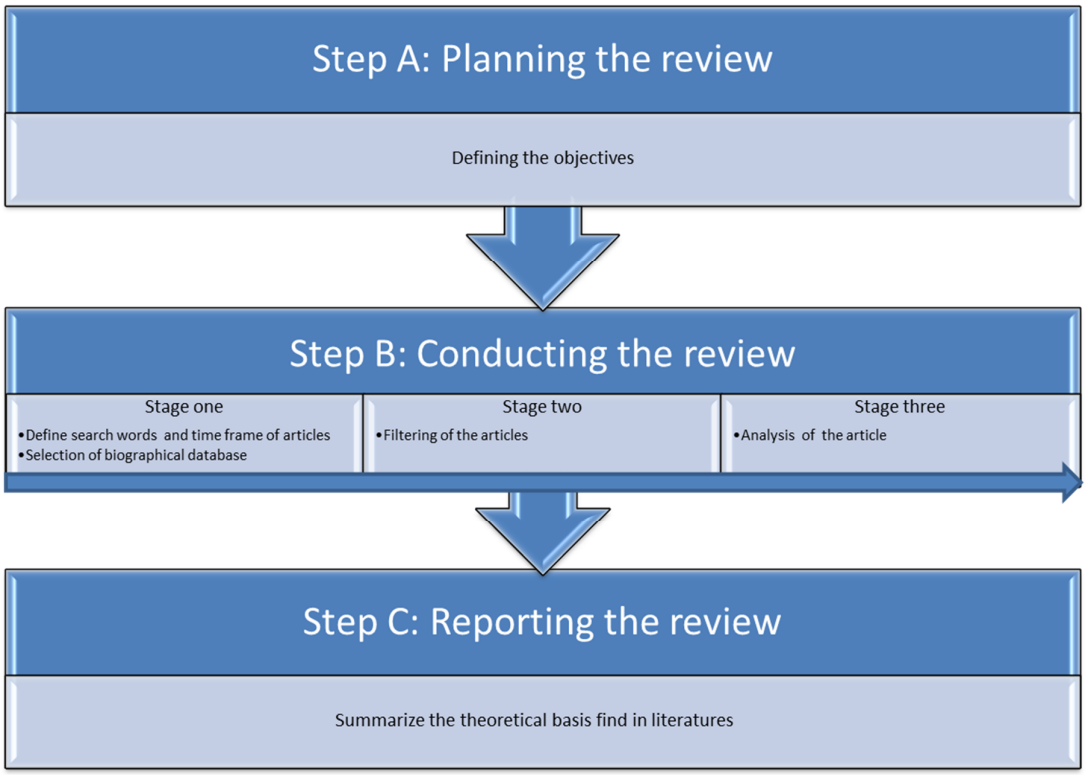


Figure 3. Systematic review process

2.2 Step A: Planning the review

The aim of step A is to define the review objectives, including the scope and intention of the review.

Define the objectives

The systematic literature research is carried out to answer the sub question 1 and 2, which is to identify the latest trends on defining the concept of value, value creation, value exchange and value modeling, as well as their relations. At the end of the review session, the theoretical and methodological backgrounds will be summarized.

2.3 Step B: Conducting the review

There are three stages in the step B, covering from defining the research key words, choosing the biographical databases, filtering and analyzing articles found in the database.

Stage one: Define search words and select database

As mentioned in the step A, the aim of conducting the research is to build a theory base of the value concept which can be modeled in ArchiMate. In order to do so, the value modeling concepts and the enrichment to ArchiMate should be identified. Hereby, the keywords selected for the literature review are:

- **Value**: What is the meaning of value, especially how it is defined in business models. The term business model involves with the creation of value and delivery process in a economic context. Understanding the features of the value concept can become a good replenishment to relate concepts modeled in ArchiMate.
- **Value modeling and ArchiMate:** It includes all the previous studies in this particular domain, especially the research on integrating E3value with ArchiMate.

Some of the bibliographic databases are selected to conduct the review: Google Scholar; Science Direct; Scopus and Web of Science. Among these databases, the databases with higher coverage coupled with functionality and full article access are selected: Google Scholar and Scopus. Google Scholar provides an ease of use approach to search scholarly literatures. However, functions provided by Google are very limited when supporting a systematic literature research. Scopus as one of the most famous search engine which provides abstract and citation database of peer-reviewed literatures are considered as an ideal platform to perform the review task. In this case, the Scopus is selected to perform the filtering and searching tasks with the keywords, while Google Scholar is used to find specific articles.

In order to study the value concept in a more appropriate scope, we narrow down the subject area in Scopus to 'computer science' and 'Business, Management and Accounting'. Besides, only the papers published in journals are chosen and all scholarly articles from January 1980 to May 2015 are considered.

Stage two: Filtering the article

The literature research starts with formalizing the search strings. A search string is composed of the keywords defined by researchers with conjunction words such as AND or OR. The query in Scopus searches by title, author and abstract and sorted by the number of citations, while Google Scholar searches by full text and ranked by relevance. The following list (Table 1) shows the used search terms and the number of articles found in both Scopus and Google Scholar:

Search keyword	Results in Scopus	Results in Google Scholar
"business model" AND enterprise architecture AND value	12	17,900
"business model" AND value	991	127,000

"value modeling" AND ArchiMate	1	45

Table 1: Literature research and results

The results from Scopus and Google Scholar show quite large differences, this can be explained partially by the searching options given by the two databases are different and Scopus is provided with more filtering options. In most of the results, the Google Scholar returned far more results than could be handled due to the time constraints. Since Google Scholar ranks the results based on the relevance to the search query, we only take the top 50 results into account. This manual filtering is acceptable considering the fact that the ranking mechanism in Google Scholar is evaluating each of the documents, include publishing year, author and the reference count. Among thes search results in Scopus, the number of articles under the searching query of ""business model" AND value" also shows a high volume of articles that is not able to be handled in this research. Hereby, we then apply a filtering mechanism based on number of citations. The decision has been made since the ranking in Google Scholar is based on relevance, sorting the articles in Scopus by citation can avoid more duplication.

Value in Business Model

In 1957, the concept of "business model" was first proposed in an academic paper as: "And many more problems arise to plague us in the construction of these business models than ever confronted an engineer." (Bellman et al., 1957). In another word, a business model represents the reality of the world through a simulation model (DaSilva & Trkman, 2014). Since 1990s (Osterwalder et al., 2005), the researchers in the field of Information Systems have started the study of business model. These studies focus on understanding the value creation process for stakeholders. Some of the definitions are summarized in Table 2.

Author(s)	**Definition**	**Features of definition**
Timmers, (1998)	The business model is: • "An architecture for products, services and information flows, including a description of various business actors and their roles; • A description of the potential benefits of the various business actors; and • A description of sources of revenues."	Architecture, Value proposition, Revenue sources.
Amit & Zott, (2001); Zott & Amit, (2010)	The business model depicts "the content, structure, and governance of transactions designed so as to create value through the exploitation of business opportunities" (2001). Based on the fact that transactions connect activities, the authors further evolved this definition to conceptualize a firm's business model as "a system of interdependent activities that transcends the focal firm and spans its boundaries" (2010).	Value creation & transaction.
Morris et al., (2005)	A business model is a "concise representation of how an interrelated set of decision variables in the areas of venture strategy, architecture, and economics are addressed to create sustainable competitive advantage in defined markets". It has six fundamental components: Value proposition, customer, internal processes/competencies, external positioning, economic model, and personal/investor factors.	Representation
Osterwalder et al., (2005)	A business model is a conceptual tool that contains a set of elements and their relationships and allows expressing the business logic of a specific firm. It is a description of the value a company offers to one or several segments of customers and of the architecture of the firm and its network of partners for creating, marketing, and delivering this value relationship capital, to generate profitable and sustainable revenue streams.	Value creation & transaction
Al-Debei et al., (2008)	The business model is an abstract representation of an organization, be it conceptual, textual, and/or graphical, of all core interrelated architectural, co-operational, and financial arrangements designed and developed by an organization presently and in the future, as well as all core products and/or services the organization offers, or will offer, based on these arrangements that are needed to achieve its strategic goals and objectives	Representation
Teece, (2010)	"A business model articulates the logic, the data and other evidence that support a value proposition for the customer and a viable structure of revenues and costs for	Value proposition &

	the enterprise delivering that value".	transaction
Osterwalder et al., (2010)	"A business model describes the rationale of how an organization creates, delivers, and captures value."	Value creation & transaction
DaSilva & Trkman, (2014)	The business model is an "incomplete approach", since it does not "give strategists all the answers for how to operate a business and generate a sustainable competitive advantage. Instead, it paints a picture of the company and reveals how the various elements of the business work together at a certain moment in time."	Short-term representation of business

Table 2: Summarize of business model definitions

Based on these definitions, we present a general understanding of the business model is an *architecture* (Timmers, 1998), a *conceptual tool* (Osterwalder et al., 2005) or *template* (Amit & Zott, 2001, Zott & Amit, 2010), which is a *representation* (Morris et al., 2005, Al-Debei et al., 2008) of how the *value is created, delivered, and captured* in an organization (Teece, 2010, Osterwalder et al., 2010). An interesting finding is that, DaSilva & Trkman, (2014) claim that it is an "incomplete approach", since there has no alignment with long-term strategies in a company while Morris et al., (2005) believe that it is able "to create sustainable competitive advantage in defined markets". These two conflicting viewpoints represent the differences in defining the scope of business model, DaSilva & Trkman distinguish it among other model concepts while in the six-component framework proposed by Morris et al., some sub models are mentioned, e.g. a subsistence model, an income model, a growth model and a speculative model. This summarization is made to provide a more comprehensive view on the nature of the business model, meanwhile this thesis is not going to evaluate these definitions and claim which one is more representative among others. Meanwhile, almost all the definitions agree that the creation of a business model is to present the highest level of a firm's value logic, by means of the creation of value.

Stage three: Analysis of the article

When the initial search is done and the scope limitation is given to Google, articles have to be filtered according to the title, authors, publish year and abstract to remove irrelevant papers and duplications. A series of filtering rules have given in the refining process:

Rule 1: Based on the title, whether the article could have contributions to answer the research questions.
Rule 2: Read the abstract to judge whether the article is primarily dealing with value (modeling) and enterprise architecture.
Rule 3: The article is not a superseded edition.
Rule 4: Except for the relevant literatures shown in the searching results, articles which are cited in these literatures can be also considered as references.

The first rule is applied based on the title, the year of publication and the publisher. The year of publication is taken into account because more recent articles will provide more information on recent developments in the field, and whether or not the article has been superseded is also determined by this. The three rules are used in consequence, only the articles fulfill rule No. 1 can be preceded with rule No. 2. If the contents are not clear when reading the title, rule 2 can also be used for further clarification. The third rule is to guarantee that the paper is up-to-date. The last rule is set as an extension to find more valuable articles. After selection, 25 articles remain in scope.

2.4 Step C: Reporting the review

The essence of value

The term value has been widely used and has been endowed with various meanings under different circumstances, such as customer value, brand value and share value. Each of them represents a tangible or intangible object. Many studies have been done on defining the concept of value through different field of study. In this thesis, we compare and summarize the definition of value

under the scope of business model and enterprise architecture in a firm since it is aligned with the research direction.

Before narrowing down the scope of this thesis, we need to first understand the origin of value. The essence of value has been studied and debated since ancient Greek, which was started by Aristotle. According to Aristotle, value can be further distinguished into two folders, "value-in-exchange" and "value-in-use" (Fleetwood, 1997; Vargoet et al., 2008).

The "value-in-exchange" is also seen as the traditional view of value, also known as goods-dominant (G-D) logic, which claims that firm creates value through the manufacturing process and instantiated through trading activities in the market (Vargo & Lusch, 2004). Take the example of cell phone, the manufacturing firm assembles a mobile phone with PCB board, chips, plastic, LED and other parts, test and package it before transported to the local store. Then the phone is purchased by a customer. In another word, the manufacturing firm creates added value in the mobile phone by assembling electronic components.

The concept of "value-in-use" refers to the knowledge based value co-creation process through a mutual beneficial relationship built between the trading partners (Bowman & Ambrosini, 2003). More specifically, manufacturers use the knowledge and expertise they have to create productions or services, and customers applying their knowledge and skills when using it in their own lives. Meanwhile, customers can gain/provide services to others based on their own needs/resources, and the firm creates value to customers and itself through the knowledge injection process. Use the cell phone case again; the mobile phone is designed by the knowledge and skills the firm has. However, if the client does not know how to use the cell phone, the cell phone means no value. Only when the customer uses it in his/her daily life, the phone shows value. As a matter of fact, it is also defined as the service-dominant (S-D) logic (Vargo, et al., 2008).

Some other studies also claim that the definition of value should be classified under different scopes, since individuals have their own needs (Vargo, et al., 2008), or they are playing different roles in a firm, by which it refers to customers, suppliers, employees and investors (Pombinho, et al., 2012) (Bowman & Ambrosini, 2003). Porter defines value as "the amount buyers are willing to pay for what a firm provides them… A firm is profitable if the value it commands exceeds the costs involved in creating the product." (Porter, 1985). From these literatures, we can summarize the character of value in general:

1. Value always has a carrier; it can be either a tangible or intangible object or both.
2. Value exists for the purpose of fulfilling a specific need.
3. The real value is estimated by the purchasing side, while the provider only makes value proposition.

After the term value is defined, the nest step is to understand the process of value creation in business. A business model is considered as an efficient and effective approach to achieve this goal. The business model approach has been widely used by consultants and business publications to represent the way a firm doing its business (Gilbert et al., 2003; Johnson, 2010).

Value Creation

Amit & Zott (2001) argue in their business model definition that the BM should be used to analyze the value creation. To illustrate the creation of value in a business model, we need to refer back to the two types of values defined in the previous sector, and then discuss the logical reason in detail. After that, we introduce one value creation models for further study, which is the Business Model Canvas (Osterwalder, 2004).

The value creation is mainly depends on "the amount of value which is subjectively realized by a

certain consumer who is focus of value creation" (Khalifa, 2004, Lepak et al. 2007), it is a "central concept in the management and organization literature" but is "not well understood" (Lepak et al., 2007)".

According to Lepak et al., (2007) there are three main reasons which lead to the confusion. The first is that scholars with different backgrounds and expertises show different focus in the direction of explaining how value is created and various disciplines formulated by researchers lead to different types of value creation. Researchers in strategic management, marketing, or entrepreneurship prefer to focus on studying the role of business owners (Porter, 1985; Sirmon, Hitt, & Ireland, 2007) and stakeholders (Post, Preston, & Sachs, 2002). Scholars from sociological or economic disciplines may focus on value creation in terms of society (Lee, Peng, & Barney, 2007). Second, the creation of value involves with two perspectives, the content and the process, the two perspectives lead to different focus areas of studying value creation. The content refers to answering the questions as "what is value, who values what, and where the value resides". When used to specify a process, it refers to "how value is generated and the role, if any, of management in this process" (Lepak et al., 2007). The last reason is the conceptual confusion between value creations, value capture. The value capture refers to the extent that a firm can retain all the new created value, considering the fact that the new value will lose or have to be shared with other stakeholders, such as employees, competitors, or society (Coff, 1999; Makadok & Coff, 2002).

Based on the analysis to the dimensions of value creation, Lepak, Smith, & Taylor (2007) refine the definition as: "value creation depends on the relative amount of value that is subjectively realized by a target user (or buyer) who is the focus of value creation—whether individual, organization, or society—and that this subjective value realization must at least translate into the user's willingness to exchange a monetary amount for the value received." Furthermore, two additional conditions are included as well. Without the additional factors, there will be no long-term trading activities between creators and consumers (Lepak, Smith, & Taylor, 2007):

1. During the trading process, the amount of money exchanged must exceeds the costs spent on creating the value, such as money, time and manpower.
2. The amount of money that a consumer is willing to pay stands for the expectation of the newly created value contained in the product or service, which is influences by the consumer's closest alternatives.

This definition quantified the term value creation, which mainly focuses on the economic side. Considering the second factor, in the definition proposed by Lepak, Smitrmh, & Taylor, the realized amount of value refers to the content perspective in the valuable delivery, while the process perspective is not properly described.

The Value Creation Process

Bouwman and Ambrosini (2003) studied the value and value creation concepts in an enterprise. In the market, an enterprise is a legal and economic entity. It can be both a seller for exchange value and a buyer for use value. When acting as a consumer, it focuses on optimizing the use value of purchasing inputs in order to maximize the trade surplus. When acting as a seller, the firm needs to maximize the exchange value to clients based on the required use value. To improve its competitive advantages in the market, firms must deliver higher consumer surplus than competitors. Under these circumstances, the firm has to differentiate the products in order to fulfill different needs of customers. There are three ways to achieve this goal: 1. Offering a lower price with equivalent use value; 2. Offering high use value with equivalent prizes to competitors; 3. A combination of above two approaches. No matter which character is played by the firm, it serves an ultimate purpose: to increase the exchange value provided by investors.

The firm is seen as both the roles of buyer and seller in the business, and five types of activity are distinguished. Two of the activities describe the process of value creation; the other two types are involved with the maintenance tasks and its capital stock. The last one refers to activities that destroy value. A detailed description is shown below:

1. *Activities that capture exchange value* – These activities include the main activities involved in the value chain (Porter, 1985), which refer to the manufacturing and selling of product and service.
2. *Activities that capture use value* – These activities involve with the motivation of firms as a client, which is to maximize the use value from the suppliers of input, for a given amount of exchange value.
3. *Capital stock creating activities* – These activities include marketing, research&development and training. The capital stock creating activities focus on generating value streams for a firm in the future.
4. *Firm maintenance activities* – This sort of activity has no connection with the profit stream to the firm. However, it is essential for the firm to conduct business, since it involves with those indispensable maintenance, such as finance, company secretariat, health and safety.
5. *Value destroying activities* – As is illustrated by its literal meaning, such activities are the inefficiencies within a firm which have zero contribution to the creation of value. Poor management ability is the main reason of causing these issues.

According to the proposition made by Bouwman and Ambrosini, activities that capture Exchange Value and use value are connected with the process of value creation. Based on these two types of value, a value creation model is proposed (Figure 4). The square stands for the value exchange between suppliers and firm, as well as the firm and customers. The circle in the middle refers to the production process, where insert inputs are transferred to productions or services. As illustrated in the picture, the inputs for the value creation process include inert inputs and human input and enduring capital, which are all the components of use value. The UVp here stands for the new use values created while the Evp refers to the exchange value paid by customers. The UVp and EVp describe how value is realized as the firm becomes a supplier and they are the components of activities that capture exchange value. The value creation components are further classified as follows:

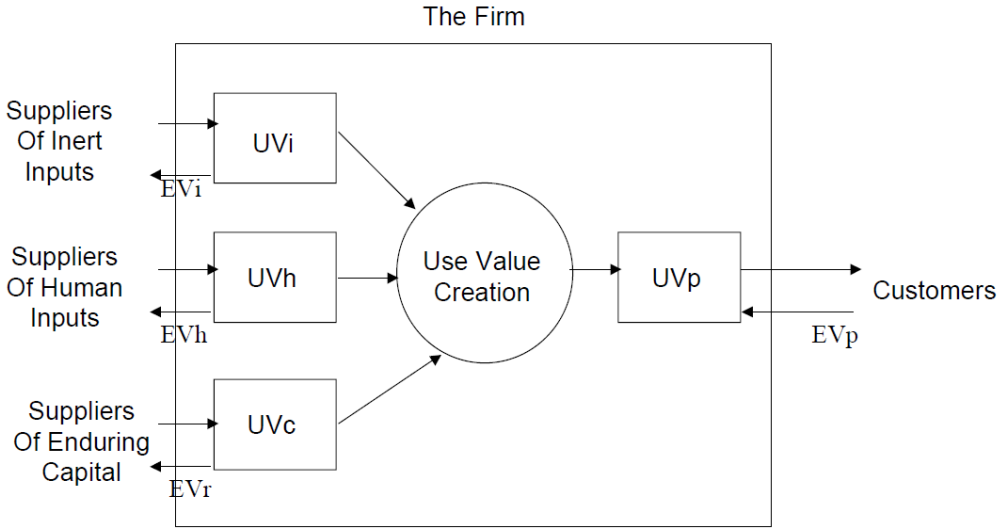


Figure 4: The value-in-use and value-in-exchange in the Value Creation Process (Bowman & Ambrosini, 2003)

1. ***Inert inputs (UVi)*** Within the firm (change of organization), employees transform the use values like components, ingredients and data into products and services. These inputs are useful, primarily physical properties in the value creation process, cannot be self-expanded. In another

word, each of the inputs has value-in-use, but cannot create additional use value by itself.

2. ***Human inputs (UVh)*** Unlike the insert inputs, the human inputs include the individual ability each employee gained from experience and learning which contributes to enhance the productive capabilities (Argote, 1993; Nonaka and Takeuchi, 1995; Senge, 1990). This category would also include the cultures of an enterprise which are embodied through the working activities (Barney 1986; Bartlett and Ghoshal, 1993; Nahapiet and Ghoshal, 1998).
3. ***Enduring capital (UVc)*** The enduring insert use values includes all the facilities of the firm, including plants and machines. The UVc is the physical basis of the enterprise to create value-in-use. It indirectly improves the efficiency & effectiveness of creating the exchange value, such as brand awareness, reputation and trust (Amit and Shoemaker, 1993; Brooking, 1997, Edvinsson and Malone, 1997, Sveiby, 1997).

Bouwman and Ambrosini provide a theoretical basis of understanding the value creation process, below we present more concrete understanding of value creation by demonstrating a widely discussed business model.

Business Model Canvas

The Business Model Canvas is composed of 9 building blocks illustrating the value creation of a firm. It is developed based on the business model ontology (Alexander Osterwalder, 2004). The model addresses several parts regarding the business of the company, including the value proposition, infrastructures, customers, and finances. The potential trade offs and aligned activities can be shown in the model. The nine building blocks of the business model canvas include:

- **Customer Segments** The segments are composed of different groups of people or organizations that the firm is going to serve.
- **Value Proposition** This block describes the bundle of products and services that has use value to a particular group of customers.
- **Channels** The channels building block describes the approach a firm delivers a value proposition to the target clients.
- **Customer Relationships** The customer relationship is involved with the way a firm builds relationship with specific customer segments.
- **Revenue Streams** This part describes how the cash is generated from each customer segment, the earnings refer to the amount of money that subtract the costs from revenues.
- **Key Resources** The key resources are the necessary assets required to make a value proposition work.
- **Key Activities** The key activities describe the most important activities performed by the company to guarantee the business model work.
- **Key Partnership** All the network of suppliers and partners that make the business model work are included in this block.
- **Cost Structure** The cost structure sector refers to the operational cost.

A business model presents the blueprint for implementing business strategy in the organization, which means value is created through a set of activities performed to the resources provided in the firm. In the model proposed by Osterwalder (2004), the resource elements are also classified into three folders, we further compare these contents with the components defined by Bouwman and Ambrosini (Table 3).

Osterwalder	**Bowman and Ambrosini**
Tangible – physical resources, such as plants and equipments	Inert inputs
	Enduring capital
Intangible – patents, brands and similar resources	
Human – employees, employee skills	Human inputs

Table 3: Comparison between Resources and Inputs

The tangible resources are partly related to the insert inputs (UVi) and Ambrosini and partly mapped

to the enduring capital mentioned by Bowman. The tangible resources include all physical stuffs which include plants and equipments, while the UVi components primarily have physical properties and only have use value, the buildings and machines belong to the enduring capital. The intangible resources are mapped to the enduring capital (UVc). The intangible resources refer to patents, brands and similar resources which have comparable meaning as is addressed in the UVc – the physical basis of the enterprise to create value-in-use. The last aspect refers to the employees and their expertise in the process of value creation.

In conclusion, the value-in-use can be further cataloged into two folders, which are the direct value-in-use and indirect value-in-use. The direct value-in-use refers to the resources which cannot be self-extended. The indirect value-in-use is generated during the activities which convert resources into products or services in order to provide usable value for consumers. The exchange value can be extended by the value-in-use added during the producing process.

Value creation and exchange in network perspective

Following with the fast-paced technology development, productions and services become more complicated for a firm to manage the whole process by itself. Under these circumstances, firms tend to cooperate and divide the task force to many other companies in order to create an agile working environment or a more efficient way of managing the assembling lines. Although the BMC is capable of modeling value proposition in a firm, it does not address the value exchange among firms. In contrast, the E3value model (Gordijn, 2003) and the Value Delivery Modeling Language (OMG,2015) are proposed for the purpose of modeling value exchange process. These two approaches will be introduced after the theoretical review.

Porter (1985) proposed the value chain framework for the purpose of presenting and analyzing the value creation logic at firm level. The framework provides a method to identify the strategically important activities of the firm, and illustrates its impact on cost and value (Stabell & Fjeldstad, 1998). Stabell & Fjeldstad adopted the Thompson's (1967) typology of long-linked, intensive and mediating technologies as value creation logic and further defined three types of value configurations, which are value chain, value shop and value network (Figure 5).

The term value chain describes the delivery of a valuable product or service through a series of activities performed by a company. It is mainly involved in transforming raw materials (inputs) into products (outputs) (Porter, 1985). In another word, value is created by transforming inputs into products and the product is the medium for transferring value between the firm and its customers. The term value shop is intended to describe ways to solve the problems of customers. This means, value is created through a series of activities to serve the clients, which include problem finding, acquisition and solving, execution control and evaluation. The third one is the value network. Value network is simply the way clients and customers are interacting and exchanging with each other. The firm provides a networking platform for users, then facilitates and organizes an exchange between customers. Value is created by enabling direct and indirect exchanges between customers.

	Chain	Shop	Network
Value creation logic	Transformation of inputs into products	(Re)solving customer problems	Linking customers
Primary technology	Long-linked	Intensive	Mediating
Primary activity categories	• Inbound logistics • Operations • Outbound logistics • Marketing • Service	• Problem-finding and acquisition • Problem-solving • Choice • Execution • Control/evaluation	• Network promotion and contract management • Service provisioning • Infrastructure operation
Main interactivity relationship logic	Sequential	Cyclical, spiralling	Simultaneous, parallel
Primary activity interdependence	• Pooled • Sequential	• Pooled • Sequential • Reciprocal	• Pooled • Reciprocal
Key cost drivers	• Scale • Capacity utilization		• Scale • Capacity utilization
Key value drivers		• Reputation	• Scale • Capacity utilization
Business value system structure	• Interlinked chains	• Referred shops	• Layered and interconnected networks

Figure 5: Overview of value configurations (Stabell & Fjeldstad, 1998).

When Stabell & Fjeldstad first defined the value configuration concepts, the importance of information technology has not been well addressed. With the fast-paced development of IT, it allows a company to make possible business configurations since the coordination and transaction costs are reduced (Coase 1937; Williamson 1975). Laffey & Gandy (2009) applied the three generic value configuration frameworks and discussed the usability in the e-commerce markets. The value chain here is described as click chain which refers to the search engines. The value shop is discussed through the use of a comparison site, which intends to minimize the information asymmetry in the comparison process. The value network has proven useful to describe the growth of comparison websites. The extension of the value configurations is a mirror of the traditional value creation. However, none of the models could describe the whole company business by itself, since the interaction between firms are more complicated nowadays. Osterwalder (2004) argues that companies are now working closely with each other, offering joint value propositions and revenue streams, together with distribution networks.

Different from the above theory, Lietaer (2001) claims that the network is the main mechanism to describe the conversion process of value. The main mechanism for value conversion here is a network, it describes the creation of value in a more comprehensive way, which addresses the exchanges of tangible and intangible values contained in the specific outcomes (MacCauley, 1963; Granovetter & Swedberg, 2001; Allee, 2002). The definition of value network is further defined as: "any set of roles and interactions in which people engage in both tangible and intangible exchanges to achieve economic or social good" (Allee, 2008). A value network is composed by the internal value network and the external-facing value network. The internal value network include activity-focused set of relationships between individuals and departments, and among work groups that make up the organization. The external-facing value networks include those between the organization and its suppliers, investors; business partners and customers.

According to literature findings, we conclude the value creation approach in the network perspective and the role of the firm (Figure 6). To create value for the targeted clients, the firm first need inputs from its supplier(s) in the form of tangible (e.g. Machines, raw-materials) or intangible (e.g. Information, licenses). These inputs only provide use-value, which means they are not self-

extendable. Within the firm, value is co-created through multiple work groups in the form of tangible or intangible goods. The co-creation process is seen as a conversion progress of value, where the knowledge and skills of the employees are involved in transferring the input materials to valuable goods for certain consumer(s). The value is finally realized during the value exchange process, which is subjectively decided by the willingness of the clients to pay for it. The clients can be an end user or other firms, where added value is created based on the current use-value provided by the firm.

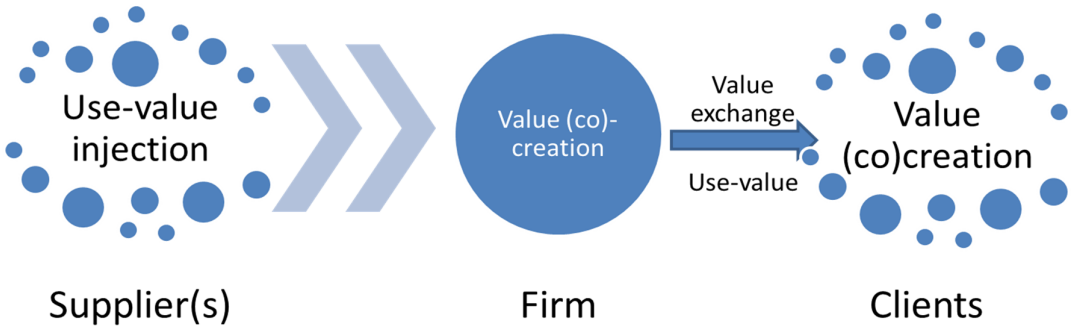


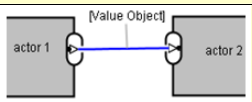
Figure 6: Value network

E3value model and e³alignment

The e3value model is a value model established based on requirements engineering and conceptual modeling techniques, serve the purpose of modeling the creation, distribution, and consumption of economic value in a multi-actor network (Gordijn & Akkermans, 2003, Kinderen, 2014). A value model illustrates the exchange of economic valuable elements between actors (Gordijn & Akkermans, 2003). It is first proposed to construct an e-commerce idea which can be easily understood by all stakeholders, while recently it also applies to other industries, such as health care and banks (Kinderen et al., 2014). The E3value model takes the value viewpoint approach to demonstrate all the requirements from various stakeholders, which lie on top of the electronic commerce framework (Table 4). The concepts defined in e3value are described in Table 5.

Viewpoint name	Viewpoint holder	Viewpoint engineer	Viewpoint focus	Viewpoint representation
Value viewpoint	CxOs, marketers, consumer groups	Business developer	Economic value object creation, distribution and consumption	e3value and UCM scenarios
Process viewpoint	Operational management	Business process (re)designer	Process ownership and flow, resources needed	UML activity, sequence, diagrams, Petri nets
Information system viewpoint	IT department	System architect	System component ownership	Ownership diagrams

Table 4: The multi-viewpoint approach (Kinderen et al., 2014)

Concept	*Notation*	*Definition*
(Composite) Actor		An (Composite) actor is one or more independent economic entity(s) with clustered value interfaces.
Value object	A label sitting on a value exchange	Services, goods, money, or even consumer experiences exchanged between actors, a value object is of value for one or more actors.
Value exchange		A value exchange is used to connect two value ports with each other. It represents that two actors owning the connected ports are willing to exchange value objects with each other.

Value port		A value port shows the provided or requested value objects in its environment that an actor wants to provide or request value objects.
Value offering	Refer to value interface.	A value offering models what an actor offers to (an outgoing offering) or requests from (an ingoing offering) its environment, and closely relates to the value interface concept
Value interface		A value interface consists of one offering, but in many cases a value interface is composed of one ingoing and one outgoing value offering. It shows the mechanism of economic reciprocity.
Value activity	value activity	A value activity is the collection of operational activities which can be assigned as a whole to actors.
Market segment	market segment	The concept of market segment shows a set of actors that for one or more of their value interfaces value objects equally from an economic perspective.
And/Or fork and join		A AND fork splits a scenario path into two or more subpaths, while the AND join collapses sub-paths into a single path. An OR fork models a continuation of the scenario path into one direction that is to be chosen from a number of alternatives. The OR join merges two or more paths into one path.
Start & End stimulate		A scenario path starts with a start stimulus, which represents a consumer need. The last segment(s) of a scenario path is connected to a stop stimulus. A stop stimulus indicates that the scenario path ends.
Scenario paths		A scenario path consists of one or more segments, related by connection elements, start and stop stimuli, and responsibility points.

Table 5: Summary of the e3value notation

The E3value technique focuses on describing only the economic value which enterprises are exchanging with each other, while the strategic rationales and the capability analysis are not addressed. To close this gap, Pijpers et al. (2009) introduces e3alignment, which address the interactions between enterprises from four different perspectives, including a strategic, value, process, and IS perspective (Figure 7). The four perspectives cover not only the economic value transformation, but also describe the strategic influences, orders and activities behind the interaction, as well as the information exchanges. The e3alignment framework takes the alignment from two domains. The vertical arrows in Figure 7 concern the alignment within an organization, while the horizontal arrows describe the interactions between actors in a value network.

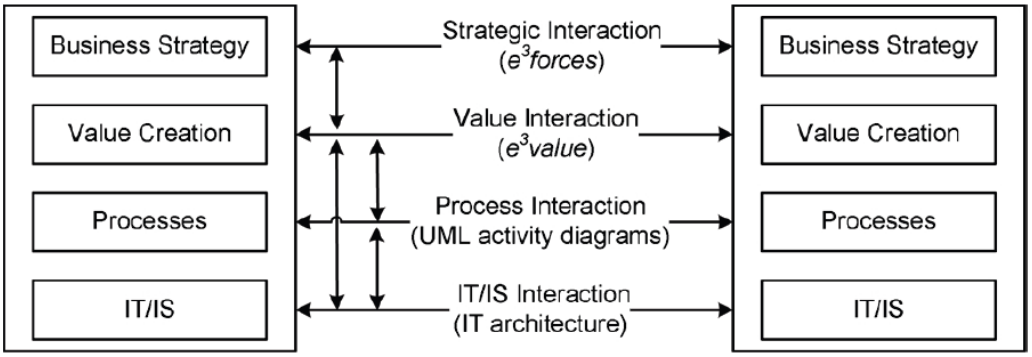


Figure 7: The e3alignment Framework (Pijpers et al., 2009)

A detailed description on each of the perspectives is shown in Table 6. The framework is similar to the ArchiMate architectural framework, which includes the business layer, application layer and the technology layer. The business strategy can be seen as the motivation concepts (Table 6).

Perspectives	Description	Mapping with ArchiMate
The Business	It considers how other organizations influence the strategic	Motivation

Strategy perspective	position of an organization on the long term.	
The Value Creation perspective	It considers how value is created by the networked value constellation in which the organization operates. It shows the things of economic value exchanged between actors in a network to ultimately be able to meet a customer need.	Business layer
The Process perspective	The cross-organizational coordination processes support the value creation by showing the actual physical transfer of objects and takes "time" into consideration.	
The IT/IS perspective	It refers to information systems and technologies used to interact with the environment to exchange information.	Application layer
		Technology

Table 6: Four perspectives in e^{3}alignment and the mapping with ArchiMate architectural framework

Value Delivery Modeling Language

Similar with e^{3}alignment, the VDML modeling is composed of different concepts addressing different aspects at the enterprise level. It supports multiple viewpoints concerns with the design of an enterprise as well as business modeling techniques (Figure 8). The current version of VDML includes sub-clauses describe the business concepts and interactions closely related model elements (Table 7).

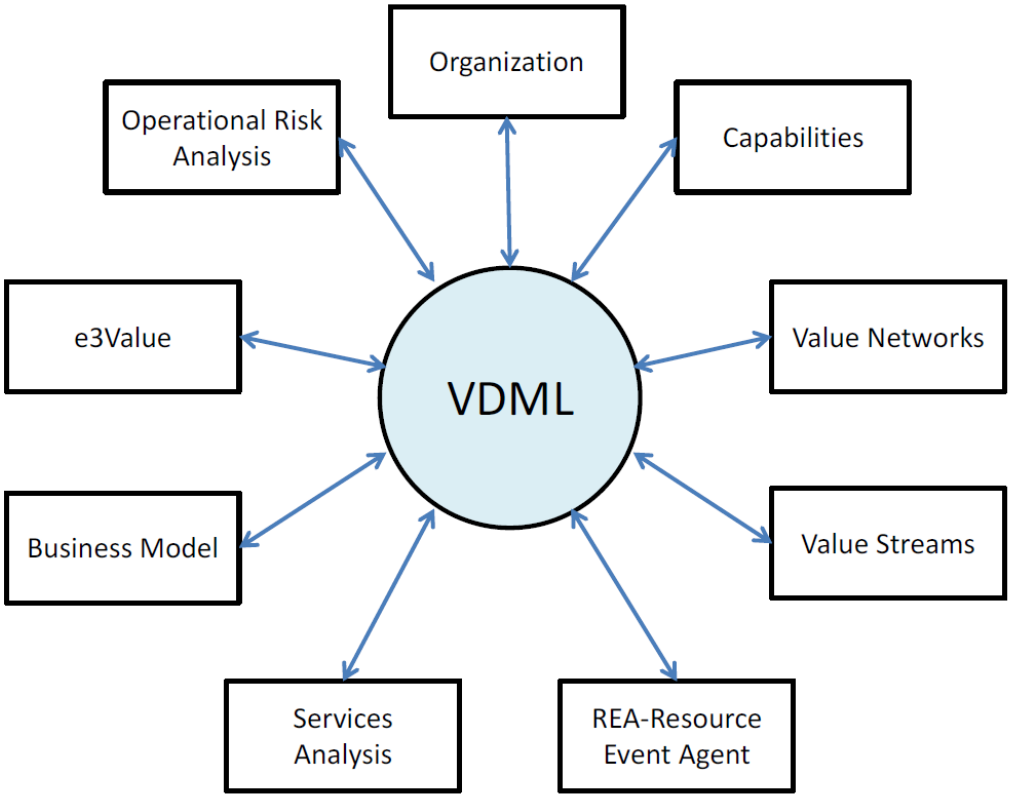


Figure 8: VDML viewpoints (OMG, 2015)

Class name	Description
Collaboration and value creation	It involves with the fundamental structure of the model, including Activity networks and deliverables along with the contributions of Activities and aggregation in ValueProposition.

Collaboration sub-types	It includes four sub-types of Collaboration: OrgUnit, Business Network, Community and Capability Method.
Models and scenarios.	It defines the scope of a ValueDeliveryModel (VDML model) and scenarios within a model. A Scenario is a set of Measurements associated with elements of a ValueDeliveryModel in a particular situation; a model could have multiple Scenarios.
Core elements.	It defines elements that represent primitive concepts in a ValueDeliveryModel
Libraries	Libraries could be shared by multiple models and include collections of business concept specifications.
Integration with SMM	It is composed of elements to measure values, performance characteristics and other aspects which are defined by the SMM specification.

Table 7: VDML Class definition

In VDML, the term value is defined as "a measurable benefit delivered to a recipient in association with a business item/deliverable" (OMG, 2015). The term measurable here could be either a subjective or objective factor to the feature represented on a value. The intrinsic of feature can be its performance, weight, composition or other benefits which can be instantiated by recipients in terms of money, warranty, contract or trustworthiness, etc. Although each of the recipients has their unique opinion to a particular value, they should hold the same opinion on "the operational Measurement of the value contribution" (OMG, 2015). A business item is composed of multiple values, multiple business items could be involved in one exchange process.

The identification of value components which should be added or maintained in the deliverables to improve the competitive advantages is called ValueProposition (OMG, 2015). A ValueProposition enhances the deliverable(s) and shows the measurement of value in terms of customer satisfaction. Since recipients may not specifically define their preferences, the recipient's satisfaction can only be estimated by the relevant ValueProposition.

As illustrated in Figure 8, the VDML covers multiple aspects which allow modeling value exchanges. As consequences, it also includes the contents in the E3value model. An alignment is also made to show the connection between the two models (Table 8):

VDML Concept and graphical representation	e3value Concept
Actor/collaboration	Actor
Business network	Composite actor
Business network	Value Constellation
Deliverable flow	Dependency element
Community	Market segment
Scenario	Scenario
Activity	Value activity
Business network	Value interface
Business item	Value object
Value proposition	Value offering
Port	Value port
Unit of production	Value transaction
Deliverable flow	Value transfer

Table 8: Alignment between VDML and E3value (OMG, 2015)

It can be seen from this integration that VDML covers a broader scope compares to the e3value. For example, the term "actor" in e3 value model only represent an economically independent entity, while VDML refine the scope with the actor: "An individual (indivisible) participant, which might be human (a person) or non-human." and Collaboration: "Collection of participants joined together for

a shared purpose or interest."(OMG, 2015). Besides, the concept of "business network" in VDML is defined as the exchanges of economic value between trading partners in a collaboration. This concept can be matched with multiple aspects in e3value, includes composite actor and value interface. The value constellation belongs to the concept of the composite actor for the purpose of aggregating actors who are cooperating with each other and have common economic interests.
Although VDML seems to be comprehensive, its analysis technique, which is the UML class diagram is still not easy to be understood by business managers. So far, OMG still does not have a official tooling to support the language.

2.5 ArchiMate and value modeling

Introduction

ArchiMate ® is known as one of the most accepted modeling language to construct enterprise architecture, which is endorsed by The Open Group ®. The function of ArchiMate is to provide a graphical representation of enterprise architectures with a time frame, which include the interrelated architectures, the specific viewpoints for selected stakeholders, their motivations and rationale, as well as the transformation and migration plan (The Open Group, 2013).

The ArchiMate language is composed of three main types of elements, which include active structure elements, behavior elements and passive structure elements (Figure 9). The active structure elements define the behavior performing entities, such as business actors, application components, and devices that display actual behavior. The active structural components are interacted with behavioral concepts, which are defined as a series of activity performed by one or more active structure elements. The objects needed to perform the behaviors are cataloged as passive structure elements. These objects can be seen as information or data, in the domain of information-intensive organizations, but also can be used to describe physical items. Meanwhile, the term service defines the functionalities that system(s) exposes to its environment, which is also seen as the external view of a system. As to the behavior elements are belong to the internal view of a system.

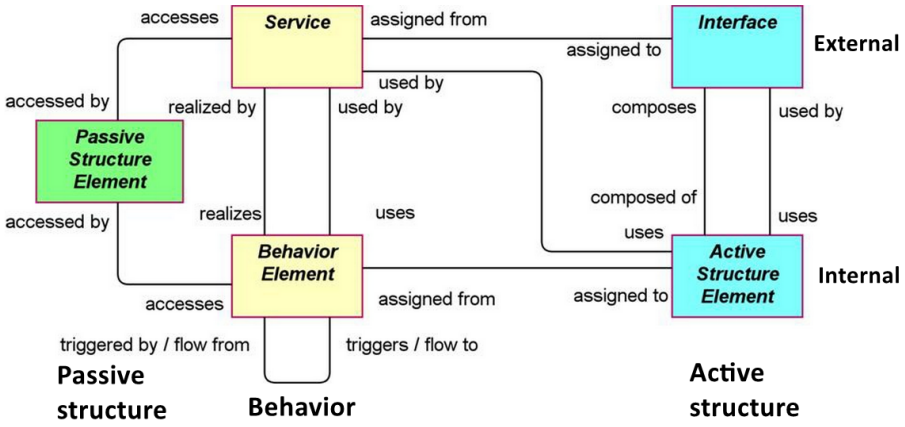


Figure 9: The Core Concepts of ArchiMate

Based on the specializations of the core concepts, the ArchiMate language defines three main layers:

- The Business Layer describes the business processes performed by business actors, which service the purpose of offering goods (products or services) to consumers.
- The Application Layer is composed of application services which support activities in the business layer.
- The Technology Layer is the fundamental basis which offers IT infrastructures needed to run applications, includes the hardwares and system softwares.

The concept of layer divides the structural and behavioral elements based on their specializations

and scope. The layers, together with the three aspects constitute the ArchiMate framework of nine cells (Figure 10). The structure of the framework is capable of modeling a firm from different viewpoints, where the concerns of the stakeholder are highlighted by one or more cell correspondingly.

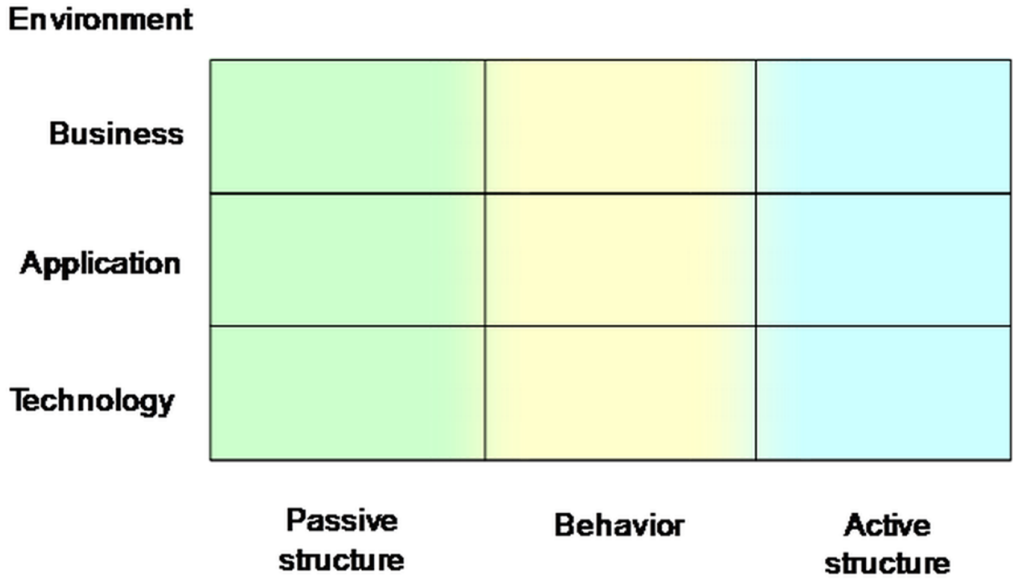


Figure 10: Architectural Framework

The framework represents the way of sorting all the necessary elements in the enterprise, while a set of relationship is also defined to show how elements can interact with each other. The concepts of relationship are partly motivated from UML (association, aggregation, composition and specialization) and from business process modeling languages (triggering). Each of the relationships is weighted to show how strong a particular relationship is as compared to another, It can be read in both directions, which is depended on the side of the relationship is being analyzed.

All of these concepts constitute the ArchiMate 1.0, which focuses on describing the architecture of systems that support the enterprise, while the motivational aspects (the Why column of the Zachman framework) is not mentioned. However, these left out components are clearly defined in ArchiMate 2.0.

ArchiMate 2.1

Compare to version 1.0, the ArchiMate 2.0 presents a more comprehensive approach to model enterprise architecture. It does not merely make corrections, clarifications, and improvements to 1.0, but also introduce two optional extensions: the Motivation extension, the Implementation and Migration extension. The latest version, ArchiMate 2.1 is a maintenance update to ArchiMate 2.0, which retaining the major features and structure.

The main purpose of introducing motivational concepts in ArchiMate is to “support requirements management and to support the Preliminary Phase and Phase A (Architecture Vision) of the TOGAF ADM, which establish the high-level business goals, architecture principles, and initial business requirements” (The Open Group, 2012). The Motivation extension addresses the way the enterprise architecture is aligned to its context by introducing the motivational elements, which include Stakeholder, Driver, Assessment, Goal, Requirement, Constraint, and Principle (Figure 11). Similarly, relationships are defined to link two motivational concepts or one motivational concept and one core element. A detailed introduction of the concepts in the motivation extension is shown below as given by The Open Group:

- **Stakeholder** A stakeholder is defined as the role of an individual, or organization who concerns the outcome of the EA.
- **Driver** A driver is defined as something that creates, motivates, and fuels change in the enterprise.
- **Assessment** An assessment shows the evaluation results of the analysis of drivers.
- **Goal** A goal is defined as an end state that a stakeholder intends to achieve.
- **Requirement** A requirement is defined as a statement of need that must be realized by a system.
- **Constraint** A constraint is defined as a restriction on the way in which a system is realized.
- **Principle** A principle is defined as a normative property of all systems in a given context.

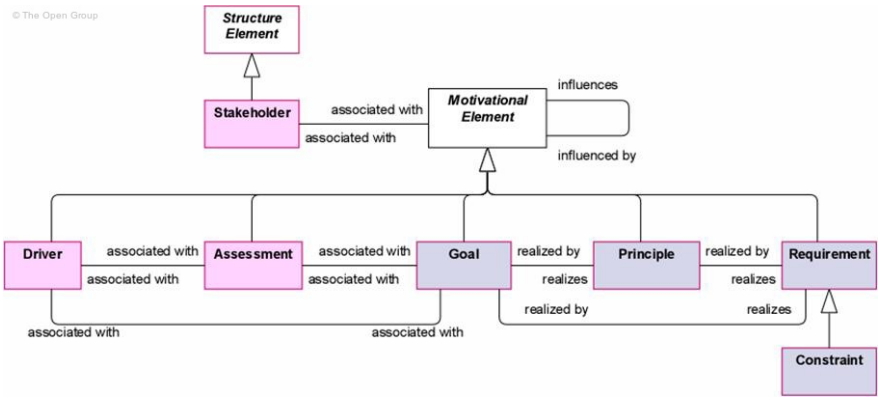


Figure 11: Meta-model of Motivation Extension (OMG, 2012)

The Implementation and Migration extension (Figure 12) of ArchiMate defines the concepts to support from phase E (Opportunities and Solutions) to Phase F (Implementation Governance) in the ADM. This extension includes concepts for modeling implemented programs and projects to support programs, portfolio, and project management, and a plateau concept to support migration planning. The concepts in the Implementation and Migration Extension are Work Package, Deliverable, Plateau and Gap. Each concept can be associated with a core element. The definitions of the concepts in the Implementation and Migration extension are shown below:

- **Work Package** A work package is defined as a series of actions designed to achieve a certain goal in a given period of time.
- **Deliverable** A deliverable is defined as a precisely-defined outcome of a work package.
- **Plateau** A plateau is defined as a relatively stable state of the architecture that exists during a limited period of time.
- **Gap** A gap is used to describe the result of gap analysis between two plateaus.

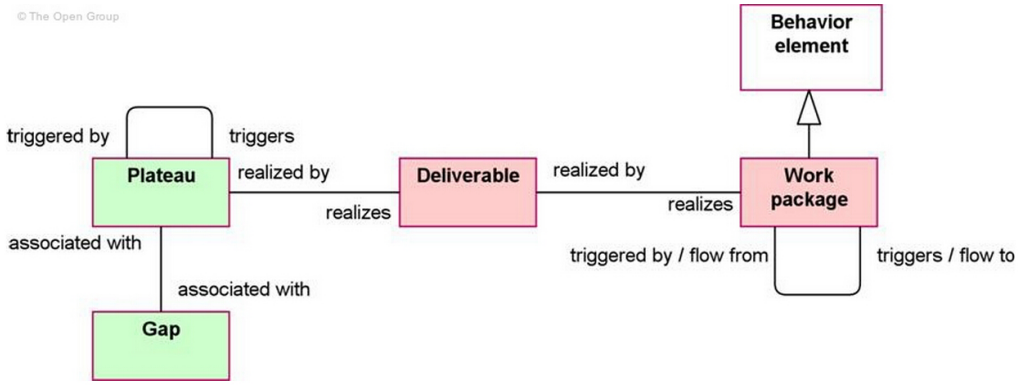


Figure 12: The Implementation and Migration extension

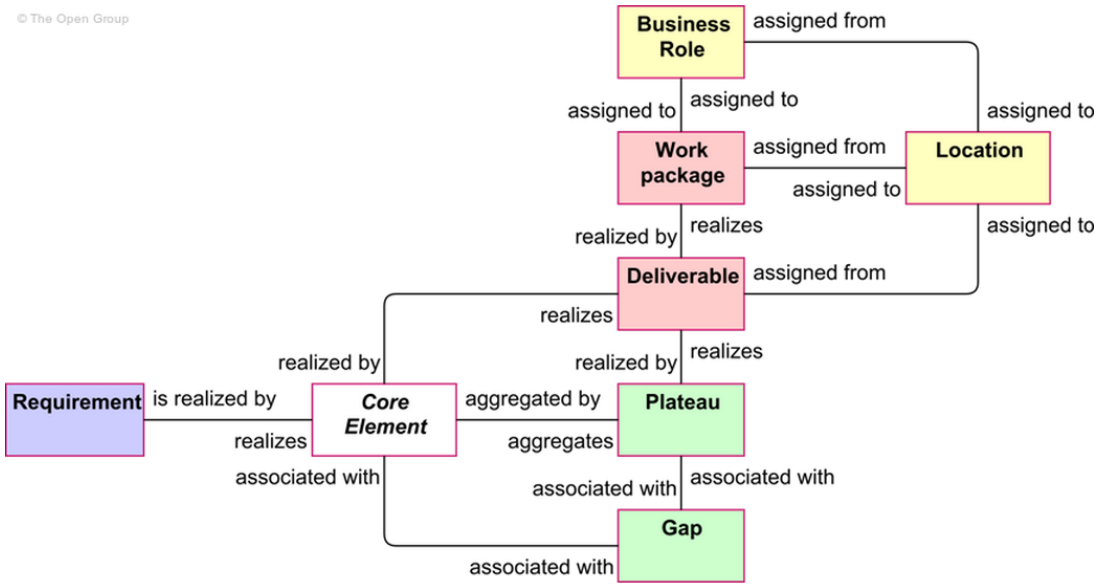


Figure 13: Relationship between concepts

Figure 13 describes the relationship between the motivation extension components, core elements and the concepts addressed in the Implementation and Migration extension. The core element is connected with the concept of deliverable, gap and plateau in the Implementation and Migration extension. Besides, the concept of requirement in the motivation extension is realized by the core elements.

Value in ArchiMate

The value concept in ArchiMate is defined as: "the relative worth, utility, or importance of a business service or product (The Open Group, 2013)". This concept further refers to two types of activities, which are: 1. "What a party gets by selling or making available some product or service"; 2. "What a party gets by buying or obtaining access to it" (The Open Group, 2013). The first type of activity refers to the realization of exchange value. Combining with the definition of value and the theory from Bouwman and Ambrosini (2003), the second kind of activity can be understood as the use value contained in a product or service, which includes 'Inert inputs' and 'Enduring capital' to the firm (Figure 4).

Although both of the use and exchange of value are addressed, these two value types are not clearly distinguished in ArchiMate, it is mainly applied to the delivery of product or service to the external environment. In contrast, there lacks a way of modeling the creation and realization process of value in the exchange activities. This model should include components such as strategies, value, capabilities, resources as well as risks (Iacob et al., 2012a). Besides, value is currently only related to products and services and defined in the business layer, while the value components in the application layer and technology layer is not present. According to Iacob et al., (2012a), every architectural element contains various kinds of value, these values will participate in creating value contained in other architectural components. In other words, value exists in all architectural layers before it is formalized as business value and presented in the business layer.

Some studies have been done to show how ArchiMate is able to address business value in a firm (Fritscher & Pigneur, 2011; Iacob et al., 2014). Fritscher & Pigneur (2011) focus on aligning the value proposition with the IT infrastructure by aligning Business model Ontology with ArchiMate, which is the foundation of transforming the value proposition into business value. As illustrated in Figure 14, the mapping shows that there are no cost/revenue components defined in ArchiMate, most of the elements in BMO are mapped in the business layer in ArchiMate.The only two concepts related to components in the application layer are activity and resource. This alignment proposed a way of prioritizing the assets to support strategic planning, e.g. outsourcing those non-core services,

understand the cost structure of the value proposition. However, their study only shows a general integration of the frameworks, no concrete component and relationship mapping methodology is proposed.

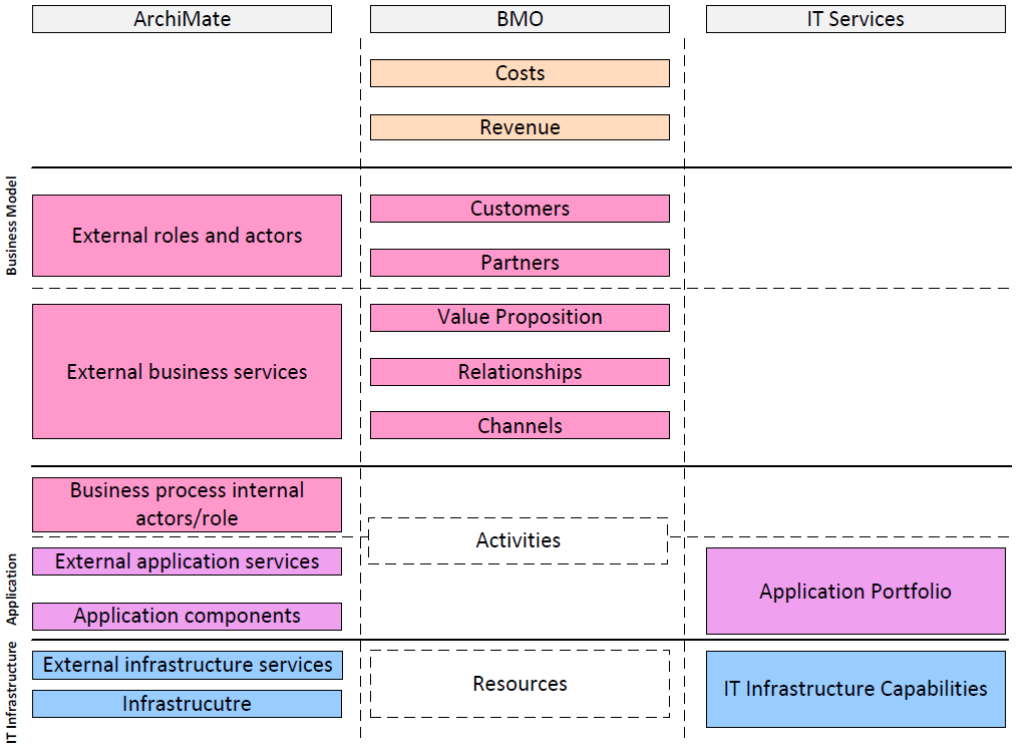


Figure 14: Correspondence between ArchiMate's and models' elements

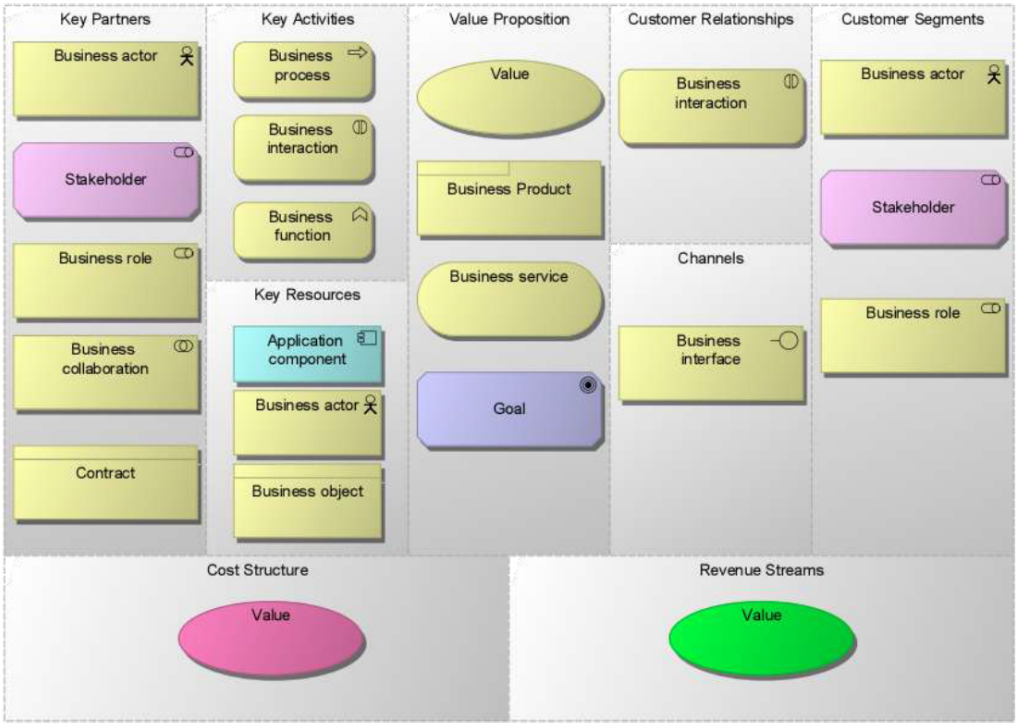


Figure 15: Mapping between BMC and ArchiMate (Iacob et al. 2014)

Similarly, Iacob et al. (2014) aligns the Business model Canvas with ArchiMate to demonstrate and quantify the business value of an architecture (Figure 15). Compare to Fritscher & Pigneur, their study provides an operable cost/benefit analysis method by combining the architecture-based cost

analysis technique with Business Model based cost/revenue analysis. Besides, a method of business model driven architecture migration is proposed based on the model integration established between BMC and ArchiMate. These two studies focus on demonstrating how ArchiMate can model the business value related concepts within a firm, while the value exchange between firms is not addressed. Besides, not all resources used in the value creation can be presented by ArchiMate, e.g. the intangible elements which include knowledge, skills and patents.

Value network and ArchiMate

Nowadays, many enterprises offer an aggregation of services to their end users, which have multiple organizations involved in a dynamic network. Assuming that a broadcasting station wants to provide Internet radio services in order to attract more audiences and gain more profits by selling advertising space. To achieve this goal, the company needs to cooperate with Internet service providers and website designer to deliver the service to these audiences. In this case, the value broadcasting station delivers to clients is realized by a value network. If we model this network in ArchiMate, multiple enterprises should be taken into consideration. In ArchiMate, some concepts are defined to describe the interactions of business roles, which include the business collaboration and business interaction

Business Collaboration: is defined as a collection of two or more business roles within an organization that work together to perform collective behavior. The business collaboration focuses on describing the interactions between business actors. It is composed of a number of business roles and interfaces.
Business Interaction: is defined as a behavior element that describes the behavior of business collaboration. Comparing to a business process/function, a business interaction is performed by multiple roles. It can trigger, or be triggered by other business behavior elements and access business objects.

Similar concepts can also be found in the application layer, which are application collaboration and application interaction. These concepts could contribute when modeling B2B interactions between different organizations (Iacob et al., 2013). However, currently ArchiMate does not define a way of modeling the activities relate to value creation and realization, as well as the relationships a firm deal with its environment, partners or even competitors.

To close this gap, Kinderen et al. (2012, 2014) and Singh (2013) explored methodologies of allowing the ArchiMate modeling value exchange in a network perspective. Kinderen et al. (2012) first make conceptual model mapping between the E3value and ArchiMate. The intension is to show the concept complementation between the two models and limitations of the direct integration. Through the concept mapping, the authors find that some compromises have to be made since the concepts are under different scope. First, the actor/ market segment (which is an aggregation of actors with common value interests) in E-3 value refers to an economically independent entity, by which it means this entity response for profit gaining and losses, while in ArchiMate, the notion of an actor is broader than in the E3value. Instead of illustrating the financial perspective, an Actor in ArchiMate is an organizational entity capable of performing behaviors. Besides, a business actor also includes entities outside the enterprise, by means of the customers and partners. Second, different criteria are given to define the concept of service. In ArchiMate, a service offered by enterprise is to fulfill a business need for a consumer, while the service in E3value is on a higher level of granularity. For future study, two levels of granularity are distinguished: services as a transaction, which involve with elementary transactions such as customer registration, and services as business services, which involve with commercial services delivered to the market The third limitation is the way of defining "value object". In ArchiMate, a business object is a passive element which represents an "informational" or "conceptual" asset; it does not trigger or perform any processes. The E3value considers a value object from the financial perspective, which means it must contain economic value for at least one actor in the network. The different viewpoint on "value object" makes this concept translate into less meaningful. Forth, the conceptual difference between a "value activity" in e3value and that of a "business function" in ArchiMate. Again, an E3value value activity is closely

connected with economic value, while an ArchiMate business function does not. The last difference is that, the illustration of economic reciprocity is the core to E3value, while ArchiMate does not have this concept due to its operational nature.

To solve the difference in the level of abstraction of the information expressed in the two models, Kinderen et al. (2012) uses DEMO (Design and Engineering Methodology for Organization) as an intermediate between E3value and ArchiMate. DEMO is a conceptual modeling a method, focusing on designing/modeling/analyzing the core aspects of an organization (Dietz, 2006). It links E3value and ArchiMate by providing strict guidelines for translating economic transactions into their operationalization (Kinderen et al., 2014). The integration is composed of meta-model mapping and transformations of instantiations. Table 9 lists the result of the mapping.

E3value	DEMO	ArchiMate
Actor/ Market Segment	Subject	Business actor
Value activity	Transaction	Business interaction
Value object	Fact	Business object
-	Act	Business behavior/Business event
-	Actor	Business role

Table 9: Mapping E3value and ArchiMate via DEMO

Compare to the direct mapping approach, using DEMO provides a more precise semantic matching between E3value and ArchiMate. This could be explained by the fact that DEMO is able to explain the social interactions between actors in an enterprise (Kinderen et al., 2014). However, this method still does not provide a useful guideline of modeling value exchange in the network perspective. Partly because that E3value is mainly focusing on just cost and revenue, and the measurement of deliverables is merely based on the cost of production. It makes the alignment with processes and service concepts in ArchiMate very difficult and unclear.

Value modeling capability with ArchiMate

Singh (2013) proposed a way of using ArchiMate concepts to model the value creation by identifying the key activities, key resources and key deliverables participated in the process (Table 10).

Resource	**Activity**	**Value Proposition**
Business Object	Business Interaction	Business Service
Data Object	Application Function	Application Service
Application Component	Business Function	Infrastructure Service
Artifact	Application Service	Business Product
System Software	Infrastructure Service	
Device	Infrastructure Function	
Network	Application Interaction	

Business Collaboration	Business Process	
Role	Business Service	
Application Collaboration		
Communication Path		
Node		

Table 10: Classification of ArchiMate elements (Singh, 2013)

This study does not only identify the elements can be used to define the value proposition and the creation process; it also calculates the weight for each of the elements in a value model. However, when modeling the networked value creation process, the value delivery concept has less clear compared to that in E3value. It could be explained by the reason that the concepts in value perspective are not clearly defined. The value perspective describes the exchanges of value between actors in a network perspective, which includes the offers delivered to others by each actor, and what it receives in return (Kinderen et al., 2014).

UML and ArchiMate

Compare to E3value, the design of ArchiMate takes a more comprehensive approach by analyzing multiple frameworks, languages and standards. Iacob et al., (2012) claim that a complete approach of enterprise architecture should fulfill the requirements listed below:

- A *framework* for the subdivision of an architecture in different domains, sometimes including the relationships between these domains.
- A *language*, defining the concepts for describing an architecture, including a (preferably graphical) representation of these concepts.
- A *process*, or a way of working, which is in most cases a step-wise prescriptive method for developing architectural descriptions.

One of the languages ArchiMate studied is the Unified Modeling Language (UML), several AchiMate concepts in the application and the technology layers are inspired by UML concepts. UML is considered to be an important language in modeling applications and has become a world standard (Eriksson & Penker, 2000; OMG, 2015). Although UML is also claimed to be able to model business process and general business architecture (OMG, 2002), it is not easy to be used by managers and business specialists since there are 13 types of diagram. To explore to what extent UML can be used to model business process and architecture concepts, Wiering et al. (2004) aligns the UML concepts with ArchiMate. The alignment takes the approach of integrating the concepts in ArchiMate meta-model to UML, which includes the structural concepts the behavioral concepts and informative concepts (Table 11).

ArchiMate Meta-model concepts		UML Diagram	Explanation
Structural Elements	Object	Class	Class has the CRUD operations (Create, Read, Update, and Delete) to perform basic operations.
	Actor	Class	An actor is described in the class diagram, it refers to something (person, department, active piece of software) that performs Roles.
	Role	Class	A Role is played by actor and describes the behavior of an actor. Such a Role is part of the collaboration.
	Collaboration	Class and Composite Structure	In the visual form of (UML) collaboration, the collaboration can be drawn when using Collaboration and Role together.
	Interface	Class &	The UML Interface is defined in both class diagrams

		composite structure	and composite structure diagrams.
Behavioral Element	Interaction	Sequence or Interaction Overview	Lifelines correspond to the Roles participating in the Collaboration.
	Process/Function	Activity or Sequence	The mapping is mainly depended on whether the Role is linked with an internal behavior (Activity diagram) or a communicative behavior (Sequence Diagram).
	Event	Interaction in Sequence or Activity	In UML, it refers to a concrete exchange of a message, a trigger, a signal or a (UML) event.
	Service	Interface Operation	A Service refers to functions that is offered or required. An interface is a collection of operation signatures and/or attribute definitions, which defines a set of behaviors.
Informative Element	Purpose	Use Case(s)	It explains the usage of the model within the given scope by introducing its functionality.
	Meaning	Note(s)	Meaning refers to the relevance of structural parts in the model.
	Representation	Note(s) or Class	Similar with Meaning, Representation also expresses the relevance of structural parts in the model's environment.

Table 11: Relating ArchiMate to UML

Although the mapping provides valuable information on the relationship between ArchiMate and UML, this work has been done over decades. The ArchiMate meta-model has been evolving since then, and new concepts (e.g. Value) has been added, which makes the mapping work a bit out of date. However, with the rise of VDML, OMG has a more formal way of modeling value creation concepts.

2.6 Summary of the Literature Review

In the summary section, we first define the meaning of value in general and how it is explained in a business model, which is a widely adopted approach by firms when proposing new business plans. After clarifying the essence of value, we further move to understand what value creation is, and how value is realized during the creating process. The value creation involves multiple actors since the firm needs resources for value creation. The resources include facilities and other items owned by the firm and raw materials (tangible or intangible) from its suppliers. Besides, a firm can play both roles of provider and supplier since the exchange value can become use value for another firm, or the value is realized by the end user through the exchange. The value co-creation with different entities forms the value network.

In order to demonstrate these statements in a more intuitive way, two business models are introduced. The first is Business Model Canvas, which is represented in a graphical chart with elements describing the value creation in a firm. The second is the E3value model, which is a value modeling language with graphical notations. After introducing the two models, we further present the VDML, which is a UML-based value modeling language recently developed by OMG. Based on the literature findings, we divide the value creation into three components:

- The value creation logic, which refers to the rational considerations & propositions of creating such a value, such as solve a problem for the clients or fulfill their needs;
- The value creation process, which refers to the activities, procedures of creating value, as well as the resources consumed;
- The value exchange, which refers to the value co-creation and value exchange activities.

We then compare the three models according to the value creation components in order to identify their focus point and the concepts missing in their model (Table 12).

Model	Value Creation			Graphic notations	Meta-model
	Value creation logic	Value creation process	Value exchange		
Business Model Canvas	Addressing value proposition, infrastructure, customers, and finances factors in a firm	-	-	Graphic chart only	Business model ontology
E3value Model	Addressing the realization of an e-business proposition in a network perspective.	-	The E3value is able to model the tractions between actors based on the value activities.	Graphical notations with scenario notations	UML-based e3value ontology
VDML	Value added and value proposition class diagram	Activity network class diagram	Collaborations and participants class diagram, Business Network	Graphical notations	VDML ontology & class diagram

Table 12: Model Comparison

The comparison shows that neither the BMC nor the E3Value is able to address all the value related concepts, only the VDML uses class diagrams to describe all of them. Previous mapping works also indicate the pros and cons of aligning ArchiMate with other models. In this thesis, we try to bring in the concepts from VDML to extend the value concepts in ArchiMate, for each value related concept, we will compare previous mapping work with VDML to find the most suitable replenishments for ArchiMate. The alignment aggregates multiple viewpoints from these models, which include value creation, value exchange, value networks and capability analysis.

CHAPTER III: Develop value model in ArchiMate

This chapter focuses on the design and development phase in DSRM. Through the D&D process, a value model framework will be proposed and the research questions will be answered. The structure of this chapter is organized as follows:
Section 3.1 summarizes the concept of value and the core elements which is used to represent the value creation at the enterprise level. This section can be used to answer sub question 1.
Section 3.2 introduces the methodology of how the value concepts in VDML can be transformed into ArchiMate. By doing this we can illustrate the missing value elements in ArchiMate. As mentioned in Chapter 2, new viewpoints could be built to cover the gap.

3.1 Refine the Concept of Value

Based on the literature findings, value is connected with a series of resources or activities (Porter, 1985; Lietaer, 2001; Bouwman and Ambrosini, 2003; Laffey & Gandy 2009). For commercial enterprises, they will continually look for ways to optimize the exchange value in order to gain more profits. However, such optimization cannot be easily observed or measured since it covers not only the economic side, but also during the value creation process in the firm. When proposing such a new product or service, managers first need to define their value proposition, since it composes of estimated benefits in the form of profits, market share, reputation, customer satisfaction, etc. After that, a value network should be constructed to illustrate how value is exchanged, including trading partners and target clients. To summarize these elements, we further catalog them into different folders, which are value creation logic, value creation process and value exchange. The value creation logic refers to the propositions made by firms in order to fulfill the needs or solve problems of the customers. The value creation describes the processes that turn the inbound resources to valuable deliveries, based on the facilities and manpower offered by the enterprise. The value exchange is the final step, where enterprise trades the valuable deliveries to customers or other enterprises and get monetary return or commodities (tangible/intangible) with equivalent value. These three components describe the essence of value, which has been defined as the value-in-use and value-in-exchange.

In ArchiMate, value is defined as “the relative worth, utility, or importance of a business service or product” (The Open Group, 2013). This definition emphasizes the relationship between value and business service or product, which, the latter two elements contain the exchange value of an enterprise. Meanwhile, OMG (2015) defines the value concept in VDML as: “a measurable benefit delivered to a recipient in association with a business item/deliverable.” According to Bouwman and Ambrosini (2003), the activities regarding the value and value creation concepts in an enterprise are divided into two folders, including activities that capture exchange value and activities capture use value. Both definitions of value given by ArchiMate and VDML emphasis the exchange value contained in a product while overlooked what the use value means to an enterprise.

From above statements, we then answer the sub question 1 (What is the meaning of value to an enterprise) by refining the definition of value as:

Value refers to the extent that the utility of a service or product fulfills the requirements of the customer.

3.2 Build a Value modelling Framework

To address the full picture of value, a methodology should be proposed to allow value modeling. Gordijn & Akkermans (2003) defines a value model illustrates the exchange of economic valuable

things between actors. This definition is given under the scope of capturing and evaluating the potential profitability of an innovative e-commerce idea. When we define the value model at the enterprise level, it only captures partial value. Instead, ***a value model is an architect, which represents how customer value can be fulfilled and realized through a series of activities.*** In this case, a more comprehensive framework should be proposed to support model such a picture.

The e3alignment framework is discussed that can be used as reference to describe the value creation process in the network perspective (Pijpers et al., 2009). It focuses on demonstrating the inside&outside interactions of an organization from four perspectives, including business strategy, value creation, process and IT/IS infrastructure (Table 6). According to Iacob et al. (2012a), the business strategy refers to the future strategic goals, which is supported by resources, competencies and capabilities. It seems that the business strategy has little to do with the value contents, but Osterwalder (2004) claims that the company strategy can be translated into a business model in terms of value propositions, customer relations and value networks. In this thesis, we also argue that the business strategy should be considered as an important fact of value creation since it addresses the resources and capabilities to achieve business goals. This argument is also in line with the alignment made by Iacob et al. (2014) between BMC and ArchiMate, where the value proposition in the BMC is mapped with business goal, product and business service in ArchiMate. Based on these arguments, we then propose the framework of modeling value creation in an enterprise (Figure 16).

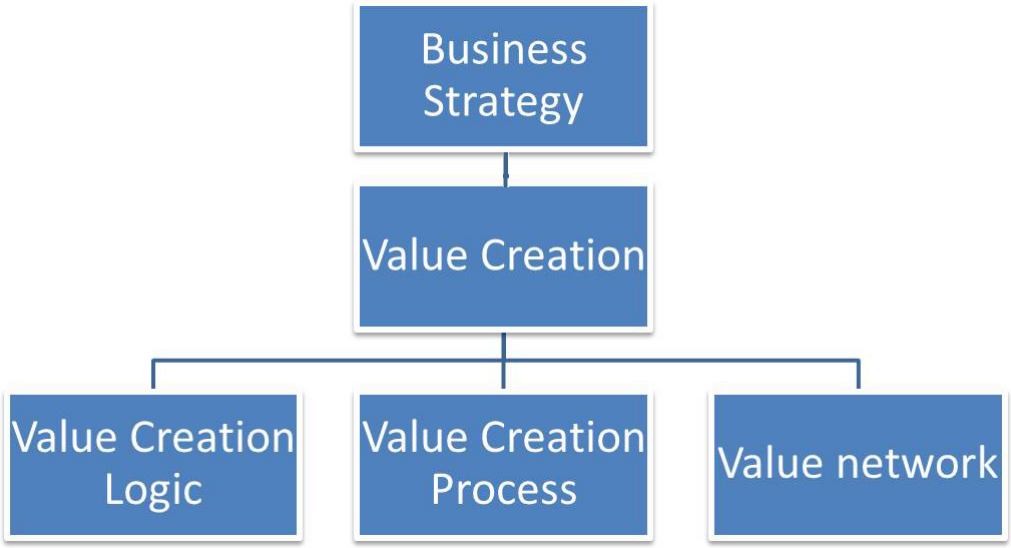


Figure 16: Value modelling Framework

Singh (2013) uses the components in ArchiMate to model the value creation, which integrates the concepts from E3value to enable the value exchange modeling supported by resources and functions/processes. It is considered to be valuable as the fundamental of extending the concepts in ArchiMate. In this thesis, we argue that the value creation should also take the business strategy into consideration, and should be formalized as a value creation viewpoint. The reason for proposing a viewpoint is that, there stands a possibility that some semantic definitions in ArchiMate may need to be redefined in order to clearly address the concepts in value creation, e.g. value. With such a viewpoint, it is possible to specify some concepts in line with value creation. Previous works focus on aligning the concepts of BMC and E3value into ArchiMate, however, the semantic differences make some concepts hardly comparable. In this case, we try to bring in the concepts from VDML to ArchiMate. Differ from these two models, VDML has a closer relation with ArchiMate:

1. Some of the ArchiMate concepts are inspired by UML, which also plays an important role in constructing VDML.

2. ArchiMate uses architecture viewpoints to emphasize one particular aspect of the architecture, which are determined by the concerns of one stakeholder. Similarly, VDML considers multiple viewpoints during the design phase to design an enterprise at different abstraction levels (Figure 8).

3. The Value Deliver Model is decomposed into several aspects, including value proposition, collaboration, activity, capability, etc. Each of the aspect has its own class diagram to illustrate its components and relationships among each other. When mapping ArchiMate into VDML, it provides us with an ideal way to create a value modeling meta-model with ArchiMate.

4. Similar to the TOGAF Architecture Development Method (ADM), VDML also has a as-is to to-be methodology.

Integration methodology

Based on the Value Creation Framework, we then propose the integration methodology. Due to the fact that currently VDML does not have an official tooling support, and the aim of the research is the extension of ArchiMate, so the integration will be only from VDML to ArchiMate. The integration method includes the mapping of meta models and graphical notations (Figure 17).

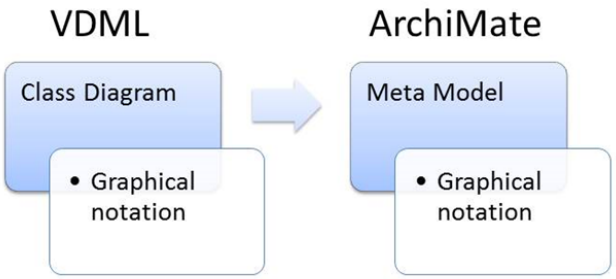


Figure 17: Integration Methodology

Integration Rules:

1. Although there are similarities between ArchiMate and VDML, the latter doesn't model the entire model by itself. In VDML, MeasuredCharacteristics are defined which is imported to another measurement model called Structured Metrics Meta-model (SMM). In the SMM, a measure refers to a methodology to assess the attribute of an element by assigning a comparable quantification or qualification standard (OMG, 2015a). Since the measurement concepts are beyond the scope of this research, all the related diagrams will be removed from the meta-model.
2. In VDML, not all the classes defined in each diagram represented by a graphical notation, instead, they are defined with attributes and operations. It makes difficult for capturing all the concepts in VDML. In this case, we use the notations in ArchiMate to represent these concepts and inherit the relationships with others.
3. For the extension of ArchiMate, try to align the elements from VDML to the concepts which have been defined in ArchiMate instead of proposing new concepts. A semantic extension of the ArchiMate concepts is allowed, but should be given a valid scope.
4. In case there is no concept matching, find new concepts recently defined in literatures, e.g. Resource is defined as: "an asset owned or controlled by an individual or organization" (Azevedo, et al., 2013).

Model strategy with ArchiMate

Aldea et al. (2015) proposes a way of modeling strategy with ArchiMate by introducing several new concepts in the motivation extension. The strategic planning process is composed of strategic analysis, formulation and implementation (Figure 18), each of which has its focus area. The strategic analysis includes the analysis of the environment and the visioning process in terms of the strengths, weaknesses, opportunities and threats to the company. The formulation of strategy considers how the company can take the advantages while eliminate the drawbacks. The last step in this model is to translate the strategies into specific outcomes that need to be achieved, such as performance measures, to make it implementable in a company. Among these three aspects, the analysis and formulation part draws closer with value modeling since it is involved with how a strategy can be proposed. The environmental analysis of an organization refers to gathering information from both external and internal for the purpose of determining which factors have impacts to the organization, while the visioning process focuses on exploring the vision of a mission by clarifying values (Collins & Porras, 1998). The mission refers to the routinely activities that organizations are doing or intending to do on a daily basis, and the vision is a high level-goal which shows the future of an organization. Both of them can be used to describe what the stakeholders want to achieve and what they are going to do. Figure 19 represents the meta-model of modeling strategy with ArchiMate. It can be seen that, the concepts of mission, vision, and strategy are associated with each other and can be modeled with the goal concept. In ArchiMate, the goal represents an intended result that a stakeholder wants to achieve, and from Aldea's work, it contains all the components relate to the strategy. In ArchiMate, the concept of requirement refers to a demand that should be fulfilled by a system, which realizes the business goal. The word "system" here is defined as a set of functionally related elements, including those active/passive structural elements and behavioral elements, such as business object, business actor or data object. In this case, we propose that the stakeholder and business goal concept formalizes the business strategy part in the value creation framework (Figure 20).

Objective. Since the objective is a statement of specific outcomes that are to be achieved, this is considered to be in line with the definition of the Goal concept of ArchiMate.

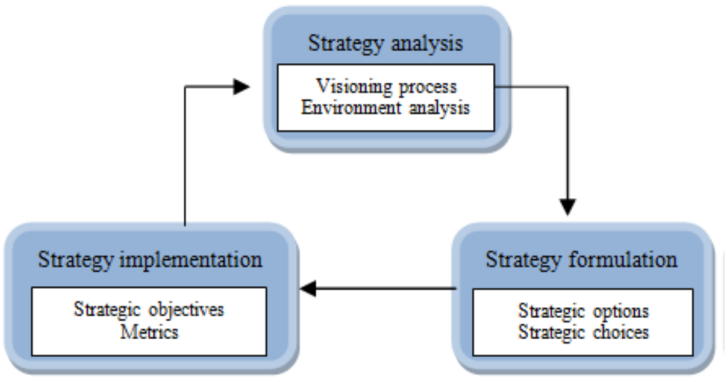


Figure 18: Strategic planning process (Aldea et al., 2015)

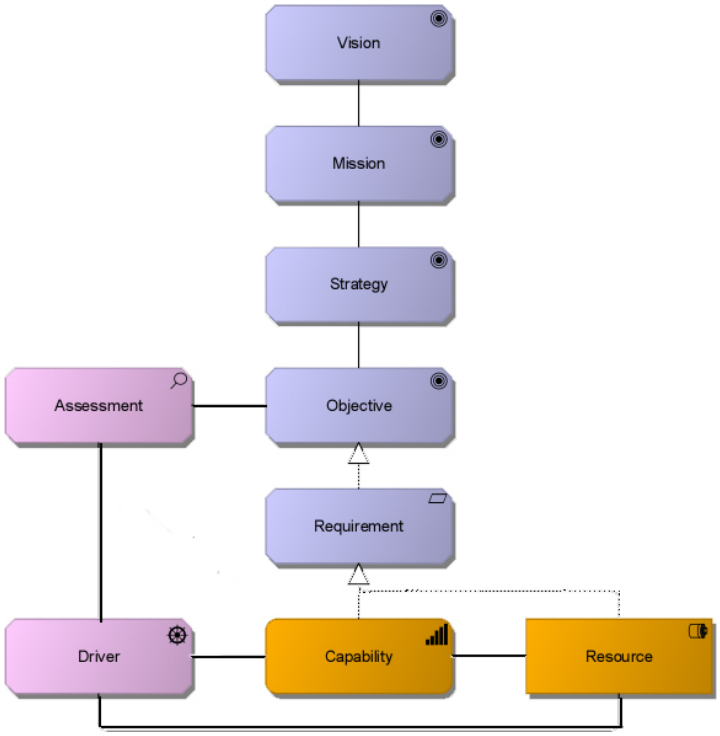


Figure 19: Modelling strategy with ArchiMate (Aldea et al., 2015)

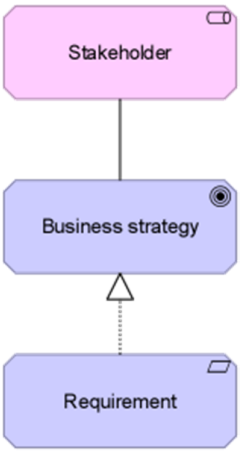


Figure 20: Model Business Strategy

ValueProposition class diagram mapping

Vargo and Lusch (2004) argue that, although the companies trade products with their partners or sell to customers, the real value is not intrinsic to the deliverables themselves. Instead, they mainly depend on how the use-value is evaluated by the customers. In this case, what firms have made are value propositions.

The fundamental driver of VDML is to analyze the creation and exchange of value. Figure 21 shows the valueProposition meta-model in VDML. The concepts relate to value proposition is defined in this model, which includes ValueProposition, ValuePropositionComponent, ValueAdd and ValueDefinition. In VDML, the value proposition is defined as a measurable element in term of customer satisfaction.

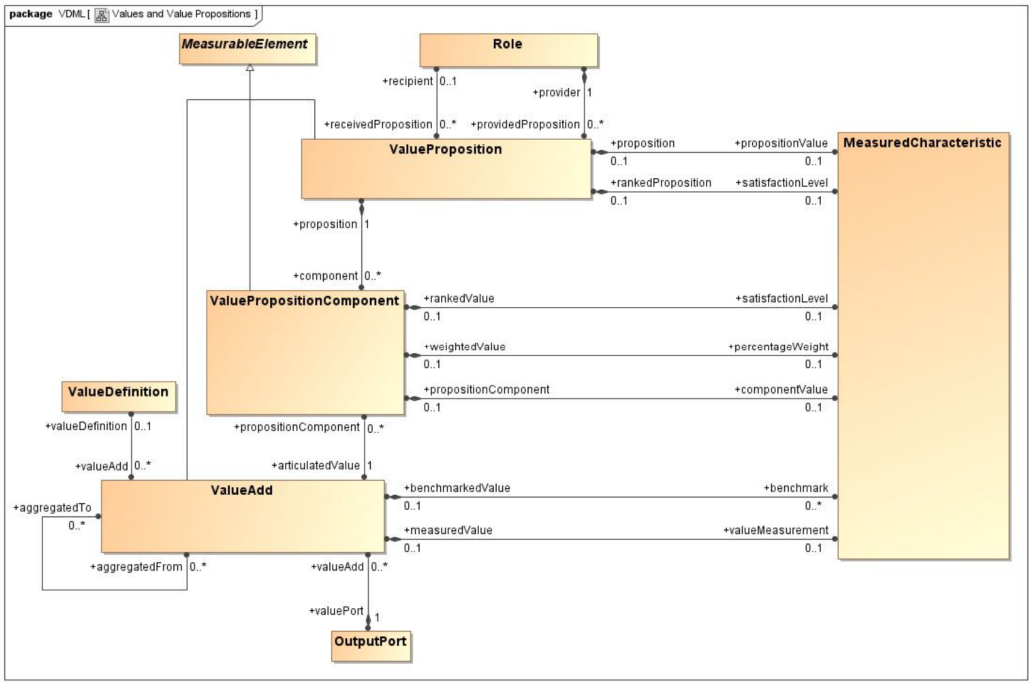


Figure 21: Values and ValueProposition diagram (OMG, 2015)

Role → Business Actor/stakeholder A Role in VDML is an expected behavior pattern participated in a collaboration. Two concepts from ArchiMate match with this concept. First, the business actor in the business layer is an organizational entity which is able to perform behaviors. Second, the stakeholder in the motivation extension is defined as the role of an individual, team, or organization that represents their opinion of the outcome of the architecture.

ValueProposition → Product In VDML, the associated value offered to a recipient in a Valueproposition is expressed by the satisfaction level of the recipient. It articulates value, which is defined as "a measurable benefit delivered to a recipient in association with a business item" (OMG, 2015). A value proposition identifies valuable deliveries, which are interesting to the recipient. In ArchiMate, the most suitable concept to map with can be the concept of Product in business layer. The Product refers to "a coherent collection of services, accompanied by a contract/set of agreements, which is offered as a whole to (internal or external) customers" (The Open Group, 2013). To a customer, a product/service has use value, which is a combination of multiple functions or services provided by the enterprise. To an enterprise, the functions or services contained in the product are based on the proposition made according to the needs of customers. In other words, it has exchange value to the enterprise. In the current business layer meta-model, the product is associated with value, which could also be seen as product articulates values. Figure 22 shows an example of value proposition: An anti-virus software company wants to design more professional software for different types of user.

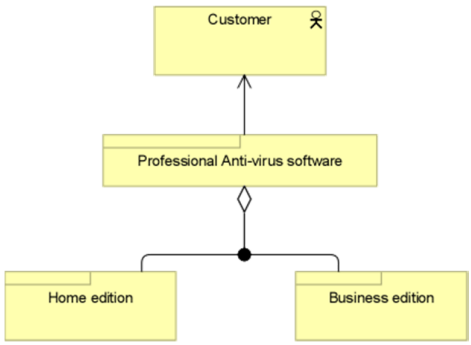


Figure 22: Value Proposition

In VDML, it argues that a business role exchanges with each other with value propositions, which represents a more abstract view in the collaboration. Hereby, the Valueproposition in VDML has been given a broader scope; it can refer to any deliverables, in terms of products, services, contracts or even monetary assets. We will give an example of the value proposition exchange later in this chapter. Figure 23 is a simple example of Valueproposition exchange in VDML, where the manufacturer called Xtrailer offer a value proposition to the transporter, which returns another proposition as an exchange. Note that in VDML, there are only two types of flows to connect different entities (shown in Table 8), which are not comparable to the relationships defined in ArchiMate. Two types of relationship can be addressed here, which are the realization relationship and used by relationship. The realization relationship "links a logical entity with a more concrete entity that realizes it (OMG, 2013)"; where the used-by relationship defines the use of services by activities or entities in the environment. From a high level view, we see the value exchange in a network as the exchange between business actors, where each valuable delivery is realized by an actor and used by its trading partner. Based on the relationship defined above, we then translate the Valueproposition exchange diagram (Figure 23) into ArchiMate, shown in Figure 24. The two relationships clearly represent the exchange directions between actors; hereby we use ArchiMate to represent the relationship between business actor and product (value proposition) as shown in Figure 25.

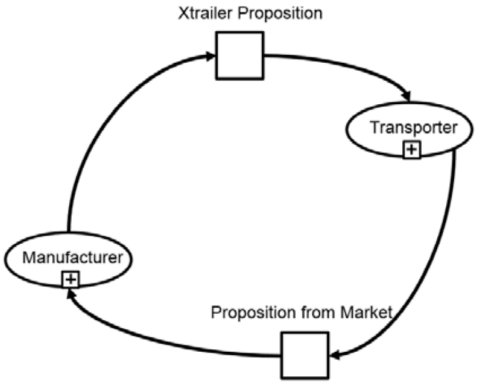


Figure 23: Example of ValueProposition Exchange

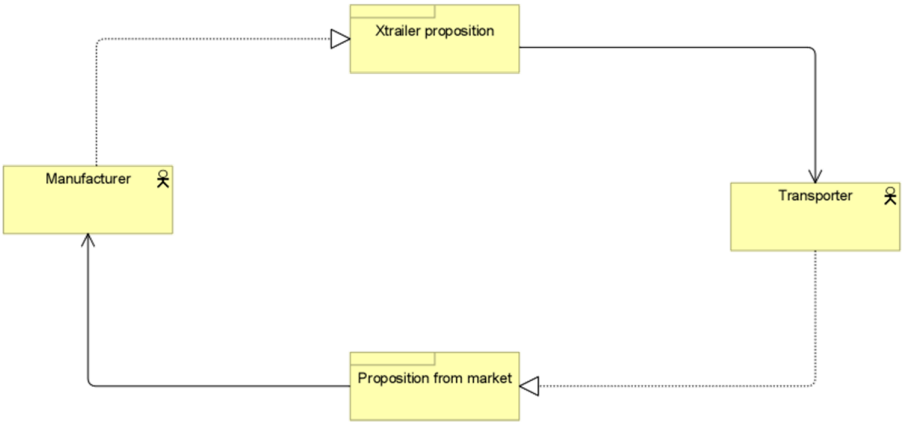


Figure 24: Value Proposition Exchange in ArchiMate

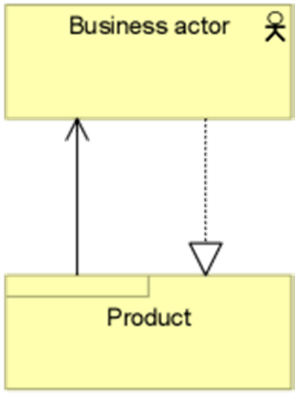


Figure 25: Proposed relationship between business actor and product

ValueProposition component → business service& contract In VDML, a ValueProposition component addresses a particular value included in the ValueProposition. In this case, the ValuePropositionComponent could be mapped with the concepts of business service and contract in ArchiMate. A business service is provided by an organization to meet the business need of a client, and a contract is a formal or an informal agreement which claims the rights and obligations associated with a product (The Open Group, 2013). Both of the concepts are closely connected with the product in ArchiMate. Similarly, the ValueProposition component can be seen as a decomposition of value, which addresses different kinds of value contained in a certain kind of product. Figure 26 shows a decomposition of the value proposition, where each of the proposition components is addressed. In VDML, the ValueProposition is composed of ValueProposition component(s) and uses composition relationship as type of connection. Since we map two concepts as value proposition components, we then use the aggregation relationship to represent the relationship between product (Value Proposition) and business service &contract (ValueProposition component).

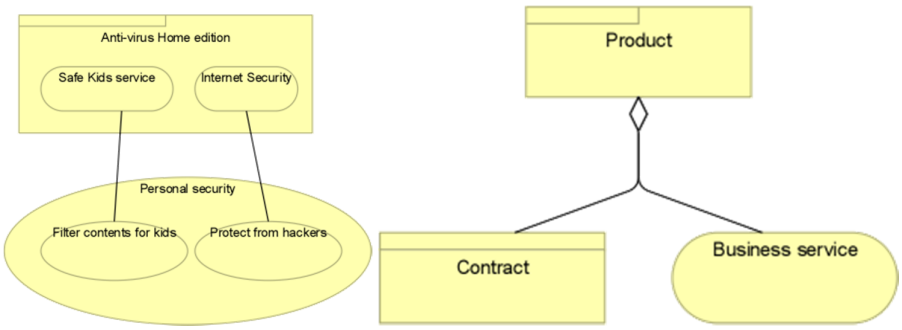


Figure 26: ValueProposition components

ValueAdd → Value A ValueAdd represents the value contribution through activities or collaborations and associate with outputs. One value contribution could be aggregated from other contributions. For example, the ValueAdd in a collaboration could be an aggregation from ValueAdds in a series of Activities contained in that Collaboration. As explained in the definition, this value contribution is realized through processes and activities and associate with a value proposition component. In ArchiMate, the value concept describes the attributions of a business item (product/service) to the clients. It can be applied to the elements a party gets by trading or getting access to it. We then map these two concepts with each other since both of them addresses an output value of an organization through a series of activities. The difference between these two languages is the use of these two concepts. VDML considers a ValueAdd is connected with activities or collaborations, while the value in ArchiMate is only associated with the product. However, VDML uses separate diagrams to illustrate different viewpoints in a value model; we will further explain how these diagrams can be connected later in this section.

ValueDefinition → Meaning For each value adds, a value definition is defined by describing the type of value that the ValueAdd represented for. We map this concept with meaning in ArchiMate, since

it refers to the knowledge or expertise contained in a business object. Figure 27 shows an example of presenting a value definition of a certain type of product.

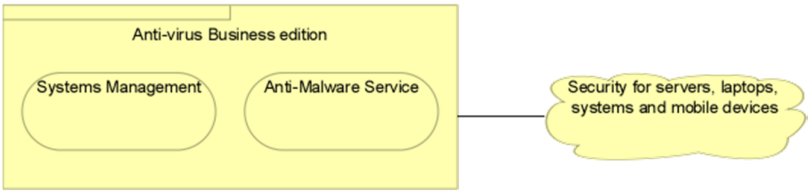


Figure 27: Value definition

Identify the exchange value and use value with ArchiMate

In VDML, the ValueProposition does not only address the deliverable elements, but also monetary assets. This concept does not match the definition of product in ArchiMate. Hereby, we propose a different way of representing the value exchange between actors. There are two ways of illustrating it; the first approach is to use flow relationship to represent the exchange of monetary value (Figure 28). The flow relationship is used to demonstrate the transaction of value between business activities. By using the flow relationship, the exchange of money between actors can be represented. However, due to the reason that each concept in ArchiMate is represented by a graphical notation, this approach cannot show how the value is transferred. In this case, the second solution is to propose a new relationship between business actor and value, which is shown as Figure 29. This approach brings into the flow relationship between business actor and value to show how value proposition is offered and the related value received as a return. With this approach, we can identify the use value and exchange value of a product. The value flow from one business actor to another actor represents the exchange value of a product, while the added value (Figure 26) which associates with value proposition components represent the use value. Due to the reason that currently the second option is not manageable in ArchiMate modeling tools, we keep it as a proposition and will be discussed in the evaluation session. For the rest of this thesis, we use the first approach to demonstrate the exchange of monetary value.

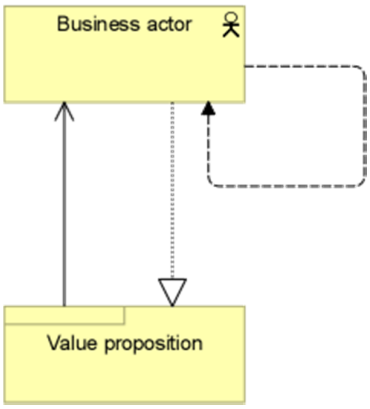


Figure 28: Value exchange with flow relationship

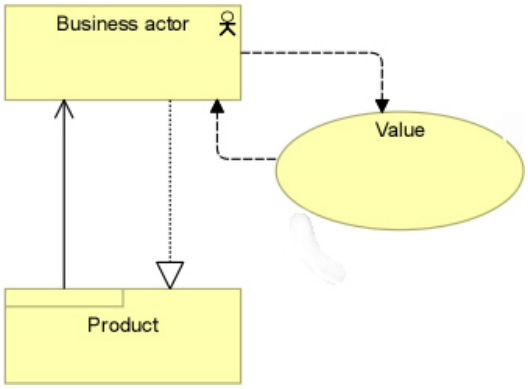


Figure 29: Proposed value exchange meta-model

Construct the value proposition meta-model with ArchiMate

Table 13 shows all the mapped concepts. Based on the mapping, we use concepts from ArchiMate in the diagram and form the Value proposition meta-model, shown as 错误!未找到引用源。. In this meta-model, the value proposition is modeled as a product. A Business actor can be either a proposition provider or a recipient. Each proposition can be seen as an aggregation of different kinds of value, and each kind of value can compose of other values generated through different activities. Each of the value has a corresponding definition to describe it.

VDML	ArchiMate
ValueProposition Name	Product Product
ValueProposition components	Business service & contract Business service Contract
Value Added	Value Value
Role Role Name Role Name	Business Role Business role
Value Definition	Meaning Meaning

Table 13: Summarize of the value proposition mapping

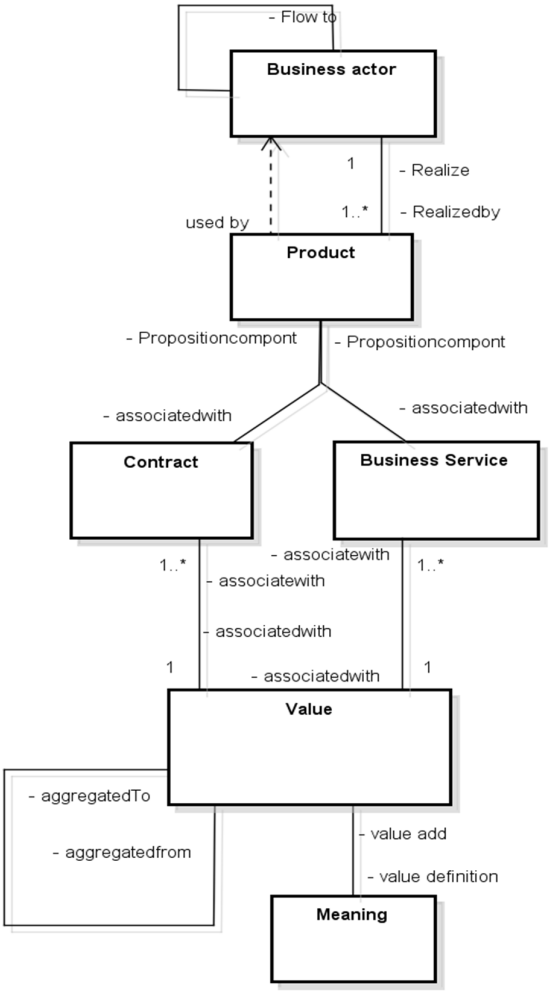


Figure 30: Value Proposition meta-model

Activity class diagram Mapping

An activity class diagram (Figure 31) describes the works performed by actors within the collaboration. Each activity can be done by one or more participants assigned to roles, meanwhile, a role can also perform one or more activities. In this diagram, the capability has connections with the activity. Capability in VDML is defined as the ability to perform a particular kind of work and deliver desired value. VDML uses the CapabilityMethod as a reusable template to represent the capability of participants to perform activities and contribute value in a particular situation. Adlea et al. (2015a) proposes a methodology of capability-based planning (CBP) and investigates how it can be modelled with ArchiMate. In this thesis, we focus on studying the value related concepts and pay less attention to the capability method.

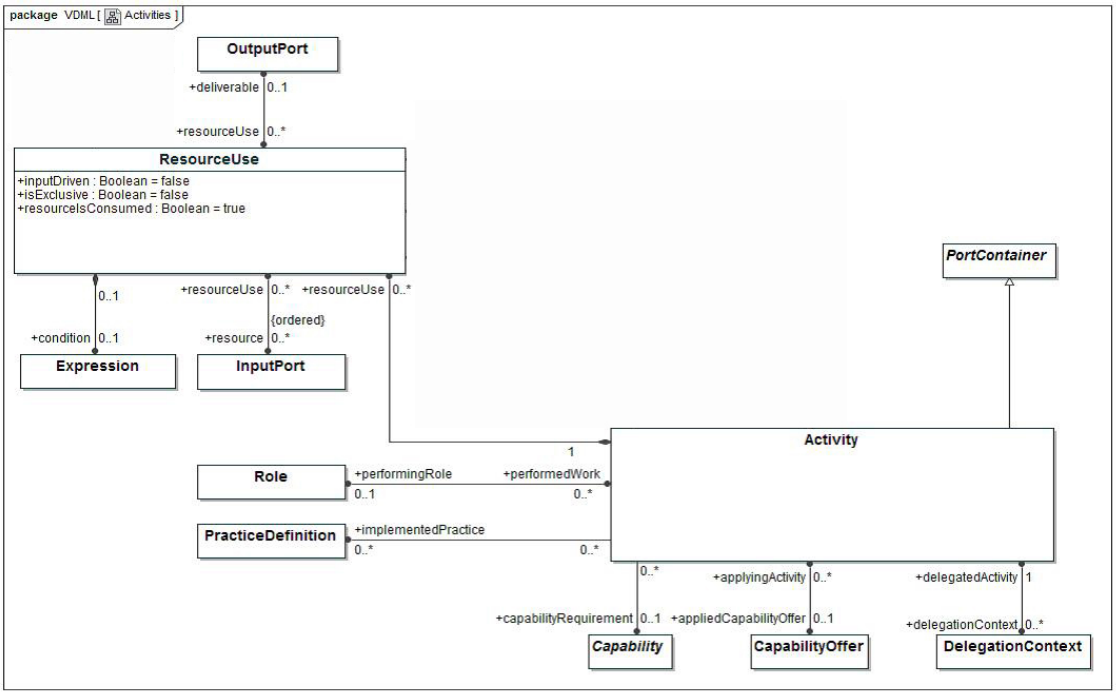


Figure 31: Activity diagram (OMG, 2015)

ResourceUse → Resource. In VDML, a resource is considered anything that is "used" or "consumed" in the production of a deliverable. The ResourceUse specifies the use or consumption of a resource within an Activity, to which the resource serves as input. Based on the definition, the ResourceUse here is composed of one or more resources which will be used by the Activity. This definition is in line with how it is defined in ArchiMate, which refers to assets owned or controlled by an individual or organization. The resource is consumed to achieve the goal requirements. Several concepts defined in ArchiMate which can be considered as a resource (Table 14). Most of these concepts represent the IT related resources, while other types of resource, such as financial resource, facilities, machines are not addressed.

Resource concept	Description
Business Object	A business object refers to a conceptual or informational asset which is relevant from a business point of view. Business objects could be accessed by a business activity or business service.
Business actor	A business actor refers to an organizational entity (humans, departments, and business units) which performs behaviors.
Data Object	A data object is a passive element which can be transferred through interactions and used or produced by application services.
Application Component	An application component may be assigned to one or more application functions, business processes, or business functions through application interfaces.
Artifact	An artifact is a concrete element (e.g. A physical piece of data) in the physical world, which is used or produced in a software development process or deployment.
Network	A network is a physical communication infrastructure used between two or more devices.
Device	A device is a hardware resource which is used to store or deploy artifacts.
System software	System software represents the software environment in which artifacts are deployed and used.

Table 14: Concepts can be used as resources

The concept of resource is initially proposed in the motivation extension. In order to illustrate what kind of resource is consumed in a value proposition, we propose that the concept of resource here can be used in the business layer. Although this proposition may lead to a confusion that some concepts in ArchiMate can also be seen as resources, it could help to reduce the complexity of a value model. When a value proposition is designed within a large value network or a large enterprise, the value model could become very complicated and difficult to identify all the inputs and outputs. In a value model, different kind of resources are addressed to define the inputs and calculate the cost.

In VDML, there are two notations represent the use of resources, Pool and Store. A store is composed of all the resources, which are modeled as a BusinessItem. The concept of Business Item will be introduced later in this chapter. A pool is a specialization of the store, where re-usable resources are aggregated, which means a resource will return to the pool after being used, this kind of resource also include people with certain kind of skills. An example of using resources from VDML is shown in Figure 32, this activity diagram represents the approve process of innovative ideas. Figure 33 shows how it can be presented in ArchiMate.

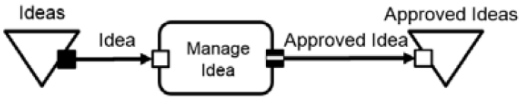


Figure 32: Example of Activity diagram

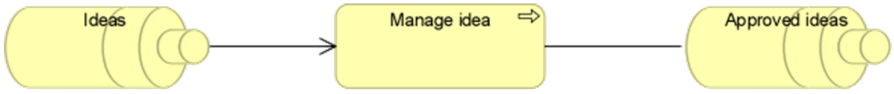


Figure 33: Idea Approvement in ArchiMate

Activity → Business process/Function/Interaction/event. Activities define the work of Participants in a Collaboration. They are linked in networks by DeliverableFlows through which they receive and produce or modify BusinessItems (inputs and outputs). The business process/Function/Interaction concepts defined in ArchiMate are all belong to the behavior elements in business layer. More specifically, a business process defines a sequence of activities which serves the purpose of producing products or services; a business interaction illustrates the business collaboration activities; a business event can be seen as a trigger (from internally or externally) of behaviors and a business function is group of behaviors based on a set of criteria to trigger other behavior elements or realizes business services. These concepts cover the "external" and "internal" behaviors of an organization. The internal behavior includes a process view (business process), a function view (business function) and a combination of them (business interaction). The external behavior is defined as the business event, which refers to something that happens (externally) and may influence business processes, functions, or interactions. Figure 34 shows an example of activities required for the customer to activate their anti-virus software online.

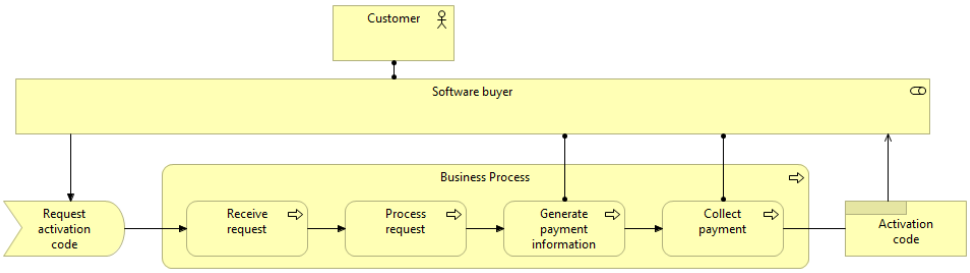


Figure 34: Example of activities

Capability → Capability Capability in VDML is defined as the ability to perform a certain type of work to deliver required value. According to Aldea et al. (2015), the capability in ArchiMate is defined as the ability (of a static structure element, e.g., actor, application component, etc.) to employ resources to achieve some goal. The goal in ArchiMate is associated with driver and both of them

are associated with stakeholder as a motivational element. The capability in ArchiMate has a broader scope than that in VDML since it can represent anything a stakeholder may desire, such as improve efficiency or a produced value, while the capability in VDML only emphasizes the ability of doing something.

CapabilityOffer → Capability. The CapabilityOffer that is applied to perform the work required by the Activity, provided by an organization unit that has the resources, facilities, intellectual capital, etc. It aligns with the concept of Resource in ArchiMate.

We give explanations to distinguish this concept with capability in VDML. When more than one CapabilityOffer methods are available, a selection process is required based on the properties. As mentioned previously, the capability in VDML only addresses the ability of performing tasks, while there is no benchmark to evaluate it. The CapabilityOffer here represents the way of evaluation, which is called capability method. The capability method is a collaboration, which is a reusable activity template for participants to follow and make value contributions. Figure 35 shows an example of a capability method, the square notation represents the required activities. If we map the concepts with ArchiMate, we then get Figure 36. In Figure 36 the initiation is described by a set of processes triggered by the request of the patient, and ended with the acceptation of the patient.

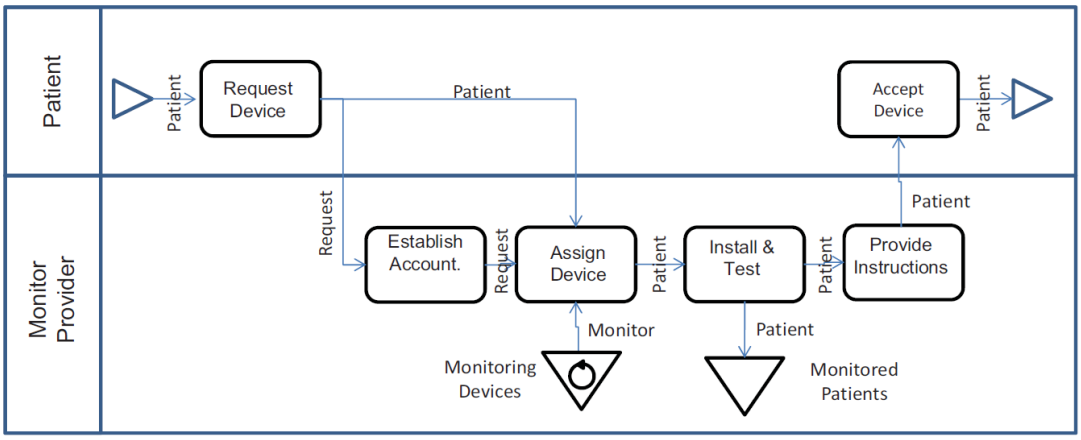


Figure 35: Initiation of Monitoring Capability Method ()

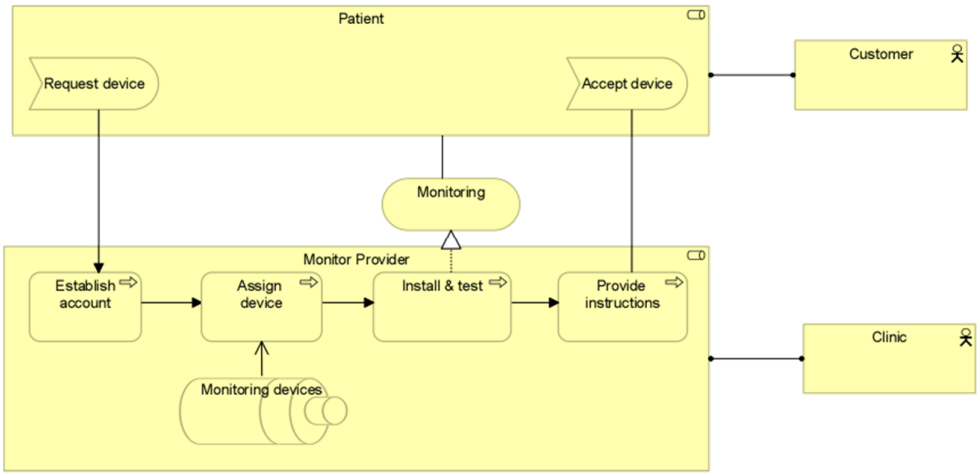


Figure 36: Initiation of Monitoring in ArchiMate

PracticeDefinition → N/A A practice is "a proven way to handle specific types of work which have been successfully adopted by multiple enterprises" (OMG, 2015). A PracticeDefinition is a standardized definition that is applied to enforce consistency in the definition of what practices are implemented by CapabilityMethods and/or Activities.

Expression → N/A The expression specifies the condition under which the resource is used. There has no concept related to this concept in ArchiMate.

Construct the activity meta-model with ArchiMate

Table 15 shows the summary of mapping in the activity diagram, Two new concepts from Aldea's work is used to map with the concepts in VDML. However, due to the relationship differences, we propose that the resource belongs to the business layer instead of motivation layer and we will give further explanation in the relationship mapping. The study of capability method is not included in this thesis since this concept is not considered as part of the value model. Hereby we only make a introduction of how VDML defines the capability method and a semantic comparison with ArchiMate.

VDML	ArchiMate
ResourceUse Store Pool Name Name	**Resource** Resource
Activity Name	**Business process/Function/Interaction/event** Business interaction Business event Business process Business function
Capability/CapabilityOffer Name1	**Capability** Capability
Capability method Name	**Capability** Capability
PracticeDefinition	**N/A**
Role (Activity diagram) Role Name	**Business Role** Business role

Table 15: Summarize of Activity diagram alignment

Based on the mapping, we present an ArchiMate version of activity diagram (Figure 37). In this model, business process, business interaction, business function and business event are all allocated in the same folder since the scope of activity defined in VDML is broader than in ArchiMate.

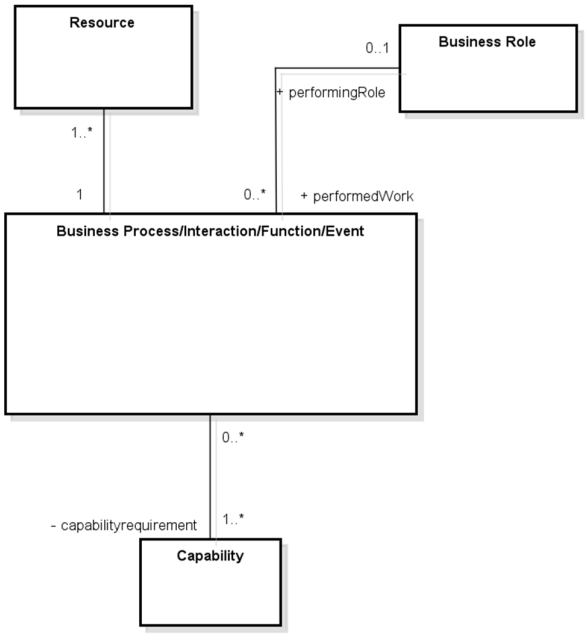


Figure 37: Activity meta-model

Relating ValueAdd with Activities

Through the value proposition and activity diagram, there is no clear connection between these two. However, in the value proposition diagram, the ValueAdd element is defined as "value properties contributed by different activities which participating in the delivery of the product or service" (OMG, 2015). Hereby, we need to go back to the value proposition diagram and discuss the function of ValueAdd. According to VDML, a value proposition may consist of several types of values (Value PropositionComponent), each of the represents a particular value (ValueAdd). A ValueAdd element is related to the output port on the boundary of the activity which the deliverable flows connected (Figure 38), which is created through this activity. The term BusinessItem is defined as "anything that can be acquired or created, that conveys information, obligation or other forms of value" (OMG, 2015). It can refer to different kinds of elements, such as raw-materials, product, orders, emails, contracts, etc. This concept has a very broad scope and is used both as input and output of an activity. We will further explain this concept in the collaboration diagram.

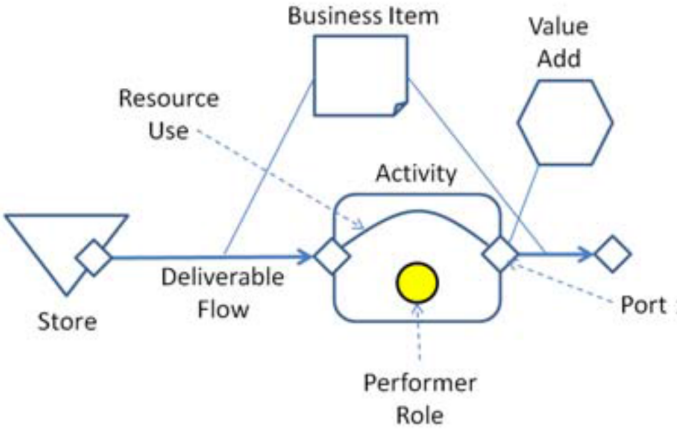


Figure 38: Schematic representation of activity (OMG, 2012)

A value proposition is supported through a series of activities, each of which may deliver a particular part of the value. To address these changes, VDML uses different types of ports to illustrate the changes of business items (e.g. From raw-materials to products), unlike E3Value which uses a single value port to represent all the value exchanges, the ports in VDML are divided by the usage. As

illustrated in VDML, a value contribution can be modeled as Figure 39; each activity addresses one or more ValueAdd, which aggregates or connected with each other, all the ValueAdd elements forms the value proposition. The term ValueAdd has use value where the value proposition has the exchange value delivered to the clients. Define the concept of value added allows enterprise to evaluate the contributions of the activity by making calculations based on the consumed resources. The activity only generates added value when the generated product or service is consumed by clients.

The way VDML modeling the value contributions is similar to the concept of value stream propose by Rother & Shook (2003). A value stream concerns how to design the sequence of activities to produce or provide good or services, together with information, materials and worth flows. It focuses on improving value delivered to customers. Currently, there is a clear connection between activities (business process/function/interaction) and value defined in ArchiMate, in other words, how a use-value can be identified through an activity remains unclear. To close this gap, we propose to use the ***association relationship*** to link activities and value in a sense of representing how activities contribute in delivering value to the product. Figure 40 shows the proposed relationship between business process/function/interaction with value added.

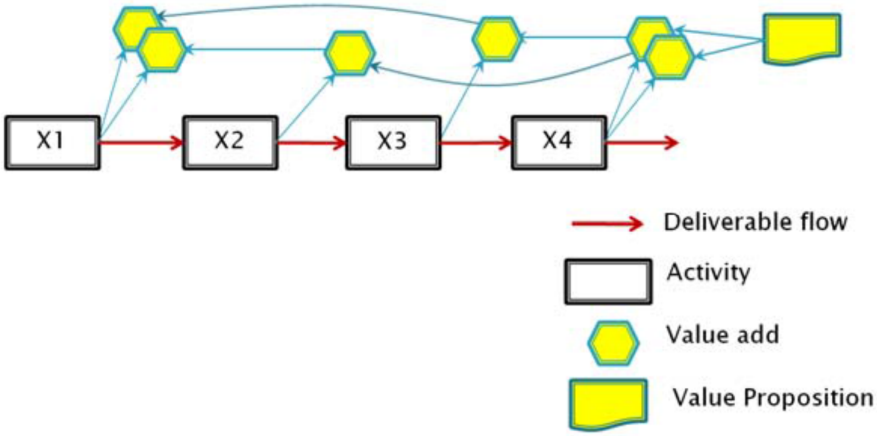


Figure 39: Value contribution (OMG, 2012)

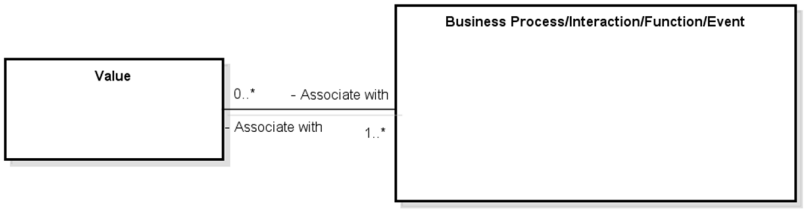


Figure 40: Relating business activities with value

Collaboration class diagram Mapping:

The collaboration diagram describes the basis of organizational concepts. Collaborations bring together Participants in assigned Roles to perform activities for a shared purpose. Participants may be people or organizations or other Roles of people or organizations. A participant can be assigned to more than one role. The collaboration is further divided into four special types, which are Community, BusinessNetwork, OrgUnit and CapabilityMethod. The community is similar to the market segment defined in E3value which refer to members associated with each other based on a common interest. A BusinessNetwork represents the exchanges between (economic independent) parties in the market An OrgUnit describes the structure of the organization. As discussed before, a

CapabilityMethod is a reusable activity template for participants to follow and make value contributions.

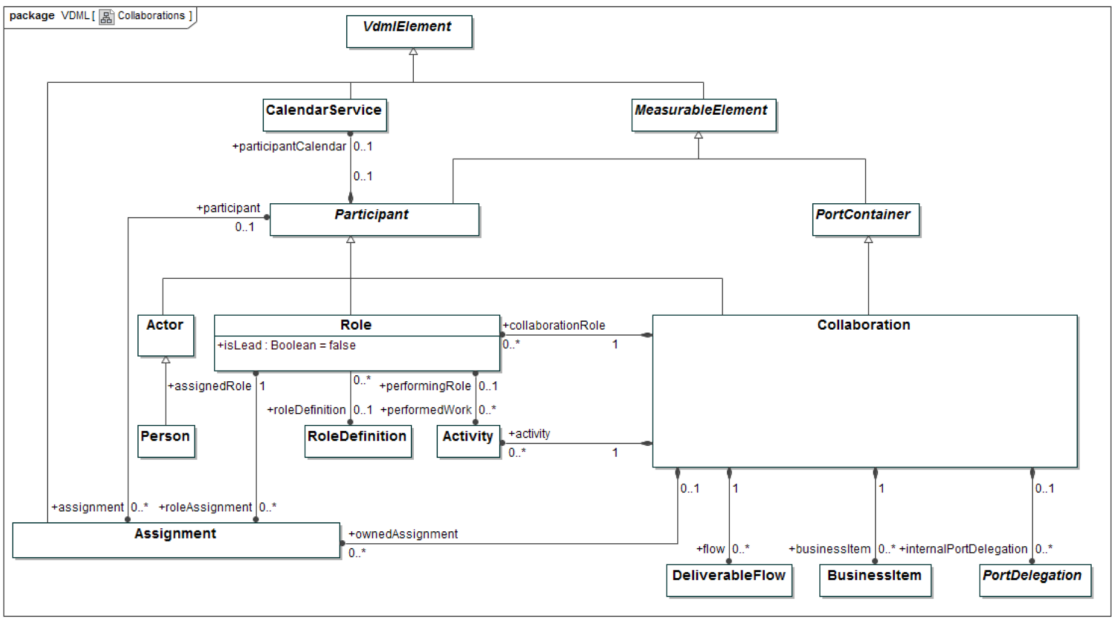


Figure 41: Collaboration Diagram (OMG, 2015)

Collaboration → Business collaboration. The collaboration brings together participants in assigned roles to perform activities for a shared purpose. As shown in Figure 41, the collaboration aggregates most components in the diagram, including activity, participant, role and business items. Similarly, a business collaboration in ArchiMate describes a collection of business roles work together within an organization for a collaborative behavior. However, the business collaboration has no direct connection with processes, but through a business interaction, which is another behavior element used to represent the behavior of a collaboration. Figure 42 shows a business collaboration in ArchiMate, the daily upgrade service is realized with the collaboration through the interaction.

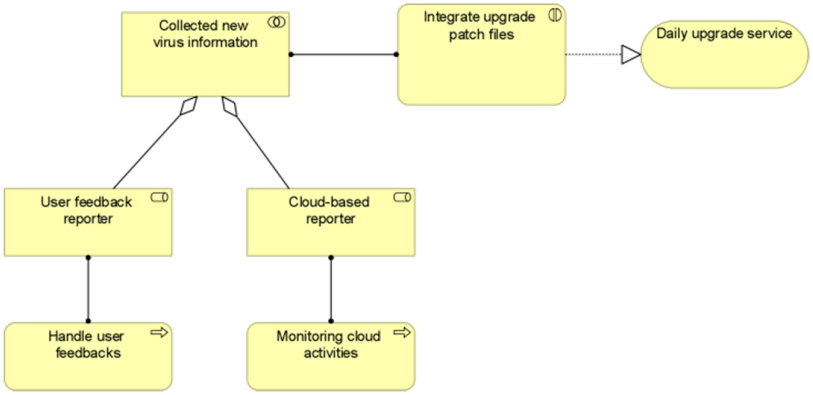


Figure 42: Business collaboration in ArciMate

Participant/Actor (Person) → Business actor. In the collaboration, a participant refers to something (people, system) which plays a particular role. Each of the participants is assigned to a role. An actor is seen as a participant. In ArchiMate, a business actor is defined as an organizational entity that is capable of performing the behavior. A business actor performs the behavior assigned to (one or more) business roles. Figure 43 represents an example of illustrating business actors in a collaboration.

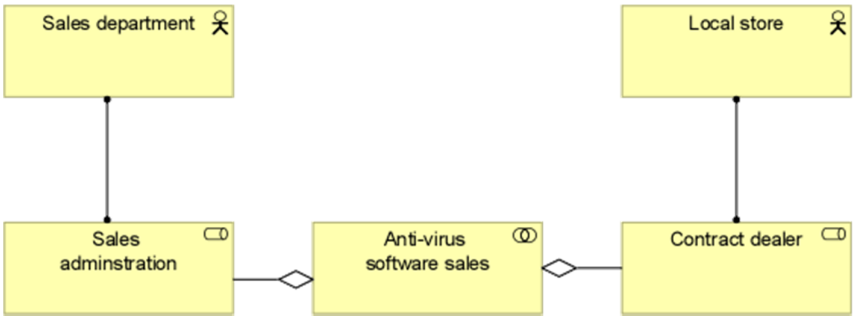


Figure 43: Business Actor in Collaboration

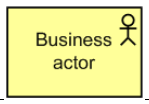
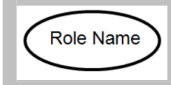
BusinessItem → Resource/Product A business item refers to elements which can be created by a provider and contain expected value to a recipient. It can represent parts, products, units of fluids, orders, emails, notices, contracts, currency, assignments, devices, property and other resources. In other words, the term BusinessItem is used to illustrate the asset exchange within a collaboration, it can be either seen as a resource or a product in ArchiMate.

Assignment → Assignment relationship An Assignment specifies the function or behavior a Role played in the collaboration. There has no related concept defined in ArchiMate, but it has the same function with the assignment relationship. The assignment relationship can be used to assign business roles to business actor, or connects a business role with behaviors (business process/function) performed by it.

CalendarService → N/A A CalendarService can be used to determine resource availability with more precision. This is relevant for simulation. Specification of the calendar structure itself is not in scope of VDML. This concept has no match with any concepts in ArchiMate.

Construct the collaboration meta-model with ArchiMate

Table 16 summarizes the alignment between the collaboration diagram and ArchiMate. The main concepts in the collaboration diagram match the elements defined in ArchiMate. Meanwhile, there exist some differences of modeling the collaboration. In ArchiMate, the business interaction is the active element which can trigger the behavior elements such as business process/function, while VDML presents a direct relation between collaboration and activities. The business interaction has been mapped with activity in VDML, we follow the way of representing business collaboration in ArchiMate. Based on the judgement, we then formalize the meta-model for collaboration using ArchiMate (Figure 44).

VDML	ArchiMate
Collaboration 	**Business collaboration** 
Participant/Actor (Person)	**Business actor** 
Role 	**Business Role** 

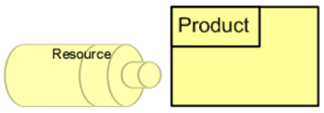
PracticeDefinition	**N/A**
BusinessItem	**Resource** Product 
Assignment	**Assignment relationship**
CalendarService	N/A

Table 16: Summarize of collaboration diagram alignment

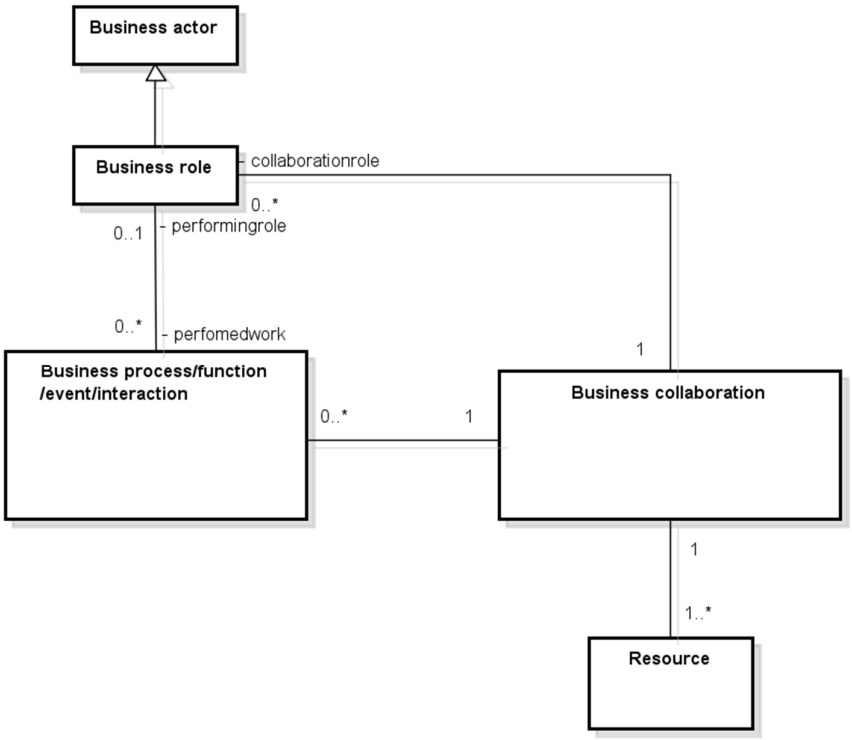


Figure 44: Collaboration meta-model

Relationships and Ports

There are only two types of graphical deliver flows defined in VDML other than the relationships defined in the class diagram, in order to distinguish what the flow represents in different diagrams, the name is given along the alongside of the connector. A deliverable flow is defined as "a transfer of a deliverable from a provider (or producer) to a Recipient (or consumer)" (OMG, 2012). Figure 45 shows the two types of flows, the arrow with solid connector means a deliverable flow with tangible element; while the arrow with a dash line represent the connection with intangible elements.

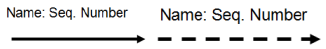


Figure 45: Deliver flow in VDML (OMG, 2015)

So far, ArchiMate has not distinguished the tangible and intangible elements. Unlike the way VDML represents the connection, ArchiMate defines multiple relationships to describe how two elements can be linked, such as realization relationship, association relationship or assignment relationship, etc. Some of the relationships actually are inspired by UML, which are also used in VDML to describe the class diagrams. In this case, it is not possible to associate relationship notations between VDML and ArchiMate, but the relationships used in the class diagram are comparable with those in ArchiMate. Table 17 shows the matching of relationships, although multiple relationships are

defined in UML, only three of them are used in the VDML diagram so far. It also happens to be the case that, all the three corresponding relationships are inspired by UML, which means there has little usage and semantic difference in the alignment.

VDML	ArchiMate	Remark
Generalization	Specialization	The specialization in ArchiMate is inspired by the generalization relationship in UML, with the ability to specialize a wider range of concepts.
Composition	Composition	The composition relationship is inspired by the composition relationship in UML class diagrams. In contrast to the aggregation relationship, an object can be part of only one composition.
Association	Association	Similar with UML, the association relationship is mainly used to model relationships between business objects or data objects that are not modeled by the standard relationships aggregation, composition, or specialization.

Table 17: Relationship matching

The concept of ports has also been defined in e3value model and named as value port. Previous mapping works done by Kinderen et al. (2014) conclude that it is not possible to align the port with any concept in ArchiMate since the scope of port is too broad. Unlike the way e3value model defines value port, VDML divides port by the type of usage. The ports defined in VDML are connected with DeliverableFlows. It can be seen in Figure 46, multiple shapes of ports are mentioned to demonstrate different types of connection. Ports define the connection points for inputs and outputs associate with Collaborations, Activities and Stores. Ports also associate with the input and output of BusinessItems by the related DeliverableFlows. The ports in VDML are mainly classified by its functionality, there are three types of ports:

1. With ValueAdd: Output ports that address the value contributions through activities.
2. With condition and/or planning percentage: Input/output ports relate to assign resources to role(s) within an activity.
3. Provides role resource for role: Input ports indicate the input/output connections under certain condition or preference, e.g. when the inputs to an Activity come from multiple, alternative DeliverableFlows, a ResourceUse could assign these inputs with a percentage allocation based on selection criteria.

Port Shape	Port Container	Shape description	Shape placement	Input or Output	With Value Add	With Condition and/or planning Percentage	Provides role Resource for Role
	Activity, Store	Small open square	On boundary of shape of Port Container	Either	-	-	-
		Small open square, with splitter		Either	-	√	-
		Small open square, with thick boundary		Input	-	-	√
		Small open square, with splitter and thick boundary		Input	-	√	√
		Small filled square		Output	√	-	-
		Small filled square, with splitter		Output	√	√	-
	Collaboration	Bottom-left open pyramid	Free-floating in Activity Network diagram of Collaboration	Either	-	-	-
		Bottom-left filled pyramid		Output	√	-	-

Figure 46: Classification of ports

The classification of ports presents a more detailed way of illustrating their functions and usage, which make it become possible to map or translate the ports in ArchiMate. The ports in VDML are closely related to each other. Referring back to Figure 38, which represent the relationship between activity and ValueAdd. The port with ValueAdd shows how activity contributes to the product or service, which is transformed from another port -- the one on the left side boundary of the activity represent the input of resource. In other words, the ports represent the transformation process of business items as well as the value contribution through activity. In VDML, the ports with ValueAdds are always the output of an activity or collaboration, the other kind of output is businessItem, which refers to all types of element generated by the activity. On the other hand, the input ports involve with the association of BusinessItem to the activity, whether it is directly allocated or based on condition or planning. The input and output ports on the boundary of an activity also connect with each other, associate with a ResourceUse. The ResourceUse quantifies the use of resources from an InputPort in terms of time or quantity.

In ArchiMate, the concept of port has not yet been defined. However, based on the description above, we argue that the ports can be aligned with concepts together with relationships in ArchiMate. To map the concepts, first we need to give a classification of all the ports defined in VDML. As shown in Figure 46, six types of ports are associated with activity, which are divided by the term of usage (with ValueAdd, condition/planning and ResourceUse). We allocate these ports into three folders and give an example of how it can be used (Table 18). Note that, each catalog contains one type of port that has the same functionality but combined with the condition. The condition here refers to the requirement of moving from the current procedure to the next step, such as, a contract only has legal authority after it has been signed by both sides. Catalog the port allows us to have a clear view on how ports are used, as well as the internal transformation between ports within an activity.

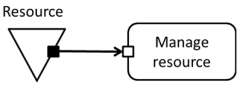
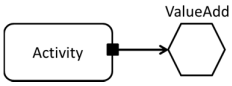
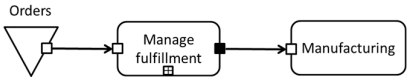
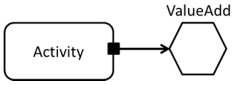
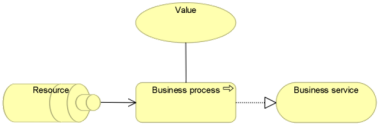
	Ports (Input only)	Ports (Output only)	Ports (Input/Output)
Graphic notation			
Description	Receiving role resource (with condition), on boundary of Activity.	Associate with ValueAdd (and Condition), on boundary of Activity.	Associate with stores or businessItem (with condition), on boundary of Activity
Example			

Table 18: Classifications of ports

Previously, we mapped the concepts which bounded by ports, we now try to match the ports with different relationships in ArchiMate, shown in Table 19. The ports with ValueAdd can relate to the realization relationship in ArchiMate, which illustrates the realization of a logical entity by a behavior element or a data object. The ports assign resources in VDML can refer to the used-by relationship in ArchiMate, which associates with the ResoureUse. A ResourceUse specifies the way resources are consumed in an activity, such as the quantity or time. There has no clear relationship in ArchiMate that can be matched with ports for condition and/planning.

VDML	**ArchiMate**	**Remark**
Ports with ValueAdd 	Association relationship 	In VDML, the ports with ValueAdd defines the association between the value contribution with corresponding BusinessItems that are output. It could be modeled by using the flow relationship between activity (business process/ function/interaction) and value. An association models a relationship between objects that

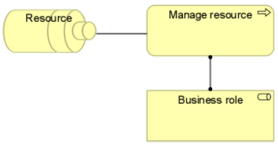
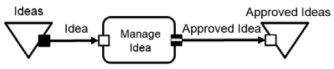
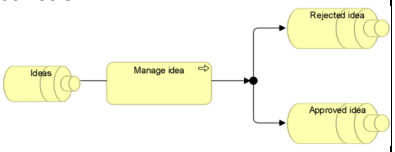
		is not covered by another, more specific relationship.
Provide resources to role	Association relationship 	In VDML, this kind of port is used to allocate resources for a role participate in an activity by connected by a deliver flow as input. An association models a relationship between objects that is not covered by another, more specific relationship.
With condition and/or planning percentage 	Junction 	The condition or planning mentioned in VDML refers to how resources are allocated or how the output is achieved. In ArchiMate, the junction is used to connect a dynamic relationship of the same type.

Table 19: Port matching

The mapping work shown in Table 19 only shows how the concepts can be translated into ArchiMate, while another factor has not been addressed. The port interacted with each other within an activity should also be translated into a sense that how the input can become the output of an activity. We use one of the diagrams (Figure 47) used in Table 19 to show how it can be modeled in ArchiMate. The port transformation can be understood as a series of sub-activities which are triggered by the input and ended at the output port. Under these circumstances, the transformation of ports can be modeled as Figure 48.

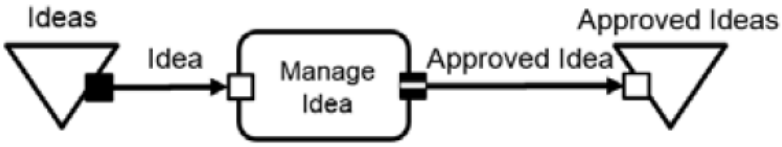


Figure 47: Activity diagram example

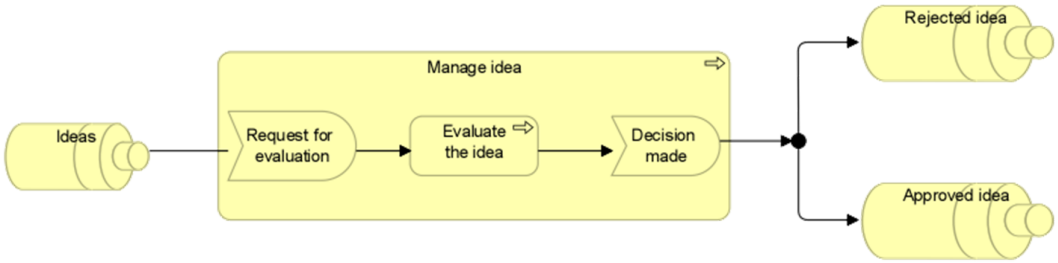


Figure 48: Translate ports into ArchiMate

3.3 The Integration of Meta-models

After aligning the class diagrams in VDML with ArchiMate, we get three inconsistent meta-model fragments based on the value modelling framework (Figure 16), the following step is to integrate these fragments into one model. Through Figure 37 and Figure 44, we can easily find the conjunction point of these two models since both of them have the same concepts of business role and activities modeled. One important remark is that, in the business layer, business collaboration is connected with the business interaction, which is used to illustrate the behavior relate to business collaboration. Hereby, we consider the resource should be associated with activity concepts instead of link with collaboration itself. The conjunction point between value proposition and activity has

been explained in section 3.2. Based on the discussions, we then formalize the proposed meta-model of value model in ArchiMate (Figure 49).

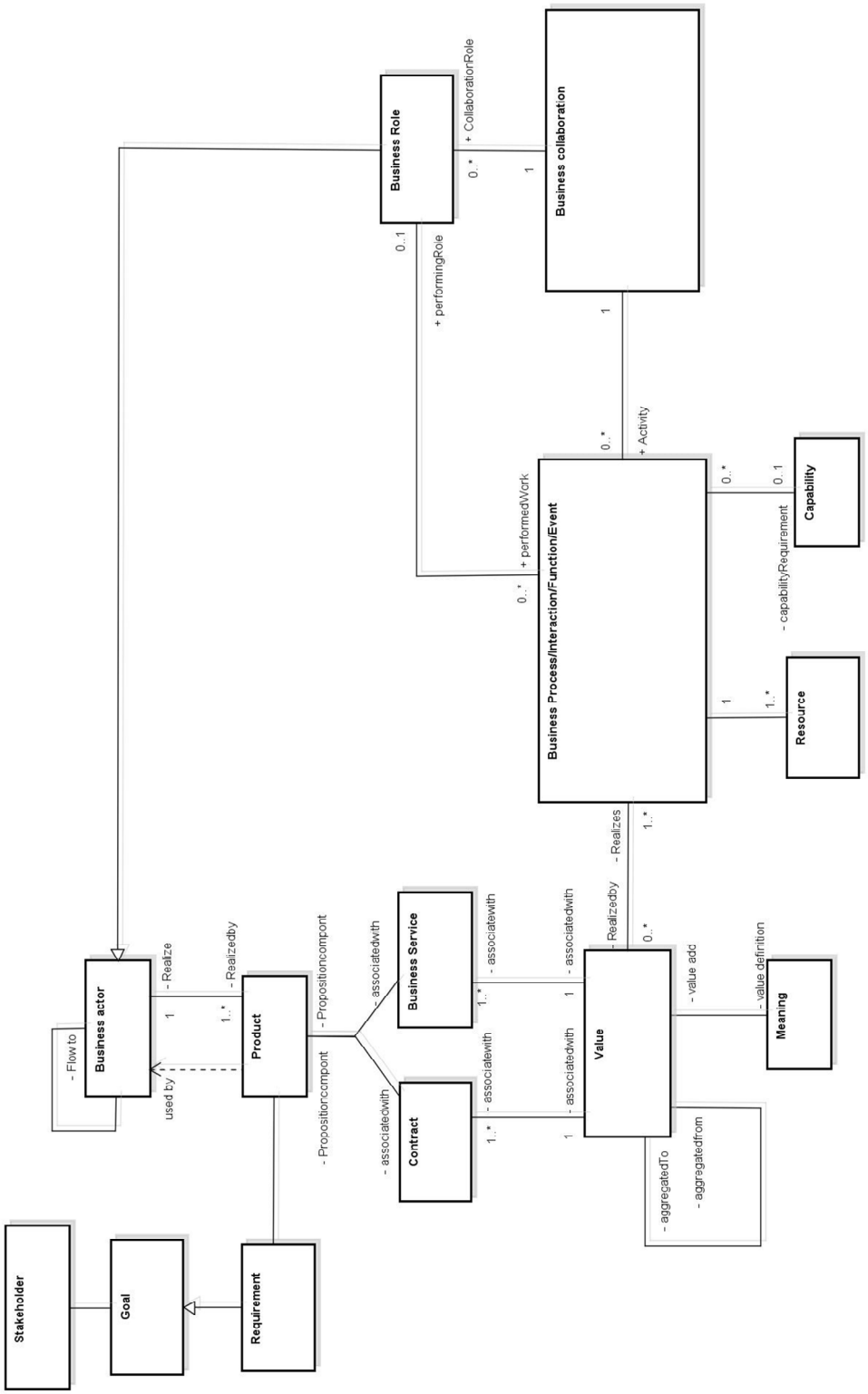


Figure 49: Value Modeling meta model

We then use graphical notations in ArchiMate to redraw this meta-model and show in Figure 50. We call this model as the ***value model.*** This model covers all the aspects we mentioned in the definition of a value model, where the customers' requirements are identified, and the related activities

(collaborations) that create a value proposition are addressed.

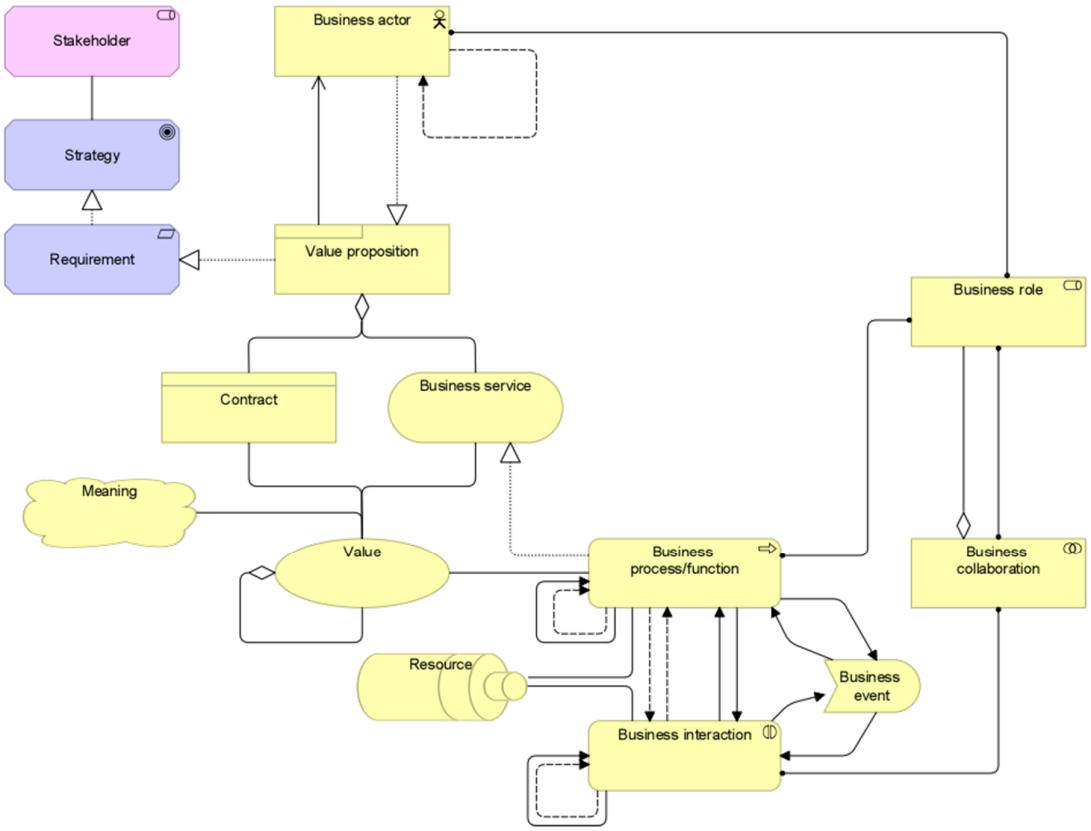


Figure 50: The Value Model

3.4 Apply the Meta-model to a VDML Case

After proposing the meta-model, we intend to apply a case study from VDML to test whether it is able to capture the full picture of a value model. The case we choose is a healthcare use case. The pregnant women need a routine examination by her obstetrician until the time for delivery. For high-risk pregnancies, they need to take more examinations at the doctor's office. Meanwhile, patients are also suggested to minimize their activities for safety reasons. To solve this conflict, the hospital decides to use remote monitoring equipment to continuously monitor the status of the high-risk pregnant woman and her fetus, so that the need for repeated examinations can be reduced. This solution can both improve outcomes and reduce the cost of maternity health care. For better analysis the consequences of monitoring high-risk pregnancies, some assumptions are made:

- Doctor's offices are independent business entities, and the doctors have "privileges" to have their patients fast treated in the hospital under contractual arrangements.
- The procedures for hospital healthcare are associated with a clinical oversight organization unit.
- The hospital provides the whole remote monitoring service, including devices, records and specialists.
- Co-occurring conditions or complications is not considered as the remote monitoring service is provided independently.
- Comparing to the treatment of normal pregnancies, the monitoring service needs minimal changes to established practices and business relationships.

The Hospital management now wants to know the impact of monitoring service delivered to the patient. To perform this analysis, the analyst must constructs models to show the value stream which supports the value proposition. A value stream, according to VDML, is composed of activities,

capabilities, deliverables and values that contribute to the value proposition. Figure 51 shows the value stream of the value proposition. Doctor's office offers the hospital with patients and manpowers, and get privileges service. The patient here pays for the medical services from the doctor and the healthcare service (remote monitoring) from the hospital.

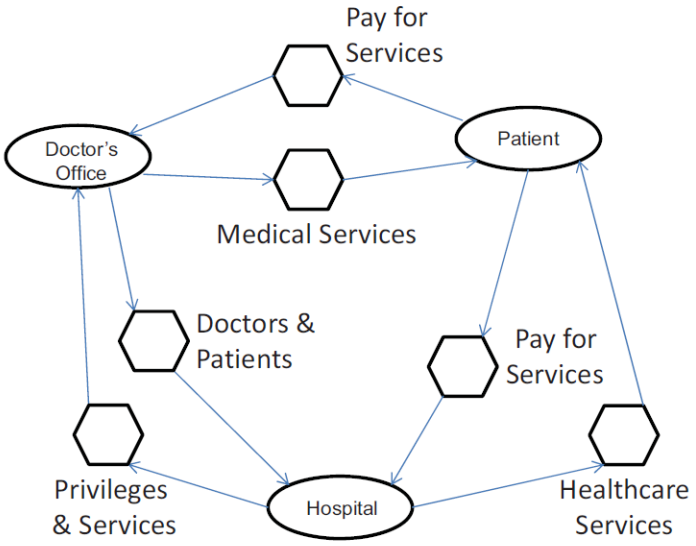


Figure 51: Value Proposition Exchange for the Value Stream (OMG, 2012)

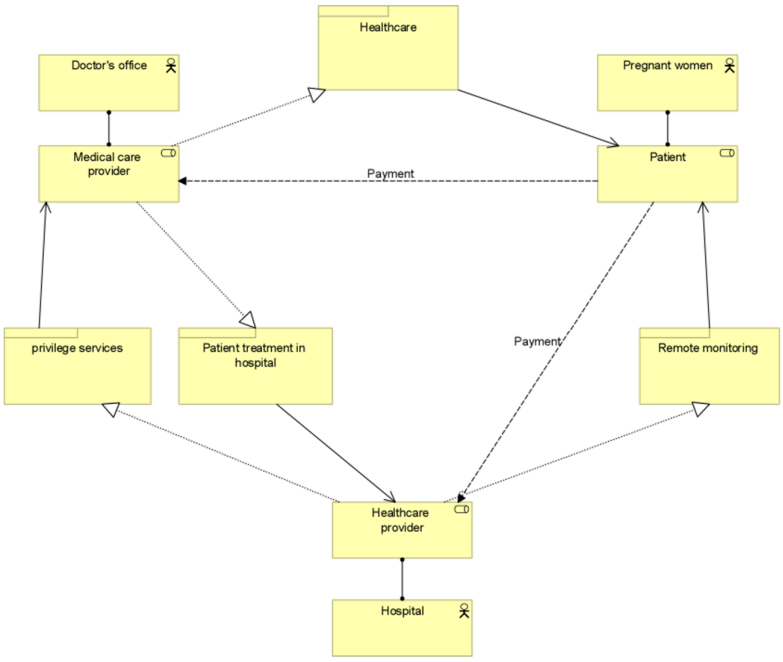


Figure 52: Model value proposition exchange with ArchiMate

After modeling the exchange of value propositions, we then need to define the components of the hospital value proposition. In this use case, the hospital provides the monitoring service to the maternity care clients, so managers must identify the interests of the clients. Since the success of a value proposition is measured based on the satisfaction of the recipient, we then identify the relevant values which will affect the use of remote monitoring service for high-risk pregnancies. Three aspects are identified:

- Cost of care
- Duration of hospitalization
- Risk of death of mother or child

For each aspect concerned by the clients, there should have a correspondingly solution or service included in the value proposition. The remote monitoring service can lower the cost of care by reducing the time and money patients spend on the regular check at the doctor's office; the privilege of treatment service can reduce the duration of hospitalization by reducing the waiting time in hospital; the monitoring record can help doctors to assess the status of the pregnant woman. We use the value model to capture these aspects with ArchiMate, shown in Figure 53.

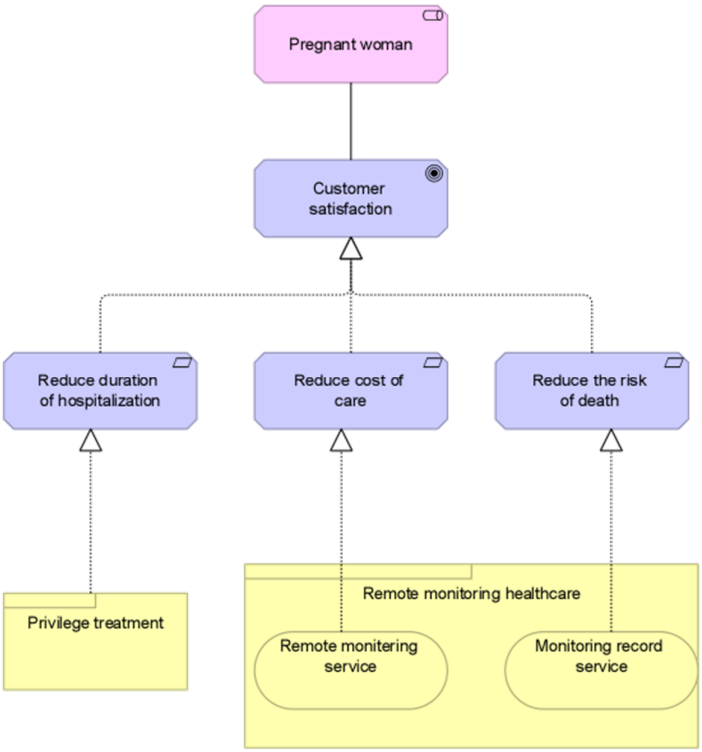


Figure 53: Customer analysis and value proposition components

After clarifying the requirements of the clients and the value proposition offered to them, the next step is to model the activities to support the value proposition. Figure 54 shows the VDML diagram which represents the activity network view of the maternity care. This network describes the activities that support the associated exchange of deliverables and value propositions. Figure 55 shows how the VDML diagram can be translated into ArchiMate.

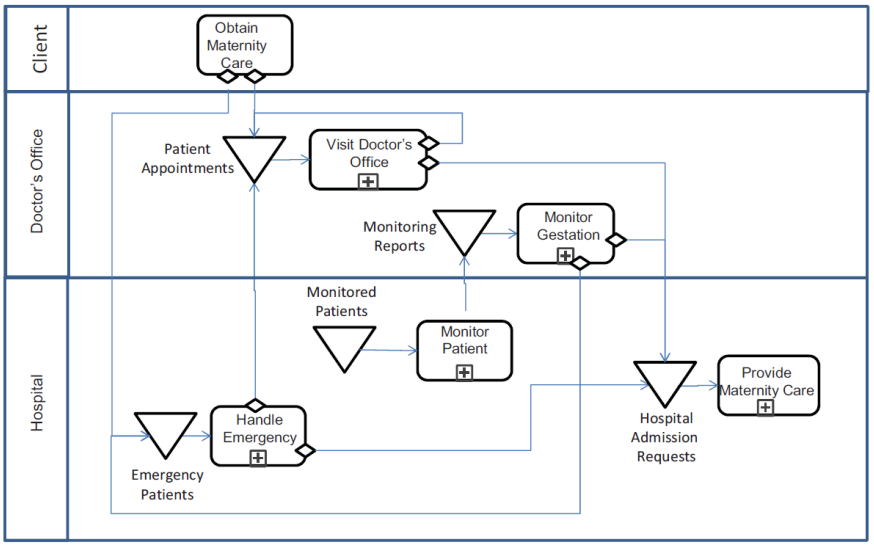


Figure 54: Maternity Care Activity Diagram

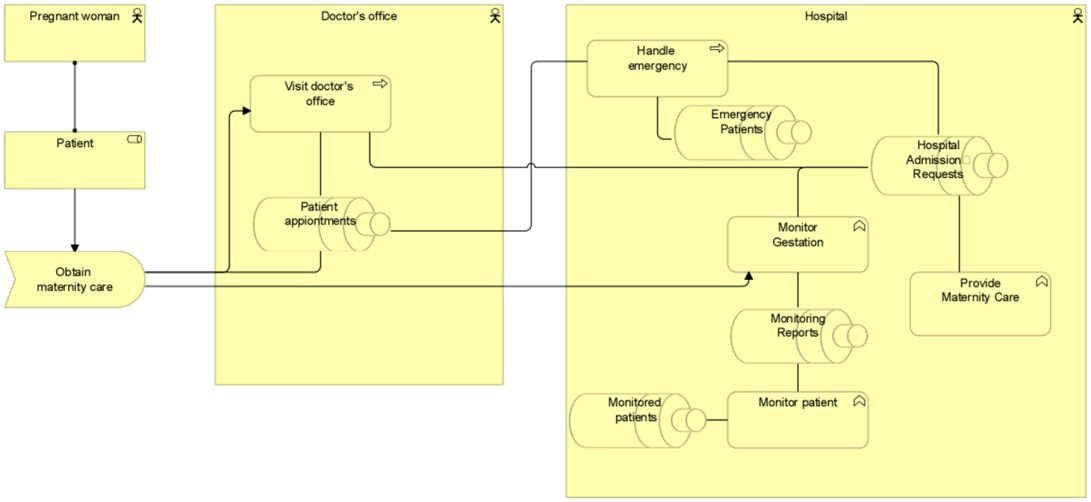


Figure 55: Model Maternity Care Activities with ArchiMate

Note that, the notation with a plus sign means that this activity includes sub-activities to support it. To further test our model, we use the activity of visit doctor's office as an example to show how it can be translated with ArchiMate. Figure 56 shows the method of visiting the doctor's office. The appointments are stored until the patients arrive at the designated time. After visiting the doctor, the patient can either request another appointment with the obstetrician or the latter makes a hospital admission request.

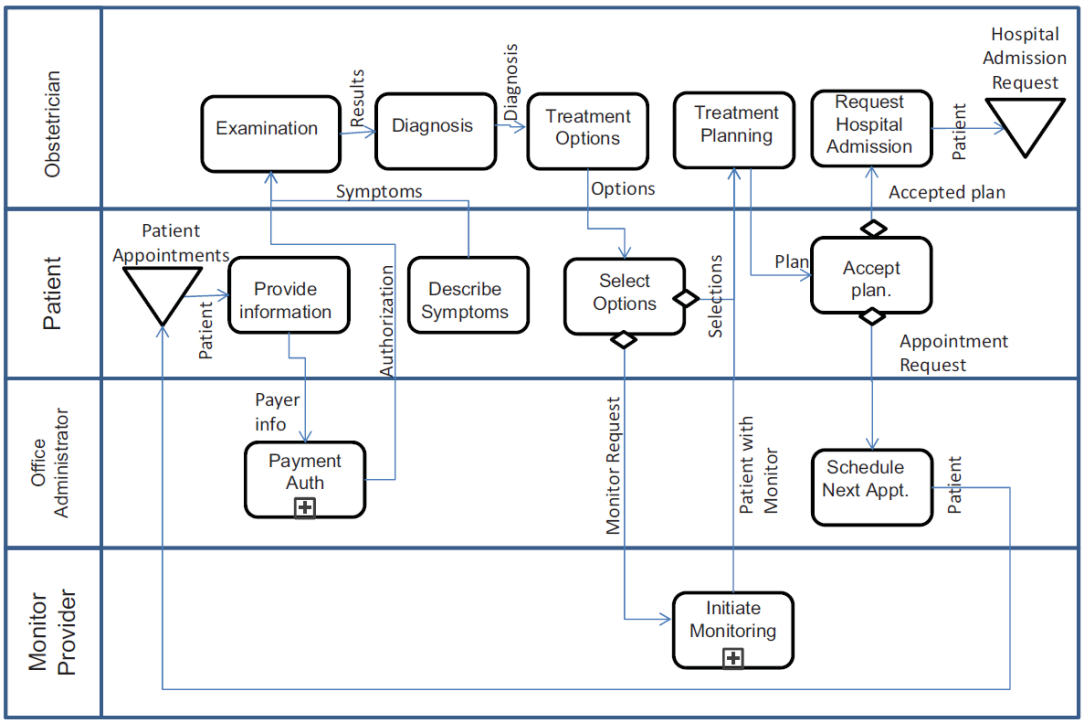


Figure 56: Method of visiting doctor's office (OMG, 2012)

Figure 57 shows the ArchiMate diagram of visiting the doctor's office. All the concepts in VDML can be modeled with ArchiMate. Compare to VDML, ArchiMate uses different types of connections to illustrate the relationship between each activity. When carrying out analyze tasks, it is easier to identify the activities, collaborations, resources and actors.

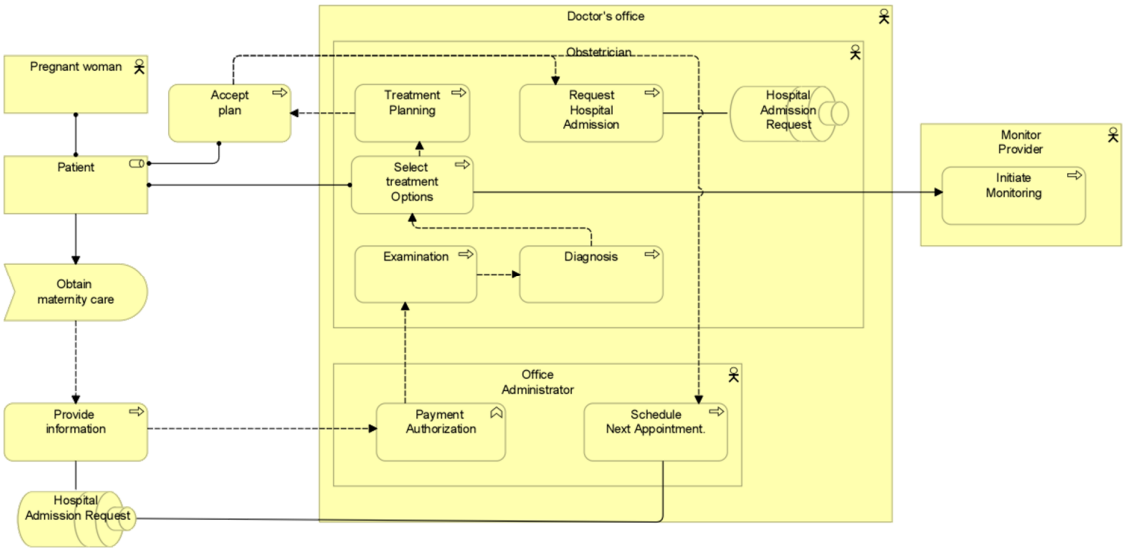


Figure 57: Visiting the doctor's office architecture

3.5 The Value Related Viewpoints

In large enterprises, managing a holistic enterprise architecture could be a very complex task since different people have various requirements and using different notations. To clearly identify each of the stakeholders' needs, ArchiMate takes a flexible approach by introducing the concept of view and viewpoint. A view refers to part of an architecture description which addresses the related concerns of a group of stakeholders. A viewpoint is a specification of a certain view, which represents a particular aspects of the architecture by showing the stakeholder's concerns. A viewpoint is designed to communicate with stakeholders on a certain aspect of the architecture. The value model we proposed can be seen as a viewpoint of value. A more detailed description of this viewpoint is shown below:

The value viewpoint

The ***value viewpoint*** is used to show how a business goal is realized by a value proposition, which is supported by a series of activities in a network perspective (Table 20). It can both be used to create a high-level design of the value proposition exchange between each stakeholders based on their business goals and to provide a guideline for operational managers to understand and arrange activities to achieve the business goal. Important aspects of value viewpoint are:

- Analysis of the business strategy of stakeholder
- Decompose value proposition(s) and align with strategy goals
- Demonstrate the value proposition exchange among partners in a value network
- Realization of value proposition through business activities

Each of these can be regarded as a value related viewpoint which address a single aspect of the entire viewpoint.

Value Viewpoint	
Stakeholders	Enterprise, product managers, process and domain architects
Concerns	Strategy goals, value proposition, business activities in value creation
Purpose	Designing, deciding
Abstraction Level	Coherence, Overview, Detail
Layer	Business layer
Aspects	Active, behavior, passive structure

Table 20: Value viewpoint description

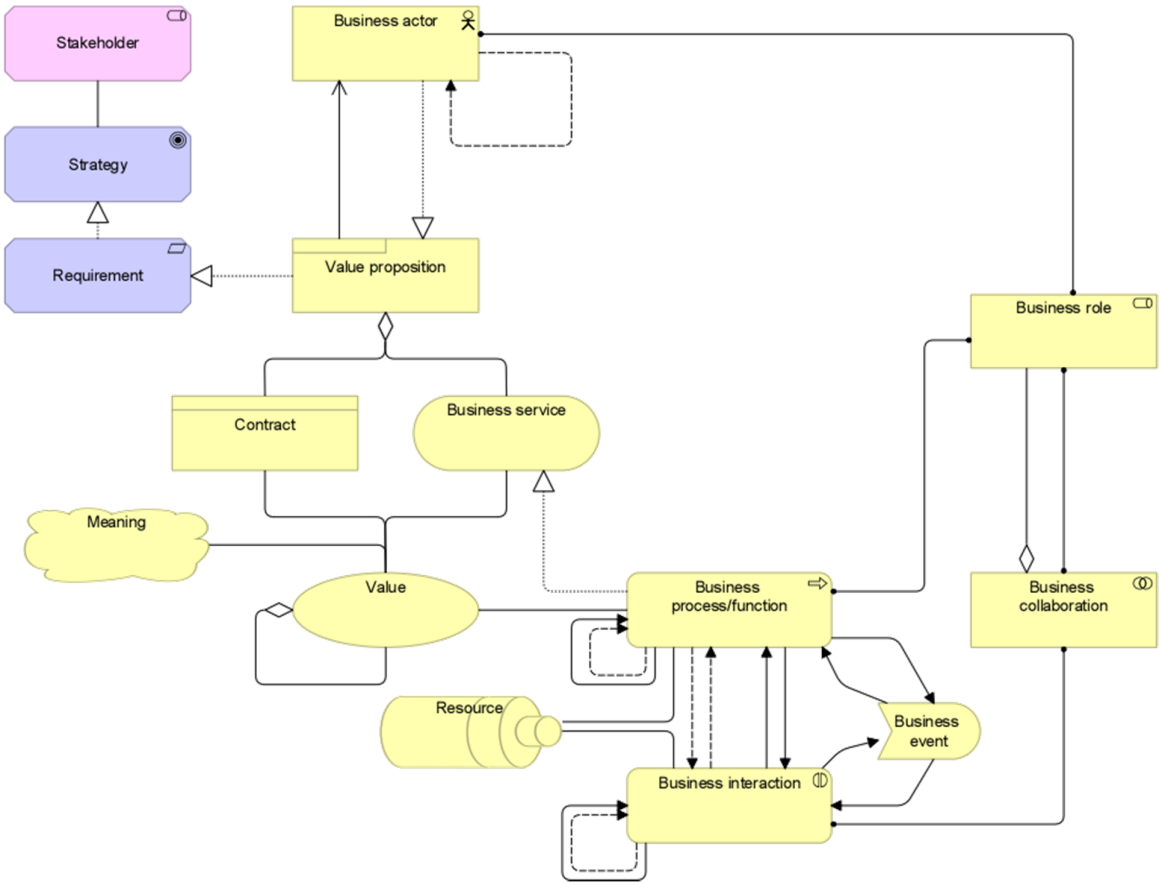


Figure 58: The value viewpoint

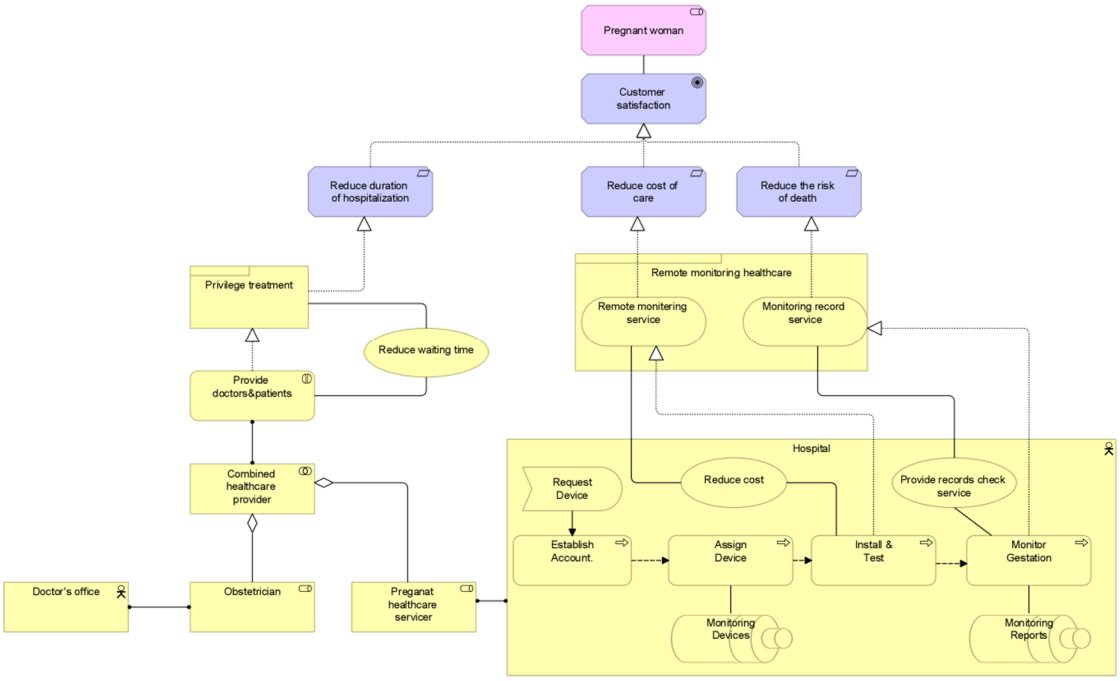


Figure 59: Example of value viewpoint

Based on the introduction, some derived viewpoints are proposed:

The stakeholder viewpoint

The stakeholder viewpoint is used to analysis the strategic goals of an organization and the requirements of the clients (Table 21). It provides insights on identifying the goals need to be achieved and the needs of customers. As a sub-view of the value viewpoint, the stakeholder viewpoint is used to evaluate whether the new value proposition can fulfill the requirements of clients. Figure 61 shows an example of stakeholder viewpoint.

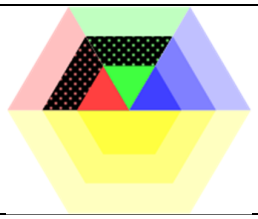
STAKEHOLDER VIEWPOINT		
Stakeholders	Upper-level management, product managers	
Concerns	Stakeholders, organization, customer	
Purpose	Designing, Deciding	
Abstraction Level	Coherence	
Layer	Business layer; Motivation extension	
Aspects	Passive structure and Motivation	

Table 21: Stakeholder viewpoint description

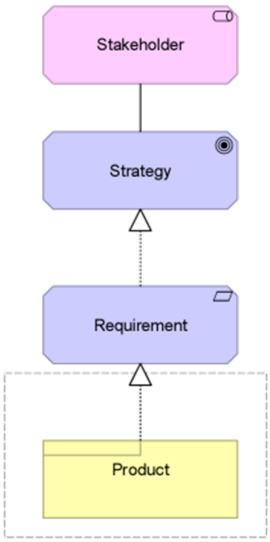


Figure 60: Stakeholder viewpoint

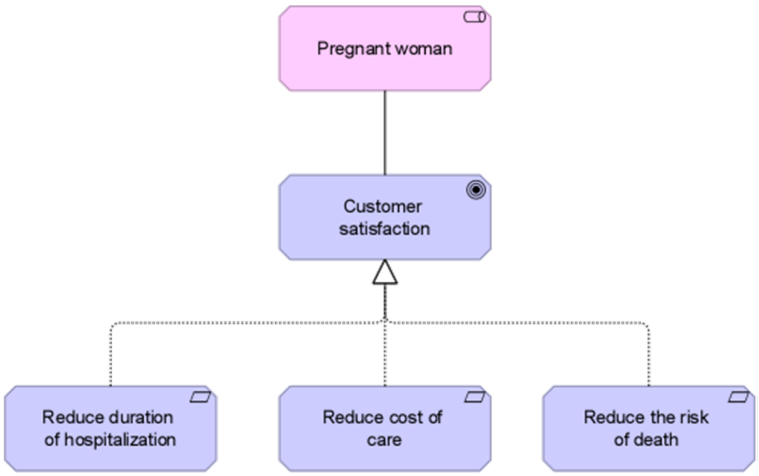


Figure 61: Example of stakeholder viewpoint

The Value proposition viewpoint

The value proposition viewpoint can be used to decompose a value proposition into more detailed components (Table 22). It represents a proposition as a collection of products, business services and contracts. Each of these components addresses a particular type of value that fulfills the need of customers. Figure 63 shows and example of a value proposition.

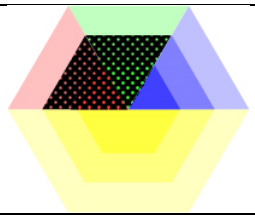
VALUE PROPOSITION VIEWPOINT		
Stakeholders	Upper-level management, product managers	
Concerns	Value proposition	
Purpose	Designing, Deciding	
Abstraction Level	Coherence, detail	
Layer	Business layer	
Aspects	Active, passive structure	

Table 22: Value proposition viewpoint description

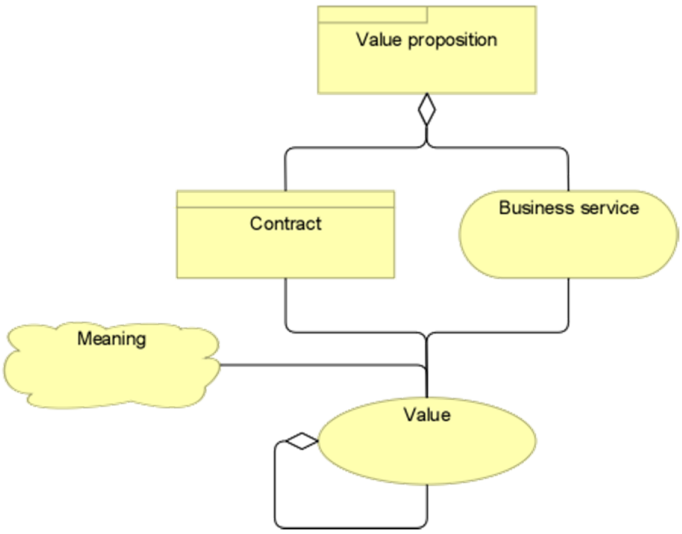


Figure 62: Value proposition viewpoint

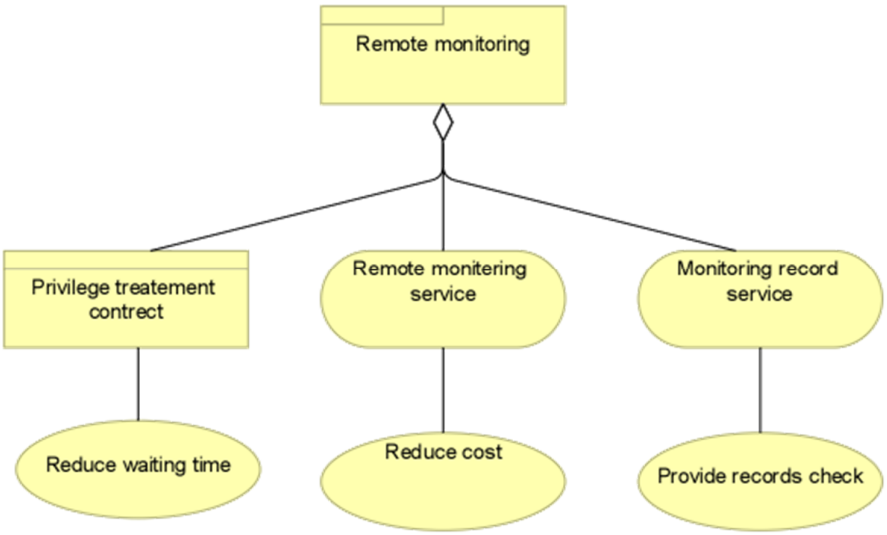


Figure 63: Example of Value Proposition viewpoint

The Value proposition exchange viewpoint

The value proposition exchange viewpoint is used to represent how an enterprise exchange deliverables with partners and customers (Table 23). It describes the exchange in a sky-high level of view to demonstrate the value exchange activities in the network perspective. This viewpoint can be seen as a mockup to illustrate new value propositions. Besides, a new relationship between business actor and value is proposed, which is the flow relationship. The flow relationship refers to the exchange or transfer of, for example, information or value between processes, function, interactions, and events. Figure 65 shows an example of a value proposition exchange.

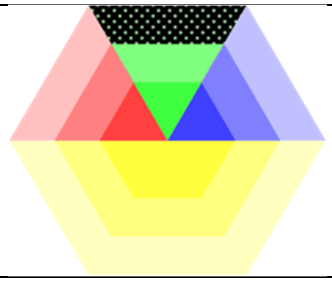
Value Proposition Exchange Viewpoint		
Stakeholders	Upper-level management	
Concerns	Value proposition exchange, Value network	
Purpose	Deciding	
Abstraction Level	Overview	
Layer	Business layer	
Aspects	Active, passive structure	

Table 23: Value Proposition Exchange description

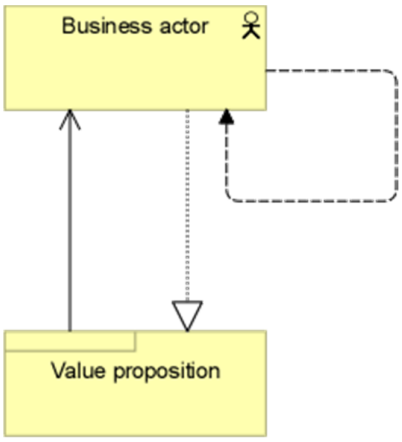


Figure 64: Value Proposition Exchange viewpoint

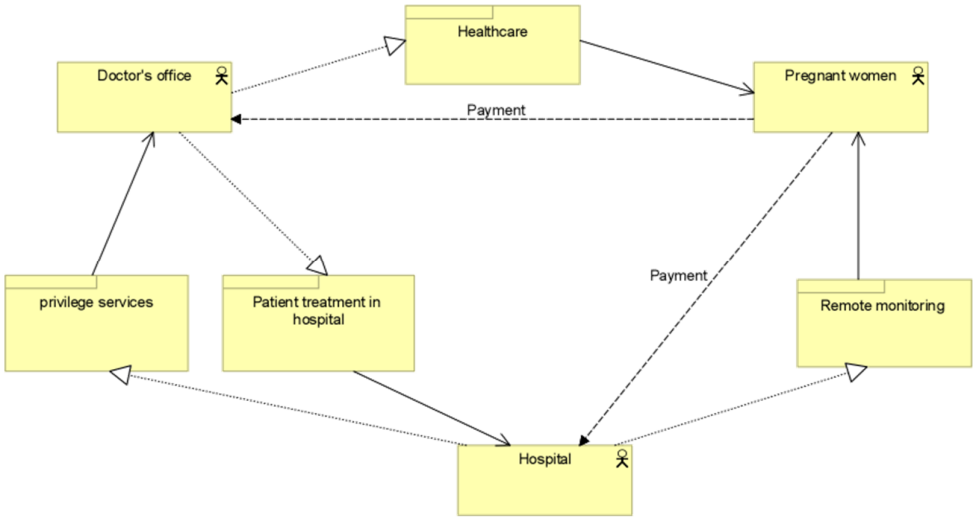


Figure 65: Example of value proposition exchange

3.6 The use of the value related viewpoints

The previous section outlined the value viewpoint which addresses all the elements present in a value model. In this section, we give an instruction on how the viewpoint can be used to construct a value model. Figure 66 demonstrates the use of value viewpoint. The construction of a value model follows a linear sequence, starting with making sketches of a new value proposition and end with drawing the full picture.

Value Proposition sketching

A new value proposition could start with making a sketch which shows a basic idea of new business potential. Due to the uncertainty of new ideas, multiple sketches could be made. These sketches can either represent the decomposition of the value proposition or the value network necessary to deliver it to the customers. Through this sketch, managers can identify what is offered to the clients and what are exchanged between business actors. The decomposition of a value proposition can be made based on the value proposition viewpoint, and the value network can be described by the value proposition exchange viewpoint.

Stakeholder analysis

Once the sketches are made, managers need to clearly identify the current strategic goals and requirements of clients in order to choose the most suitable sketch. Based on the model of value viewpoint, the requirements of stakeholders are connected with the value proposition. In this case, an alignment can be made between the stakeholder analysis and the value proposition. If all the proposed concepts can fulfill the requirements of stakeholders, managers can further move to define the activities in supporting or realizing the proposition. If some gaps are found through the alignment, managers can then go back to refine the value proposition based on the requirements.

Construct the value model

After refining the value proposition, the next step is to complete the value model by constructing the activities which support or realize each of the value proposition components derived in the first step. Except for the concept of resource, each of the concepts included in the value viewpoint can be found in the ArchiMate 2.1 specification. To clearly identify the activities and business actors involved in delivering each of the value proposition component, we use Table 24 to list all the business activities associated with each of the value proposition components. After identifying all the activities support the value proposition, we can then construct the value model for each value proposition component and formalize the whole value model structure.

Value proposition components	Receiver	Provider	Business activity

Table 24: Identify value related activities

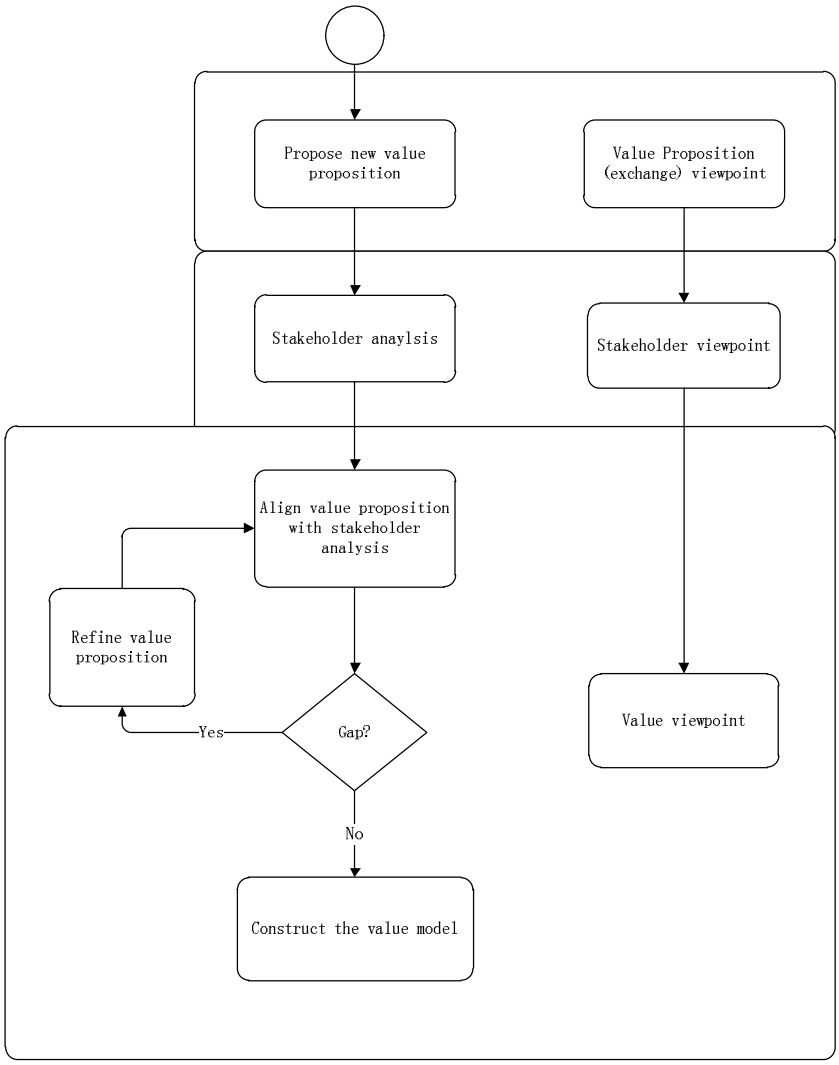


Figure 66: Value model developing method

CHAPTER IV: Demonstration

This chapter is associated with the fourth step of the Design Science Research Methodology, which is to demonstrate the use of meta-model. The case used for the demonstration is a newspaper case from Schuster & Motal (2009). This case has been used by Singh (2013) in his thesis to represent how business value can be integrated into ArchiMate. In this thesis, we use the same case to represent how the proposed value viewpoint can be used.

4.1 Case introduction

There is a Newspaper Publisher, which wants to sustain and increase its coverage by retaining its current customers and by increasing its customer base. To accomplish this, the Newspaper Publisher has started providing a monthly gift to all its current readers and to every new reader, so that they continue their subscription the Newspaper and do not start a subscription from another newspaper. Since the newspaper does not make (or produce) gift items (and neither does it want to start doing that), it obtains them from a gift vendor. The gift is sent by the vendor to the office of the Newspaper, from where they are sent to the customers. The Vendor gets paid for every Advertising Gift which is delivered to the Newspaper office. New customer acquisition is an important function of the Newspaper, which is performed by the Marketing Department. This is done in two ways.
1. By Online Marketing on the Internet;
2. By Cold Calling. Customer Acquisition via cold calling is outsourced to a Call Center. The call center transfers the details of interested customers to the Newspaper. The call center is paid a fixed amount per month by the newspaper.

Schuster & Motal (2009) proposed the E3Value model based on the case Figure 67.

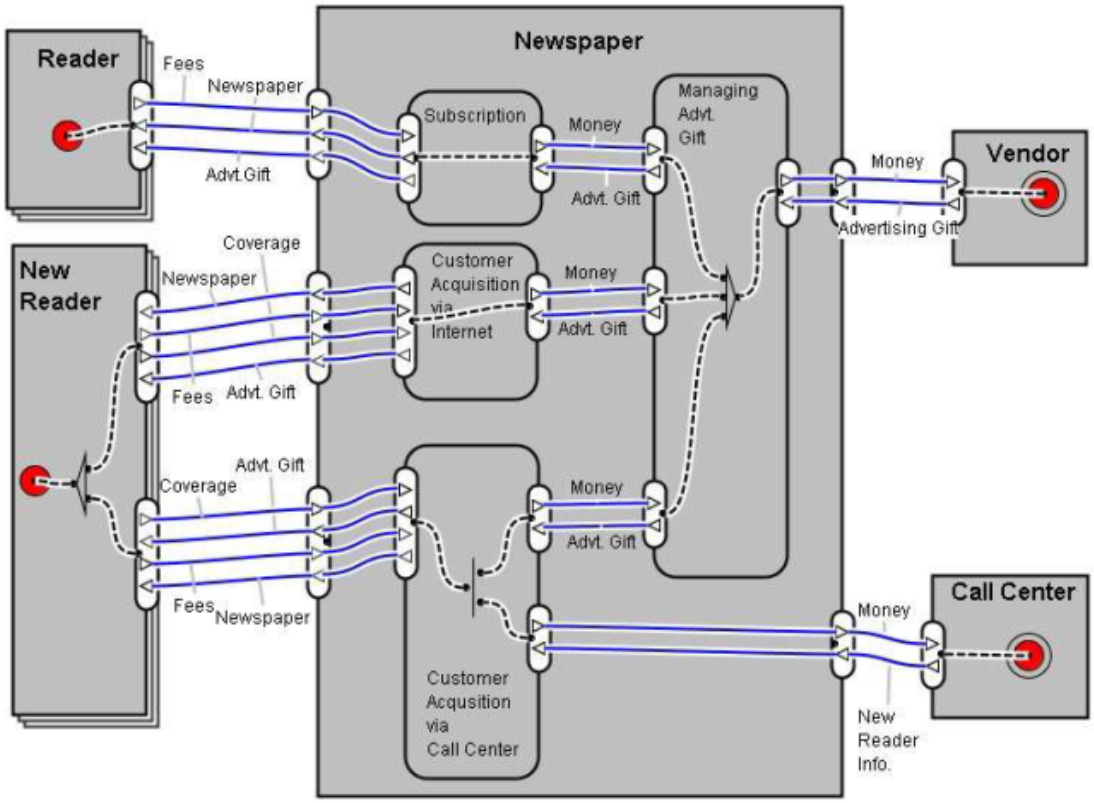


Figure 67: Acquiring Test Readers in e3value (Schuster & Motal, 2009)

4.2 Design the value model

We now use our value viewpoint and follow the instruction to construct the value model with ArchiMate, then compare with the model draw using e3value.

1. Make Value Proposition sketching

Based on the instruction, the first step is to draw the value network and decompose the value proposition. According to the case description, there are five stakeholders involved in the network, including the gift vendor, call center, newspaper publisher, annual reader and new reader. Among these stakeholders, the gift vendor and call center are the partners of the publisher, the reader and new reader are the target clients. The value proposition is to provide gifts for readers and new readers in order to sustain and increase its coverage. In this proposition, the gift vendor responses for sending gifts to the newspaper, and the newspaper publisher cooperates with the call center to provide consulting services through telephones. Figure 68 shows the value proposition exchange diagram of the newspaper.

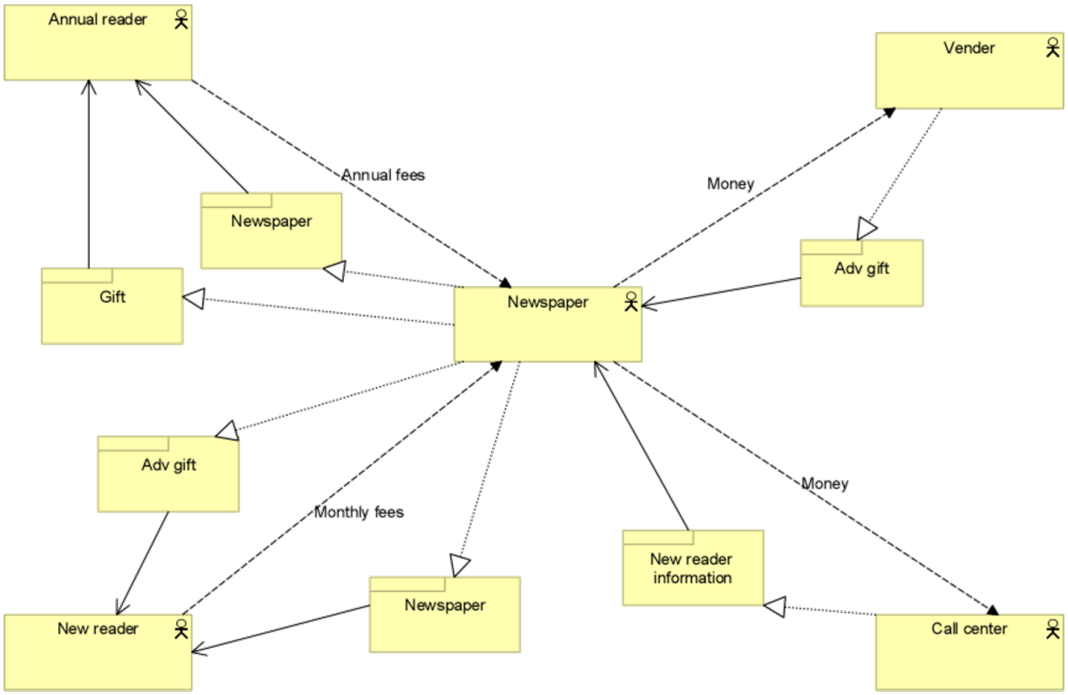


Figure 68: Newspaper value proposition exchange

According to the case, we identify three components in the value proposition, which includes the consulting service from the call center, the test contract provided by the newspaper and the gift purchased from the gift vendor. The consulting service is provided through various platforms, including telecommunication and internet Users can choose either way to get contact with the newspaper publisher, and the gift could attract more new readers become a user of the publisher. Figure 69 represents the decomposition of the value proposition.

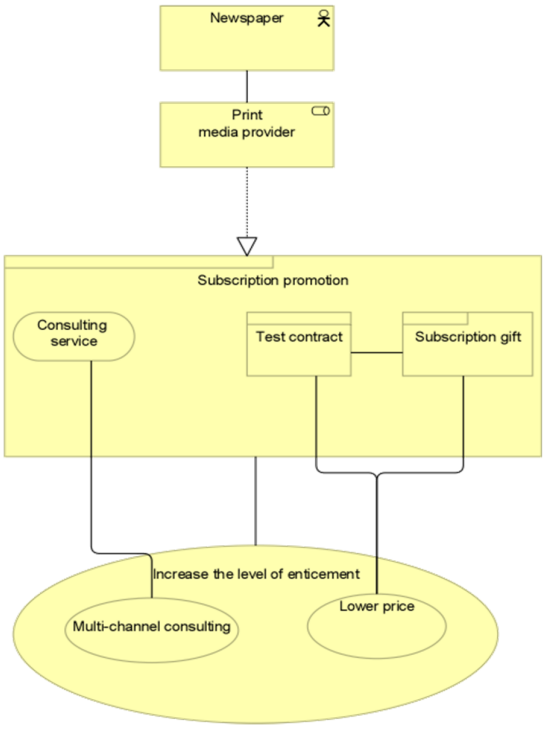


Figure 69: Newspaper value proposition

2. Stakeholder analysis

As discussed before, five stakeholders are involved in this proposition. We use the stakeholder viewpoint to analyze each of the stakeholder's goals and requirements. Both gift vendor and call center service the newspaper publisher as a supplier by means of simply a trade relation, so we focus on analyzing the strategic goals of the publisher and the requirements from the customers. As shown in Figure 70, the publisher wants to increase the coverage and gain more profit, which requires that the publisher needs to sustain the current customer group while attract more new readers. Meanwhile, as a new user, people prefer to gain a better service from the media provider by means of on-time deliver and easy booking, besides, promotions are welcome.

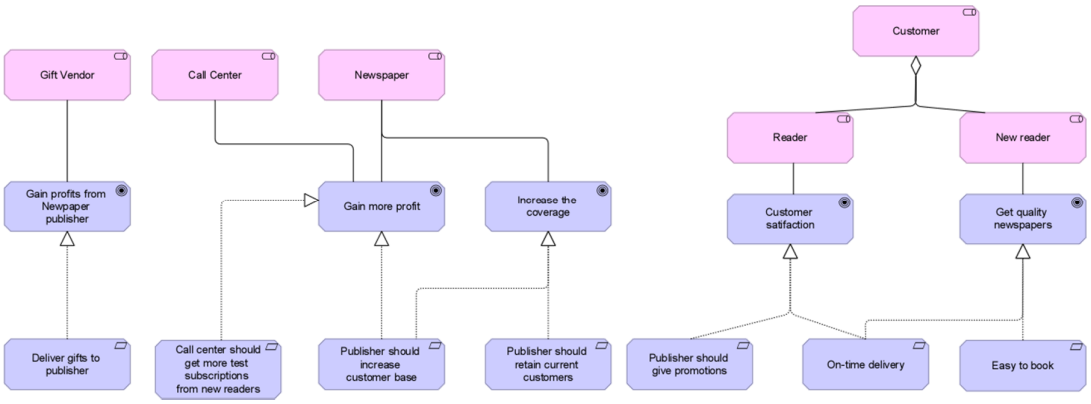


Figure 70: Stakeholder analysis

3. Align value proposition with stakeholder's requirements

Through the previous analysis, we have identified the stakeholders' requirements and shows the decomposition of the value proposition, now we need to align the requirements with the value proposition components to see whether there are gaps between them. Figure 71 shows the

alignment. The alignment shows that the proposition does not cover all the requirements of the customers, the quality of the service is also a key factor to the level of customer satisfaction. In this case, the publisher need also to think whether they can timely dispatch newspapers to customers and updating on the website at the same time. Although this concern does not affect the adoption of the new value proposition, it still needs to be taken into consideration since the sustain of coverage is also an important factor to the publisher.

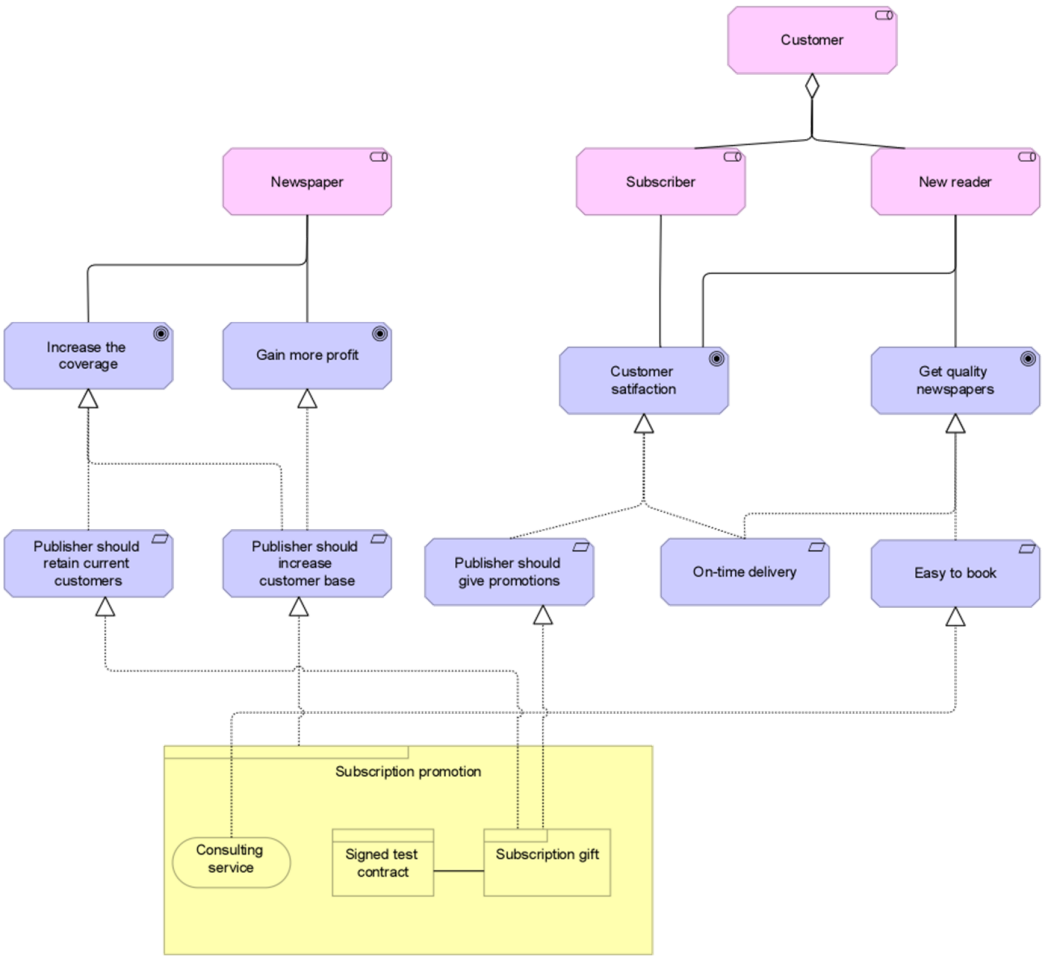


Figure 71: Reuirement-proposition alignment

Figure 72 shows the refined value proposition. The newly added components are modeled apart from the previous one since it concerns with the quality of the core business that publisher provides to clients. It indirectly influences the success of the subscription promotion. We now identify the value contributions of the promotion:

- Low price: It refers to the subscription fees a test reader has to pay, which include a discount.

- Multi-channel consulting: The new reader can ask for information through multiple channels, which include face-to-face consulting, through the internet (mail, internet) and phone calls.

- Subscription gift: The gift is provided to both new readers and annual readers. Compare to the cost of a one-year permanent subscription fee (80 EUR), the gift is very attractive (an iPod Shuffle for 29 EUR).
- On-time delivery: The newspapers should be delivered on time to enable readers to get the

latest news from this publisher.

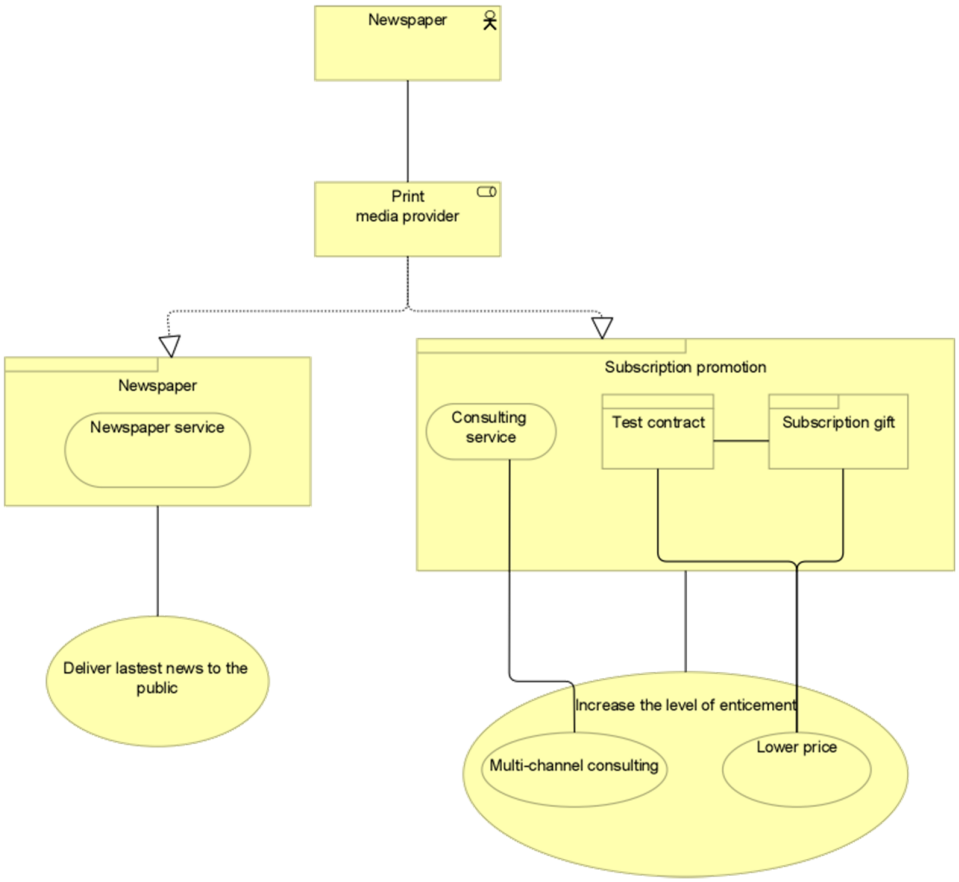


Figure 72: Refined value proposition

Based on the refinement, we then redraw the alignment diagram as shown in Figure 73.

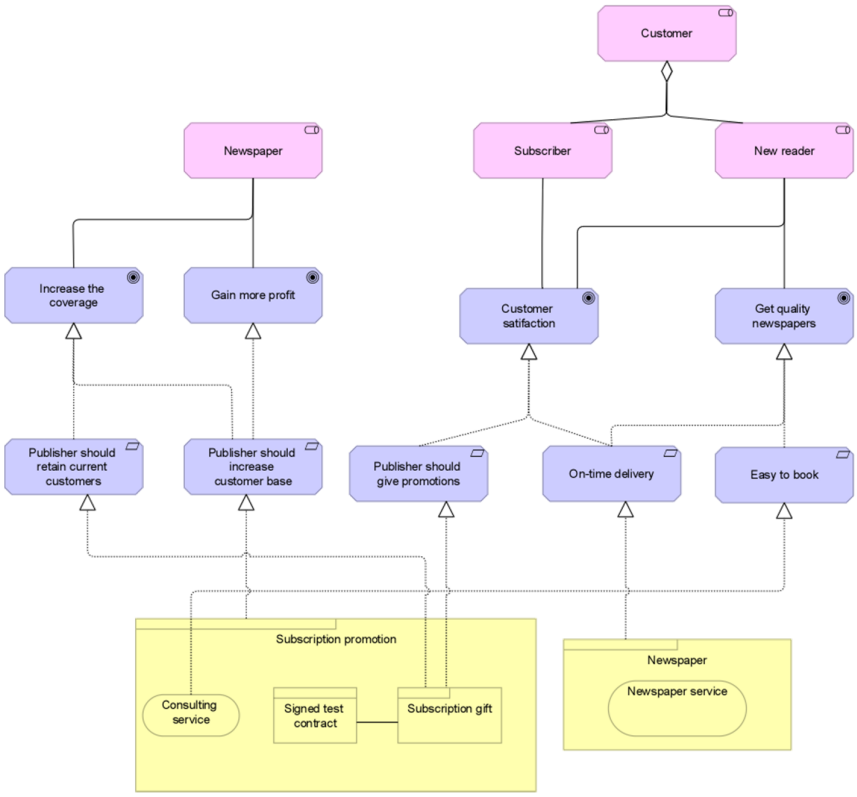


Figure 73: Refine the value proposition alignment

4. Construct the value model

The new readers as the target clients receives the value proposition offered by the publisher. Based on the decomposition of value proposition, we list the services that new readers get from the publisher as shown in Table 25.

Value proposition component	***Receiver***	***Provider***	***Activities***
Phone calls consulting service	New reader	Call center	Collaboration; Business event; function&process
Online consulting service	New reader	Newspaper	Business function&process
Gift	New reader; annual reader	Newspaper	Collaboration; Business process
Newspaper delivery service	New reader; annual reader	Newspaper	Business process

Table 25: Analysis of value proposition components

After defining each of the value proposition components, the next step is to model the activities that support these components with ArchiMate. We first look at the activities that newspaper interact with the gift provider. The two organizations cooperate with each other; the gift vendor sends iPods to the publisher based on the requirement. Similarly, the publisher sign contract with the call center to get support from them. Figure 74 shows the value model of call center and gift vendor.

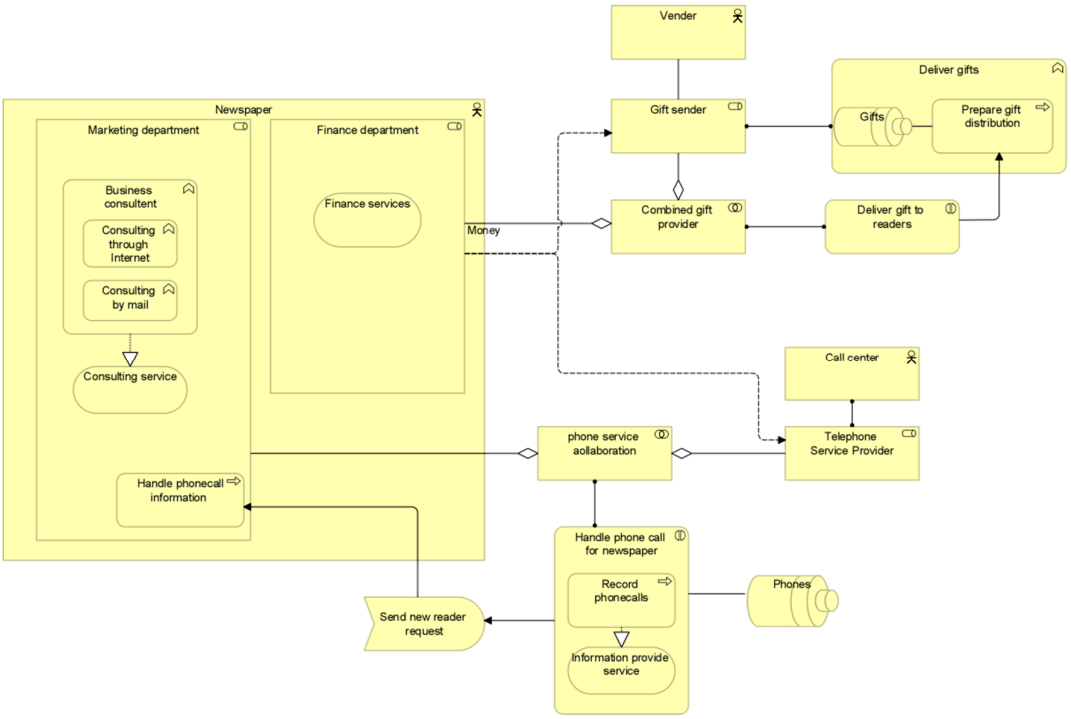


Figure 74: Value model of the Call center and gift vendor

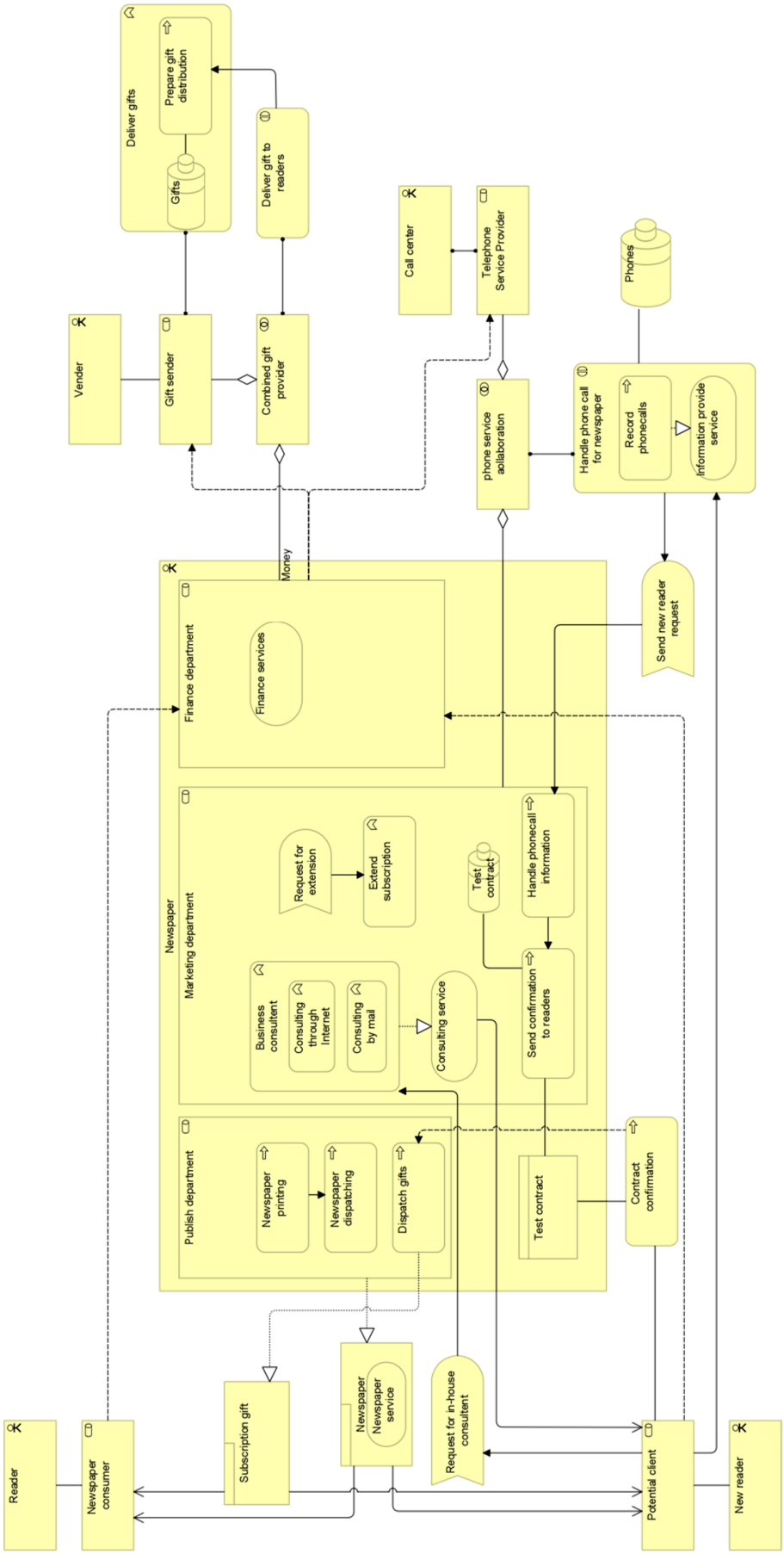


Figure 75: The value model of newspaper case

4.3 Compare the value viewpoints with e3value

By using the value viewpoint of ArchiMate, we are able to draw a picture of the proposition of the newspaper case. Compare our model with the model created by e3value, several points can be addressed:

1. Using the value viewpoint of ArchiMate, it is possible to refine the value proposition through a more effective way. The analysis of stakeholders makes it clear on what the company wants to achieve and what kind of services that clients expect the newspaper to deliver to them. Based on the analysis, some adjustments can be made accordingly and also alternatives can be proposed to improve the value proposition. In e3value, scenarios are used to create a common understanding of the proposition by identifying the products, services and stakeholders, as well as the potential profitability for all parties through a sensitivity analysis. The scenario approach could be efficient when dealing with small-scale business, when facing a more complex situation, this method could become complicated and unable to clearly identify whether stakeholders share common interests or conflicts exist between them.

2. The concept of value port is defined and used in the e3value. The port allows modelers focus only on the incomes and outcomes between actors and other components, while paying less attention to the internal processes. As a lightweight approach, the use of value port is efficient since it only concerns with the value proposition at a high level of abstraction. Meanwhile, the enterprise architecture takes a holistic approach to model the whole picture of an enterprise, the difference in level of abstractions makes it less effective when mapping with models like e3value (Kinderen et al., 2012). With the use of value viewpoints, architects are able to use the value proposition exchange viewpoint to create a value exchange model at a high level of abstraction. This model contains all the business actors involved in the value proposition and the exchanges between actors. It can be easily understood by managers and other employees.

3. Through the study on VDML, we draw the conclusion that the value port represents either a transformation of status or a triggering point inside/between activities. These kind of changes can be modeled with ArchiMate by using the concepts such as business event and business process. More importantly, ArchiMate is hereby able to describe the transformation in a more detailed way, rather than a simple link between the ports. As to the concept of value port in e3value, it is only concerned with the value objects (services, goods, money or even consumer experiences) which are provided or requested. In other words, the value port in e3value only represents the transaction process, while the transformation process is not addressed.

CHAPTER V: Evaluation

Evaluation is a key activity of the Design Science Research Methodology. It is concerned with the acceptance of the artifact by readers and reviewers. There are many ways to perform the evaluation task. The first method is to compare the artifact's functionality with the solution objectives. The second approach is to use quantitative performance measures such as budgets or outputs, satisfaction surveys, client feedback, or simulations. (Peffers et al., 2008). In the field of Information Technology, various models are proposed to verify whether new technology can be accepted by users.

5.1 The Survey Approach

The survey approach emphasizes the quantitative analysis method, which refers to a large number of data collected through methods such as mail questionnaires, telephone interviews, or from published statistics. A survey could indicate the causal relationship or even descriptive statistics on the conditions that all the right questions asked in the right way (Gable, 1994). Vidich and Shapiro (1955) suggest that: "Without the survey data, the observer could only make reasonable guesses about his area of ignorance in the effort to reduce bias." Jick (1979) also claims that the survey research can contribute to the generalizability of the results.

In this thesis, request for expert opinion is used as the evaluation of the methodology. Ask for the expert's opinion is one of the survey methods. Expert opinion refers to the researcher present the work to experts in the related field, ask them about the perceived usability and utility of the new artifact. This approach usually takes place at a location which is mutually agreed and comfortable for the participants. The presenter can use personal interview or questionnaire to get the feedbacks. To guarantee the success of the survey, the researcher must follow a good methodology as guideline to formalize the questionnaire.

5.2 The Acceptance of Information Technology

The acceptance of new technology is considered as one of the most mature research areas in the field of information systems (IS) (Goodhue & Thompson, 1995; Hu et al., 1999). In the field of Information System (IS), there are many models defined to evaluate the success of new technologies, such as Theory of Reasoned Action (TRA), Task-technology fit (TTF), Technology Acceptance Model (TAM). These approached can be divided in two groups. The first group focuses on identifying the acceptance of technology by dependent variables, such as the intention of use or the usage. The second group intends to evaluate the new technology by its implementation success at the organizational level and task-technology fit (Venkatesh et al., 2003).

Dealing with various models, researchers have to face the situation that they must pick the most favorable model and ignore the others. Venkatesh et al., (2003) studied different types of model and formulated the Unified Theory of Acceptance and Use of Technology (UTAUT). In the UTAUT model, four constructs are considered to have significant and direct impacts on determining the user acceptance and usage behavior, which include performance expectancy, effort expectancy, social influence, and facilitating conditions (Figure 76). The other four aspects, such as gender, age, experience and voluntariness of use, play a moderate role between the four independent constructs and user behavior.

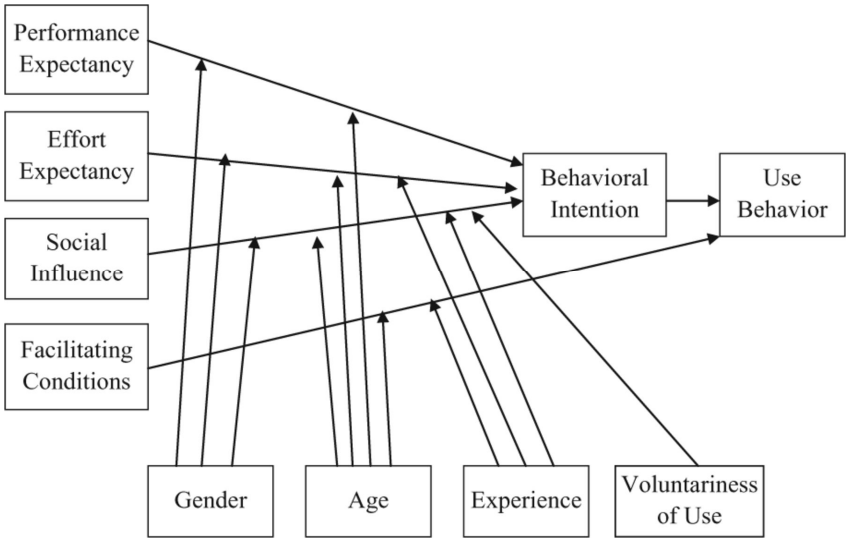


Figure 76: The Unified Theory of Acceptance and Use of Technology (Venkatesh et al., 2003)

Performance Expectancy

The performance expectancy concerns with the extend that an individual thinks that the job performance can be enhanced by using the system. Five constructs are contained in it, including perceived usefulness, extrinsic motivation, job-fit, relative advantage, and outcome expectations. The performance expectancy is seen as the strongest predictor of intention.

Effort Expectancy

The effort expectancy refers to the ease of use of the system, three constructs are included to capture this concept: perceived ease of use, complexity, and ease of use. This concept has significant impact on both voluntary and mandatory usage contexts, however, its impacts decrease over time and sustained usage.

Social Influence

Social influence concerns to what extent a person feels that others believe he or she should use the new system. This concept has a direct determinant of behavioral intention. The role of social influence in the model depends on a wide range of contingent influences. Individual behavior is influenced by the concept through three mechanisms, including compliance, internalization, and identification.

Facilitating Conditions

Facilitating conditions concerns to what extent a person thinks that an organizational infrastructure exists to support the use of the system. This concept is composed of three constructs: perceived behavioral control, facilitating conditions, and compatibility. These constructs involve with the usage barriers that the external environment should be designed to remove them.

5.3 Construct the questionnaire

The intention of writing the thesis is that the business side often uses different technologies to describe the business requirements, meanwhile enterprise architects use other languages to model the IT infrastructures. The differences of technologies used by both sides made it very difficult to communicate and capture the whole picture. ArchiMate as an enterprise architecture modeling language, takes a comprehensive approach of modeling IT infrastructures and business changes, hereby it is important if it can be used to model value related concepts at the business side, such as

value propositions and value exchange. Unlike some business model technologies which take a lightweight approach, the concepts defined in ArchiMate are more complicated. For large businesses, using ArchiMate to model value could be a complex task, hereby we propose a lightweight approach by constructing the value viewpoint which involves only the concepts in the business layer and the motivation extension. Based on this scope, we address three aspects when constructing the questionnaire: usefulness, ease of use and self-efficacy. These questions are shown in Table 26.

Catalog	Questions	Score
Usefulness	1-1. I would find the method useful in my job.	1 2 3 4 5
	1-2. Using the method in my job would enable me to accomplish tasks more quickly.	1 2 3 4 5
	1-3. Using the method would improve my job performance (how well I do my job).	1 2 3 4 5
	1-4. Using the method in my job would increase my productivity.	1 2 3 4 5
	1-5. Using the method would increase my effectiveness on the job (how successful).	1 2 3 4 5
Ease of use	2-1. Learning to use the method would be easy for me.	1 2 3 4 5
	2-2. I would find it easy to get the method to do what I want it to do.	1 2 3 4 5
	2-3. My interaction with the method would be clear and understandable.	1 2 3 4 5
	2-4. It would be easy for me to become skillful at using the method.	1 2 3 4 5
	2-5. I would find the method easy to use.	1 2 3 4 5
Self-efficacy	I could complete a job or task using the system...	
	3-1. If there was no one around to tell me what to do as I go.	1 2 3 4 5
	3-2. If I had a lot of time to complete the job for which the software was provided.	1 2 3 4 5
	3-3. If I had just the built-in help facility for assistance.	1 2 3 4 5

Table 26: Questions for expert opinion

5.4 Data analysis and feedbacks

The evaluation takes place at BiZZdesign, which is a worldwide famous company offers solutions for Enterprise Architecture and BPM. Four experts from BiZZdesign participated in the evaluation. After the presentation of the research, participants are asked to fill in the questionnaire and answer an open question: Is the proposed value viewpoint a good representation of value creation at both strategy and process level?

The data analysis provides valuable insights about the study, Appendix A shows the result of analysis. In the evaluation, three aspects are addressed, which are usefulness, ease of use and self-efficacy. We now analysis each of the aspects in detail:

Usefulness: The overall score of usefulness is a bit lower than the other two aspects. The questions regarding the usefulness mainly consider the performance of using the technology. Table 27 represents the result of survey data. These questions concern the following points: usefulness in the

job (Q1-1), the improvement in efficiency (Q1-2; Q1-4) and effectiveness (Q1-3; Q1-5). There are three out of four participants (75%) agrees that this method is useful in the job. Regarding the two other aspects, 50% people agree that the value viewpoint could improve the job performance. By using value related viewpoints, architects could improve the communication with business managers by graphically represent the value proposition with ArchiMate. Around 50% participants hold a neutral attitude regarding the efficiency of the method, while others disagree with the statement. The main argument is that, there are many modeling techniques available for business managers analyzing their business plans/propositions, while ArchiMate lacks of abilities to cover all the aspects. It is suggested to use the BMC as reference to study the way of constructing a business model in order to improve the efficiency of the method.

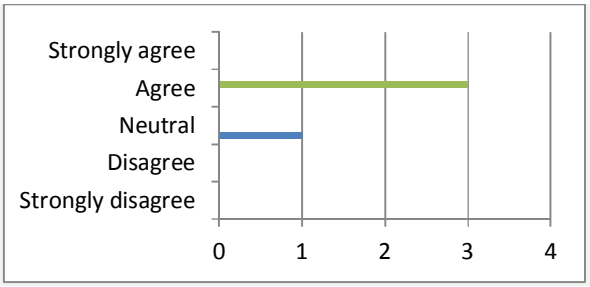
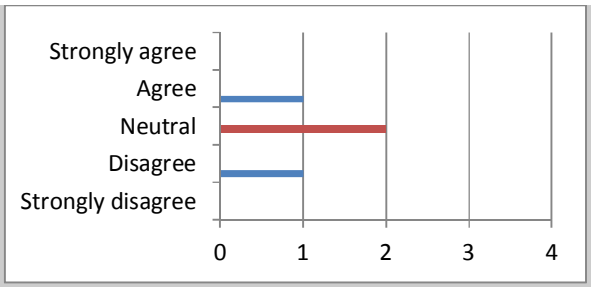
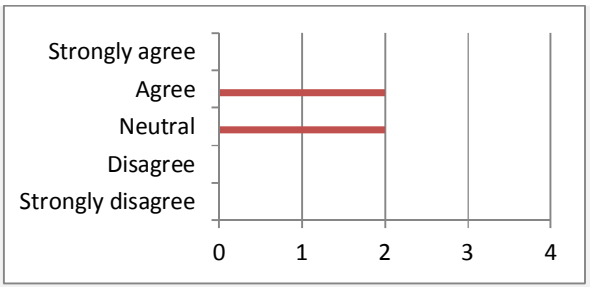
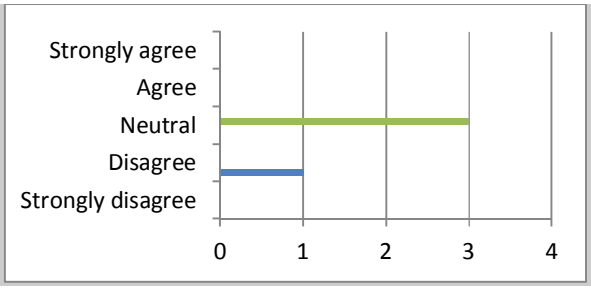
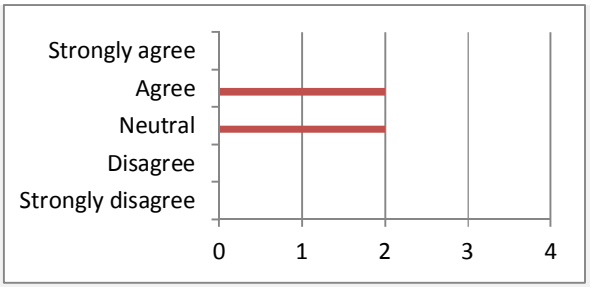
Catalog	Questions	Score
Usefulness	1-1. I would find the method useful in my job.	
	1-2. Using the method in my job would enable me to accomplish tasks more quickly.	
	1-3. Using the method would improve my job performance (how well I do my job).	
	1-4. Using the method in my job would increase my productivity.	
	1-5. Using the method would increase my effectiveness on the job (how successful).	

Table 27: Data analysis of usefulness

Ease of use: The term ease of use mainly concerns whether this method can be easily learned (Q2-1; Q2-3) and easily to be used at work (Q2-2; Q2-4; Q2-5). Table 28 shows the survey results. Regarding the learning curve, most of the experts (over 75% on average) agree that the method can be easily understood and learned. As to the questions whether it can be handled easily at work, over 50% participants on average have agreed with this point. Some experts think that it may still not be easily handled by business managers, but enterprise architects could use it to construct the business model and show to managers for better communications.

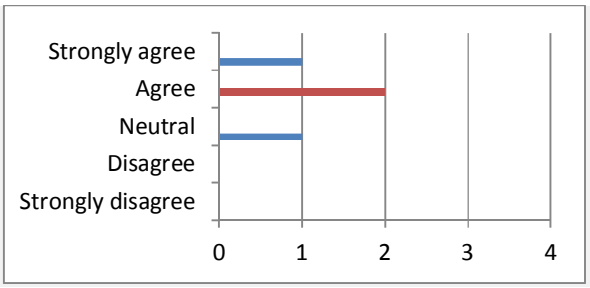
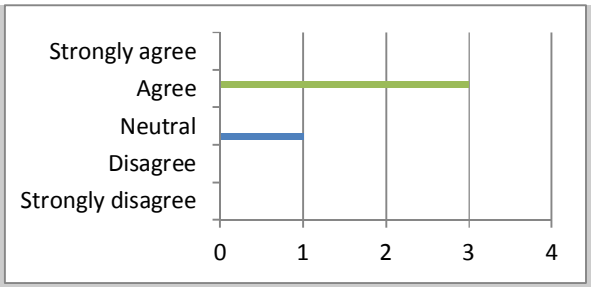
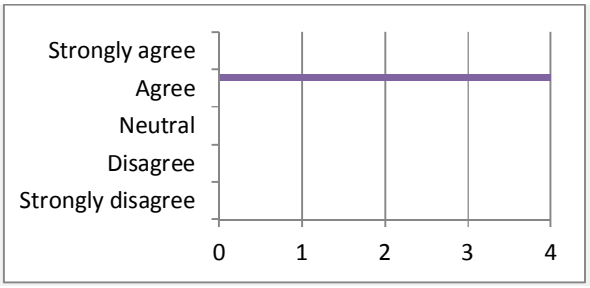
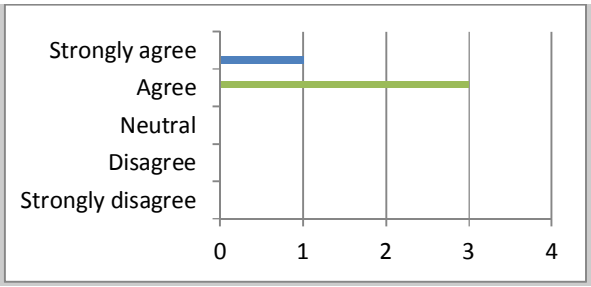
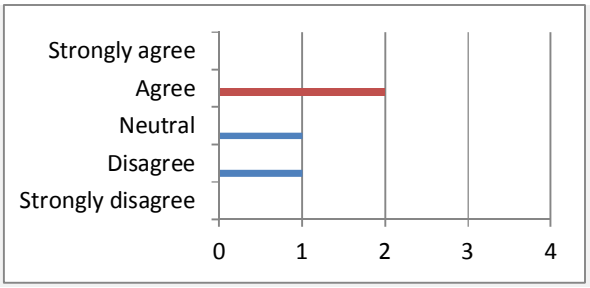
Catalog	Questions	Score
Ease of use	2-1. Learning to use the method would be easy for me.	
	2-2. I would find it easy to get the method to do what I want it to do.	
	2-3. My interaction with the method would be clear and understandable.	
	2-4. It would be easy for me to become skillful at using the method.	
	2-5. I would find the method easy to use.	

Table 28: Data analysis of ease of use

Self-efficacy: The term self-efficacy considers whether a user is able to finish the task by using the guidance or build-in help facilities offered by the technology. Table 29 shows the survey result. From this table, we can see that the guidance on using value related viewpoints to construct a value proposition is clear to the users.

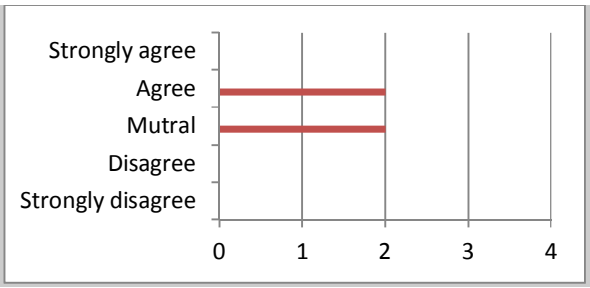
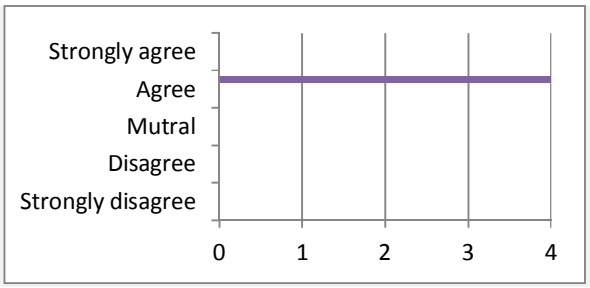
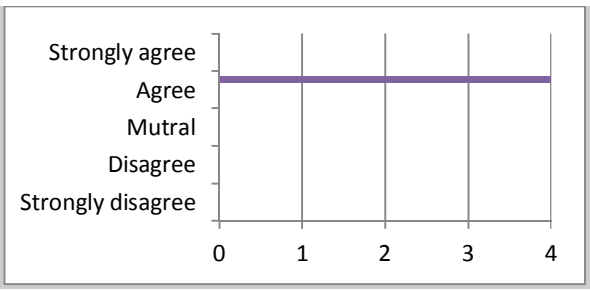
Catalog	Questions	Score
Self-efficacy	I could complete a job or task using the system...	
	3-1. If there was no one around to tell me what to do as I go.	
	3-2. If I had a lot of time to complete the job for which the software was provided.	
	3-3. If I had just the built-in help facility for assistance.	

Table 29: Data analysis of self-efficacy

Regarding the open question, three participants think that the methodology could be a useful replenishment on using ArchiMate to model value creation. The other participant thinks that other modeling technology performs better than use ArchiMate, such as the Business Model Canvas. Compare to ArchiMate, the BMC is more flexible when modeling value propositions.

CHAPTER VI: Conclusion

The last chapter of this thesis reports the achievements of this research. First, we summarize the research and answer the research questions. Second, we discuss the academic contributions of the research. The last part discusses the limitations of the research and future works.

6.1 Summary

This research starts with the study of value and value creation, which are two important aspects in the field of economic management. Through the literature study, we define the definition of value and its two features: value-in-use and value-in-exchange, followed by the study of the value creation process and related business modeling techniques. The motivation of this research is to explore the possibility of using ArchiMate to model value creation. The intension of proposing such an approach is that ArchiMate currently lacks a way of distinguishing the exchange value and use value. Although some works have been done regarding aligning business (value) models with ArchiMate, the solutions are still not easy to be managed by all stakeholders in an organization. A lightweight approach should be proposed since model value proposition and value exchange often are the jobs done by managers. As an Enterprise Architect, it could become difficult on capturing the whole picture from business side since they are using different languages.

To close this gap, it is necessary to define an ease of use approach to use ArchiMate describe the entire value creation process, which is also known as a value model. The methodology used to achieve this goal is to use the Value Delivery Modeling Language as reference to construct a value model with ArchiMate. By comparing and mapping the concepts in the two languages, we construct a series of viewpoints to model the value creation process from both economic and strategic levels. After constructing the viewpoint, a case study is followed to check whether the model is applicable. To summarize the findings, we now answer the main research question and sub questions:

Main question: How to create modeling support for value modeling in (EA) Archimate?

In this thesis, a ***value model is defined as an architect, which represents how customer value can be fulfilled and realized through a series of activities.*** In ArchiMate, multiple viewpoints are defined to address a single aspect of concern from a stakeholder. Similarly, a viewpoint can be created to support to carry out value modeling tasks, we call it the value viewpoint. This value viewpoint is composed of concepts in the business layer and motivation extension. A guideline of usage is proposed to verify the value proposition and build a value model.

In order to support the main question, three sub-questions need to be addressed:

Sub 1. What is the meaning of value to an enterprise?

Based on the literature review, ***value refers to the extent that the utility of a service or product fulfills the needs of the customer.***

Sub 2. How the value exchange modeling method can be integrated into the ArchiMate meta-model?

The Value Delivery Modeling Language provides a analyze and design solution for enterprises to capture the creation and exchange of value. It provides a graphical representation of business activities, roles and capabilities in the enterprise. In this thesis, we use VDML as a mapping reference with the concepts in ArchiMate. The VDML provides a detailed way of addressing each part of the value creation process, including value proposition, business activity and business collaboration. By mapping the related concepts in ArchiMate with VDML, we are able to construct a meta-model which could represent a comprehensive view of the value creation process.

Sub 2.1. What are the aspects which the integration does not address while it should be included in a comprehensive value modeling approach?

Through the mapping task with VDML, ArchiMate is shown to have the capability to cover most of the concepts and able to construct a meta-model which address each aspect in the value creation process. Some new relationships are proposed to construct the value viewpoint, shown in Table 30. Besides, in the value viewpoint, we propose the concept of resource should be used in the business layer. We give a broad scope to this concept to make the design phase more flexible, since resource covers a large range of facilities in an enterprise. For the purpose of turning a value model into an enterprise architecture or compiling a value model with the current enterprise architecture, we identified the concepts that can be used as a single type of resource in Table 14.

Concept 1	**Concept 2**	**Relationship**	**Meaning**
Business Role	Value	Flow relationship	In a value network, business partners exchange the commodities with each other, and get a monetary value in return. This relationship indicates the value-in-exchange that are chased by the sellers.
Value	Business process/function/ event/interaction	Association relationship	Each of the outputs from business activities should be a part of the element contained in the value proposition, which has value-in-use to the buyers.

Table 30: Proposed new relationship in ArchiMate

Sub 3. How to extend ArchiMate making it able to value modeling?

In ArchiMate, viewpoint is used by a stakeholder to define his/her own view on the enterprise architecture. For managers, the value viewpoint can be used to model the value proposition, value exchange and the value creation process.

6.2 Contributions

This research provides multiple viewpoints to address the value creation process in the enterprise. It also answers the question whether ArchiMate is able to construct a value model. Some major contributions of this research are mentioned below.

- This research briefly introduces the essence of value through a systemic literature review, as well as the creation of value in a network perspective. A definition of value is given in Section 3.1, which refines the concept of value in the enterprise.
- Based on the literature review, a value creation framework is proposed. This framework addresses the creation of value from both strategic and economic perspectives. This could become a useful reference for both managers and enterprise architects to capture all the aspects in the value creation process.
- The proposed value viewpoint distinguishes the exchange value and use value. By adding a new relationship between business activity and value, the value contribution through activities are addressed, which is the use value included in each of the value proposition components. The flow relationship added to the business actor concept represents the value exchange between actors, each of the exchange value is associated with an exchange of value proposition. We use different viewpoint to address different types of value in firms.
- The concept of Resource defined in the business layer gives flexibility when modeling all types of resources consumed in the value creation process. Meanwhile, a resource table

(Table 14) is summarized when extending these resources to the application and technology layer.

- The value viewpoint provides a lightweight approach of constructing a value model. This viewpoint could be used by managers to represent the value proposition from different abstraction level.
- The value model developing method provides a guideline of designing a comprehensive value model, which include the alignment of value proposition with business strategic goals and requirements from clients.

6.3 Limitations

Some limitations of the study are summarized below:

- Although the value creation framework is summarized through literature studies, it has not been verified and evaluated.
- The proposed new relationships still need to be verified, as well as the resource concept.
- The constructed value viewpoint is not applied to a real life case, whether it can improve the efficiency of communication between managers and enterprise architects still need to be verified.
- The VDML includes a series of viewpoints and also involves with capability and measurement methods, which are not included in this research. The mapping task between VDML and ArchiMate only captures part of the value modeling technique, as to the analysis methods, such as cost/benefit analysis, traceability are not addressed.
- Currently VDML lacks of a public and official tooling for individuals to use it. This has a negative impact on the mapping work since it is not possible to verify whether there could have a model transformation possibility between VDML and ArchiMate.

6.4 Future works

Nowadays, many business processes are heavily relying on the support of complex information systems. Furthermore, the cooperation between enterprises becomes a key factor in successfully delivering services to end users. A well structured IT infrastructure is crucial for the success of business. Meanwhile, new value propositions need quick response from the IT side in order to get support and avoid duplicate investment in systems. This research intends to close the communication gap between the business side and IT side. Based on these features, some future research are identified and shown below:

- The verification and use of the value viewpoint should be carried out. The value viewpoint creates possibility to use ArchiMate as a value modeling tool for managers to design new value propositions, its usefulness needs to be verified.
- The VDML as a recently developed modeling language has been used in some real cases. Studying its ability on business analysis and measurement could become useful replenishment to ArchiMate.
- The verification of the value creation framework is meaningful for exploring business process modeling techniques.
- The proposed value viewpoint has some newly proposed relationships and concept, whether these are meaningful as an extension of ArchiMate still need to be verified.
- Further uses of the value viewpoint can be studied.

REFERENCES

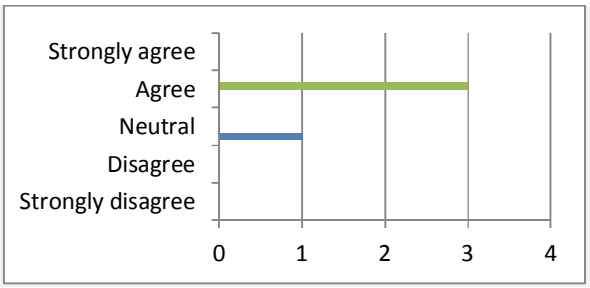
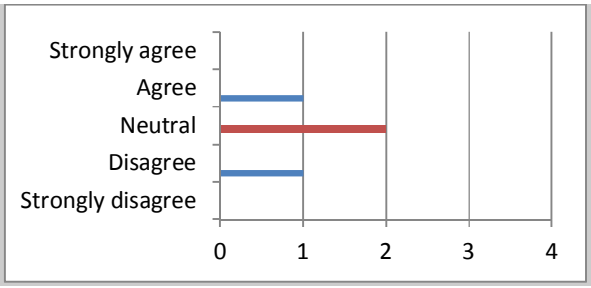
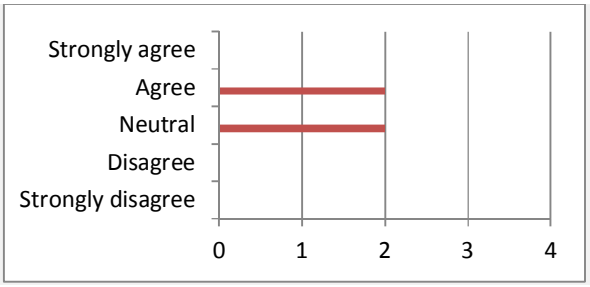
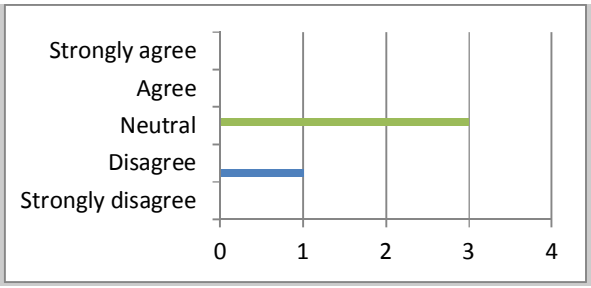
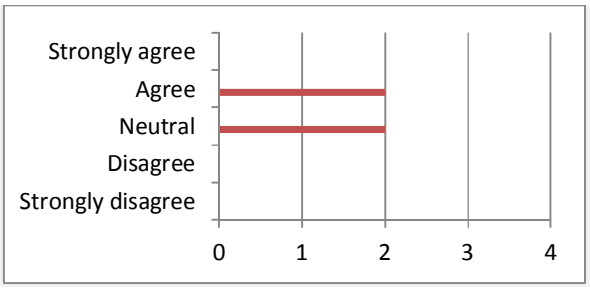
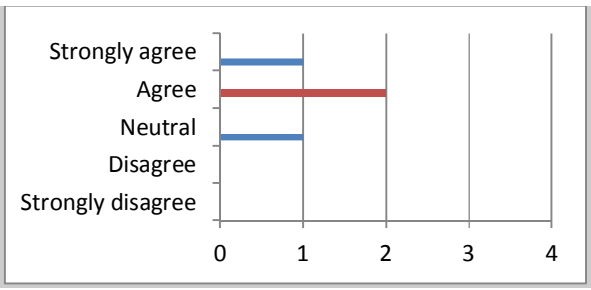
1. Aldea, A. Iacob, M. E. Van Hillegersberg, J. Quartel, D. and Franken, H. (2015a) Capability-based planning with ArchiMate. in 17th International Conference on Enterprise Systems (ICEIS), pp. 352-359.
2. Aldea, A., Iacob, M. E., van Hillegersberg, J., Quartel, D., Bodenstaff, L., & Franken, H. (2015, April). Modelling strategy with ArchiMate. In *Proceedings of the 30th Annual ACM Symposium on Applied Computing* (pp. 1211-1218). ACM.
3. Al-Debei, M. M., El-Haddadeh, R., & Avison, D. (2008). Defining the business model in the new world of digital business. In Proceedings of the Americas Conference on Information Systems (AMCIS) (Vol. 2008, pp. 1-11).
4. Allee, V. (2002), "A value network approach for measuring and modeling intangibles", paper presented at the Transparent Enterprise Conference, Madrid.
5. Amit, R., & Schoemaker, P. J. (1993). Strategic assets and organizational rent.Strategic management journal, 14(1), 33-46.
6. Amit, R., and Zott, C. (2001). Value Creation in eBusiness, Strategic Management Journal, 6-7, 22, 493-520.
7. Argote, L. (1993). Group and organisational learning curves. British Journal of Social Psychology, 32: 31-51.
8. Azevedo, C. L., Iacob, M. E., Almeida, J. P., van Sinderen, M., Ferreira Pires, L., & Guizzardi, G. (2013, September). An ontology-based well-founded proposal for modeling resources and capabilities in ArchiMate. In *Enterprise Distributed Object Computing Conference (EDOC), 2013 17th IEEE International* (pp. 39-48). IEEE.
9. Barney, J.B. (1986). Organizational culture: can it be a source of sustained competitive advantage?. Academy of Management Review, 11 (3): 656-665.
10. Bartlett, C.A. &and Ghoshal, S. (1993). Beyond the M-form: Toward a managerial theory of the firm. Strategic Management Journal, 14: 23-47.
11. Baudry, B., Ghosh, S., Fleurey, F., France, R., Le Traon, Y., & Mottu, J. M. (2010). Barriers to systematic model transformation testing. Communications of the ACM, 53(6), 139-143.
12. Bellman, R., Clark, C.E., Malcolm, D.G., Craft, C.J., Ricciardi, F.M., (1957). On the construction of a multi-stage, multi-person business game. Operations Research 5 (4), 469–503.
13. Bowman, C., & Ambrosini, V. (2003). What Does Value Mean and How is it Created, Maintained and Destroyed?.
14. Brooking, A. (1997. Management of intellectual capital. Long Range Planning, 30 (3): 364-365
15. Cherbakov, L., Galambos, G., Harishankar, R., Kalyana, S., & Rackham, G. (2005). Impact of service orientation at the business level. IBM Systems Journal, 44(4), 653-668.
16. Chesbrough, H. (2010). Business model innovation: opportunities and barriers.Long range planning, 43 (2), 354-363.
17. Chesbrough, H., & Rosenbloom, R. S. (2002). The role of the business model in capturing value from innovation: evidence from Xerox Corporation's technology spin-off companies. Industrial and corporate change, 11(3), 529-555.
18. Coase, R. H. (1937). "The Nature of the Firm." Economica N.S. 4: 386-405.
19. Coff, R. W. (1999). When competitive advantage doesn't lead to performance: Resource-based theory and stakeholder bargaining power. Organization Science, 10: 119–133.
20. Collins, J. C., & Porras, J. I. (1998). Organizational vision and visionary organizations. Leading organizations–Perspectives for a new era, 234-249.
21. DaSilva, C. M., & Trkman, P. (2014). Business Model: What It Is and What It Is Not. Long Range Planning, 47(6), 379-389.
22. de Kinderen, S., Gaaloul, K., & Proper, H. A. (2 Baudry, B., Ghosh, S., Fleurey, F., France, R., Le Traon, Y., Mottu, J.M. (2010). Barriers to systematic model transformation testing. Commun. ACM 53(6), 139–143.
23. de Kinderen, S., Gaaloul, K., & Proper, H. A. (2014). Bridging value modelling to ArchiMate via transaction modelling. Software & Systems Modeling, 13 (3), 1043-1057.
24. de Kinderen, S., Gaaloul, K., & Proper, H. E. (2012). Integrating value modelling into archimate. In Exploring Services Science (pp. 125-139). Springer Berlin Heidelberg.
25. Demil, B., Lecocq, X. (2010). Business model evolution: in search of dynamic consistency. Long Range Plan. 43, 227–246
26. Dietz, J.L.G. (2006). Enterprise ontology: theory and methodology. Springer, Berlin.
27. Dietz, J.L.G. (2006). The deep structure of business processes. Commun. ACM 49 (5), 58–64.
28. Edvinsson, L. and Malone, M. S. 1997. Intellectual capital. The proven way to establish your company's real value by measuring its hidden brainpower. London: Piatkus

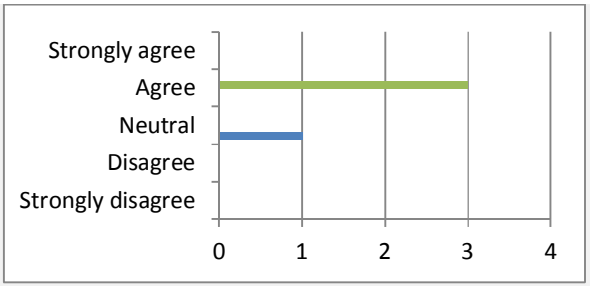
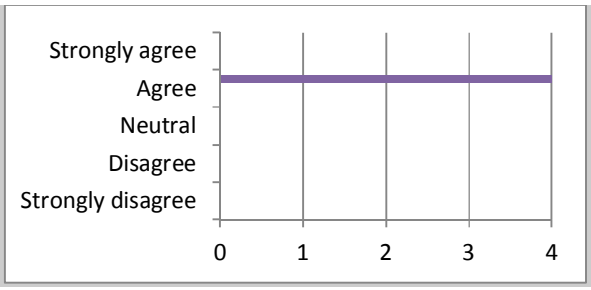
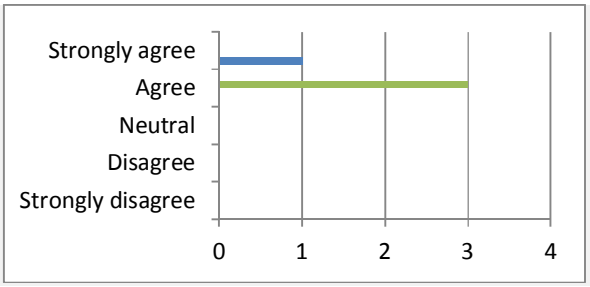
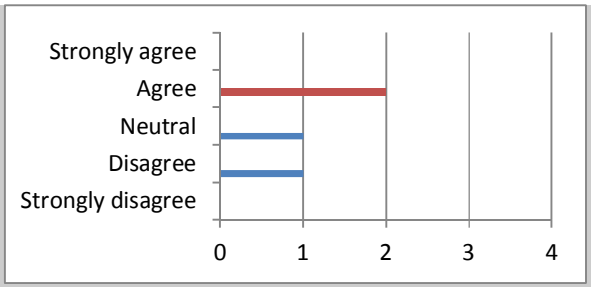
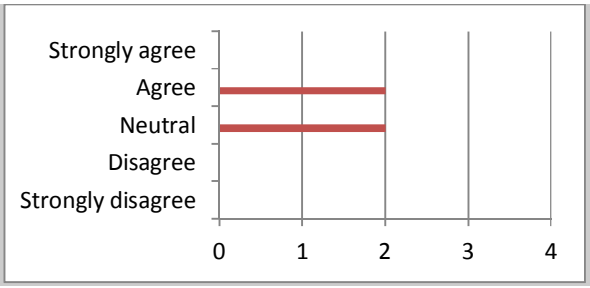
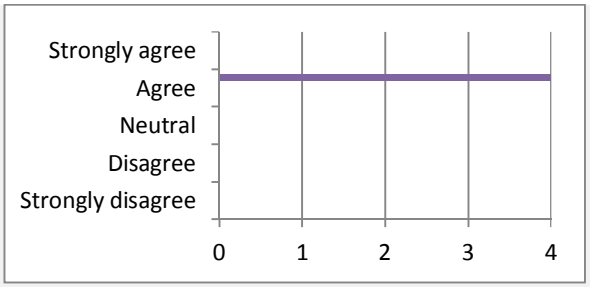
29. Eriksson, H. E., & Penker, M. (2000). Business modeling with UML. Business Patterns at Work, John Wiley & Sons, New York, USA.
30. Ettema, R., & Dietz, J. L. (2009). Archimate and demo–mates to date?. InAdvances in Enterprise Engineering III (pp. 172-186). Springer Berlin Heidelberg.
31. Finkelstein A, Kramer J, Nuseibeh B, Finkelstein L, Goedicke M (1992) Viewpoints: a framework for integrating multiple perspectives in system development. Int J Softw Eng Knowl Eng 2(1):31–58
32. Fleetwood, S. (1997) Aristotle in the 21st century. Cambridge Journal of Economics 21, 729–744.
33. Fritscher, B., & Pigneur, Y. (2011, January). Business IT alignment from Business model to enterprise architecture. In Advanced Information Systems Engineering Workshops (pp. 4-15). Springer Berlin Heidelberg.
34. Gable, G. G. (1994). Integrating case study and survey research methods: an example in information systems. European journal of information systems,3(2), 112-126.
35. Gilbert, J., Henske, P., & Singh, A. (2003). Rebuilding big pharma's business model. IN VIVO-NEW YORK THEN NORWALK-, 21(10), 73-80.
36. Goodhue, D. L., & Thompson, R. L. (1995). Task-technology fit and individual performance. MIS quarterly, 213-236.
37. Gordijn J. and Akkermans J.M. (2001) Designing and Evaluating E-Business Models, IEEE Intelligent Systems, 16 (4), 11-17.
38. Gordijn J., Akkermans H. and Van Vliet J. (2000a) Business Modelling Is Not Process Modelling, in Conceptual Modeling for E-Business and the Web (ECOMO-2000), Springer-Verlag, LNCS 1921, Salt Lake City, USA, October 9-12, 2000, 40-51.
39. Gordijn J., Akkermans J. and Van Vliet J. (2000b) What's in an electronic business model?, in Knowledge Engineering and Knowledge Management - Methods, Models, and Tools, LNAI 1937, 2000, 257-273
40. Gordijn, J. (2002). Value-based requirements engineering: exploring innovative e-Commerce ideas. PhD thesis. Vrije Universiteit Amsterdam.
41. Gordijn, J., & Akkermans, J. M. (2003). Value-based requirements engineering: exploring innovative e-commerce ideas. Requirements engineering, 8 (2), 114-134.
42. Gordijn, J., Yu, E., & van der Raadt, B. (2006). e-Service Design Using i* and e3value Modeling. IEEE software, 23(3), 26-33.
43. Granovetter, M. and Swedberg, M. (2001), The Sociology of Economic Life, Westview Press, Boulder, CO.
44. Hedman, J., Kalling, T. (2003). The business model concept: theoretical underpinnings and empirical illustrations. Eur. J. Inf. Syst. 12(1), 49–59
45. Hu, P. J., Chau, P. Y., Sheng, O. R. L., & Tam, K. Y. (1999). Examining the technology acceptance model using physician acceptance of telemedicine technology. Journal of management information systems, 91-112.
46. Iacob, M. E., Jonkers, D., Quartel, H., Franken, H., & Berg, H. (2012). Delivering Enterprise Architecture with TOGAF® and ARCHIMATE®. BIZZdesign.
47. Iacob, M. E., Meertens, L. O., Jonkers, H., Quartel, D. A. C., Nieuwenhuis, L. J. M., & Van Sinderen, M. J. (2014). From enterprise architecture to business models and back. Software & Systems Modeling, 13 (3), 1059-1083.
48. Iacob, M. E., Quartel, D., & Jonkers, H. (2012a, September). Capturing business strategy and value in enterprise architecture to support portfolio valuation. InEnterprise Distributed Object Computing Conference (EDOC), 2012 IEEE 16th International (pp. 11-20). IEEE.
49. Iacob, M., Jonkers, H., Lankhorst, M., Proper, E., & Quartel, D. A. C. (2013). ArchiMate 2.1 Specification.
50. Janssen, W., van Buuren, R., & Gordijn, J. (2005). Business case modelling for e-services. Proceedings 18th Bled eConference: eIntegration in Action, Bled, Slovenia.
51. Jick, T. D. (1979). Mixing qualitative and quantitative methods: Triangulation in action. Administrative science quarterly, 602-611.
52. Johnson, M. W. (2010). Seizing the white space: business model innovation for growth and renewal. Harvard Business Press.
53. Jonkers, H., Band, I., & Quartel, D. (2012). The ArchiSurance case study. White paper, The Open Group, Spring.
54. Jonkers, H., Proper, E., & Turner, M. (2009). TOGAF™ and ArchiMate®: A Future Together. White Paper W, 192.
55. Khalifa A.S. (2004) Customer value: a review of recent literature and an integrative configuration, Management Decision, 42 (5), 645-666.
56. Kim, W. C. (2005). Blue Ocean Strategy: How to Create Uncontested Market Space and Make Competition Irrelevant/W. *Chan Kim, Renee Mauborgne–Harvard Business Review*.
57. Klein, H. K., & Myers, M. D. (1999). A set of principles for conducting and evaluating interpretive field studies in information systems. MIS quarterly, 67-93.
58. Laffey, D., Gandy, A. (2009). Applying Stabell and Fjeldstad's value configurations to Ecommerce: A cross-case analysis of UK comparison websites, The Journal of Strategic Information Systems. 18 (4), 192-204.

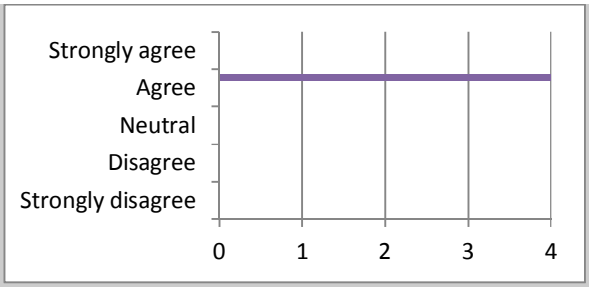
59. Lankhorst, M. (2009). {Enterprise Architecture at Work: Modelling, Communication and Analysis (The Enterprise Engineering Series)}.
60. Lankhorst, M. (2013). Enterprise Architecture at Work: Modelling, Communication and Analysis (The Enterprise Engineering Series).
61. Lee, S.-H., Peng, M. W., & Barney, J. B. (2007). Bankruptcy law and entrepreneurship development: A real options perspective. Academy of Management Review, 32: 257–272.
62. Leist, S., & Zellner, G. (2006, April). Evaluation of current architecture frameworks. In Proceedings of the 2006 ACM symposium on Applied computing (pp. 1546-1553). ACM.
63. Lepak, D. P., Smith, K. G., & Taylor, M. S. (2007). Value creation and value capture: a multilevel perspective. Academy of management review, 32(1), 180-194.
64. MacCauley, S. (1963), "Non-contractual relations in business: A preliminary study", American Sociological Review, vol. 28 no. 1, 55-67.
65. Magretta, J. (2002). Why business models matter. Harvard Business Review, 80(5): 86-92.
66. Makadok, R., & Coff, R. (2002). The theory of value and the value of theory: Breaking new ground versus reinventing the wheel. Academy of Management Review, 27: 10–13.
67. Morris, M., Schindehutte, M., Allen, J. (2005): The entrepreneur's business model: toward a unified perspective. J. Bus. Res. 58(6), 726-735
68. Nahapiet, J. &and Ghoshal, S. (1998). Social capital, intellectual capital and the organizational advantage. Academy of Management Review, 23 (2):42-267
69. Nonaka, I. &and Takeuchi, H. (1995). The knowledge-creating company. Oxford: Oxford University Press.
70. Normann, R., & Ramirez, R. (1993). Designing interactive strategy. Harvard business review, 71(4), 65-77.
71. OMG, (2002). UML profile for enterprise distributed object computing (EDOC), final adopted specification ptc/02-02-05. In 6th International Enterprise Distributed Object Computing Conference (EDOC 2002), 17-20 September 2002, Lausanne, Switzerland, Proceedings. IEEE Computer Society Press.
72. OMG, (2012). VDML Manufacturing Use Case, Doc. No. bmi/2012-11-10. Retrieved from http://files.modelbased.net/vdml/12-11-10.pdf
73. OMG, (2015). Value Delivery Modeling Language (VDML), Doc. No. dtc/2015-03-10. Retrieved from http://www.omg.org/spec/VDML/1.0/Beta2
74. OMG, (2015a). Structured Metrics Meta-Model (SMM) Version 1.1. Retrieved on 10 Sep 2015, from http://www.omg.org/spec/SMM/1.1/
75. Op't Land, M., Proper, E., Waage, M., Cloo, J., & Steghuis, C. (2008).Enterprise architecture: creating value by informed governance. Springer Science & Business Media.
76. Osterwalder, A. (2004). The business model ontology—a proposition in a design science approach. PhD thesis, Universite de Lausanne
77. Osterwalder, A., Pigneur, Y., & Tucci, C. L. (2005). Clarifying business models: Origins, present and future of the concept. Communications of the Association for Information Science (CAIS), 16: 1-25.
78. Osterwalder, A., Pigneur, Y., Oliveira, M. A. Y., & Ferreira, J. J. P. (2011). Business Model Generation: A handbook for visionaries, game changers and challengers. John Wiley & Sons, Inc., Hoboken, New Jersey.
79. Pateli A.G. and Giaglis G.M. (2004) A research framework for analyzing eBusiness models, European Journal of Information Systems, 13, 302-314.
80. Peffers, K., Tuunanen, T., Rothenberger, M. A., & Chatterjee, S. (2008). A design science research methodology for information systems research. Journal of management information systems, 24 (3), 45-77.
81. Phelps, R., Adams, R. & Bessant, J., (2007). Life cycles of growing organizations: A review with implications for knowledge and learning. International Journal of Management Reviews, 9(1), 1-30.
82. Pijpers, V., Gordijn, J., & Akkermans, H. (2009). e3alignment: Exploring inter-organizational alignment in net worked value constellations. IJCSA, 6(5), 59-88.
83. Pombinho, J., Aveiro, D., & Tribolet, J. (2012). A Value-Oriented Approach to Business/IT Alignment–Towards Formalizing Purpose in System Engineering. Advanced Information Systems Engineering Workshops (pp. 555-566). Springer Berlin Heidelberg.
84. Porter, M. (1985). Competitive advantage: Creating and sustaining superior performance. New York: Free Press.
85. Porter, M. E. (2008). Competitive advantage: Creating and sustaining superior performance. Simon and Schuster.
86. Post, J., Preston, L., & Sachs, S. (2002). Redefining the corporation: Stakeholder management and organizational wealth. Stanford, CA: Stanford University Press.
87. Priem R.L. (2007) A Consumer Perspective on Value Creation, The Academy of Management Review, 32 (1), 219-235.
88. Rother, M., & Shook, J. (2003). Learning to see: value stream mapping to add value and eliminate muda. Lean Enterprise Institute.
89. Salem Khalifa, A. (2004). Customer value: a review of recent literature and an integrative

configuration. Management decision, 42(5), 645-666.
90. Schuster, R., & Motal, T. (2009, July). From e3value to REA: Modeling Multi-party E-business Collaborations. In Commerce and Enterprise Computing, 2009. CEC'09. IEEE Conference on (pp. 202-208). IEEE.
91. Senge, P. (1990). The Fifth Discipline. New York: Doubleday.
92. Singh, P. M. (2013). Integrating business value in enterprise architecture modeling and analysis.
93. Sirmon, D. G., Hitt, M. A., & Ireland, R. D. 2007. Managing firm resources in dynamic environments to create value: Looking inside the black box. Academy of Management Review, 32: 273–292.
94. Stabell, C. B., & Fjeldstad, Ø. D. (1998). Configuring value for competitive advantage: on chains, shops, and networks. Strategic management journal,19(5), 413-437.
95. Sveiby, K. E. (1997). The new organizational wealth. Managing and measuring knowledge-based assets. San Francisco: Berrett-Koehler Publishers
96. Teece, D. J. (2010). Business models, business strategy and innovation. Long range planning, 43(2), 172-194.
97. The Open Group. (2013). ArchiMate 2.1 Specifications. Zaltbommel: Van Haren Publishing.
98. Timmers, P. 1998. Business models for electronic markets. Electronic Markets, 8(2): 3-8.
99. Tranfield, D., Denyer, D. & Smart, P., (2003). Towards a Methodology for Developing Evidence-Informed Management Knowledge by Means of Systematic Re-view. British Journal of Management, 14, 207-222.
100. van Buuren, R., Jonkers, H., Iacob, M. E., & Strating, P. (2004, January). Composition of relations in enterprise architecture models. In ICGT (Vol. 3256, pp. 39-53).
101. Vanhaverbeke, W., & Cloodt, M. (2006). Open innovation in value networks. Open innovation: Researching a new paradigm, 258-281.
102. Vargo, S. L., Lusch, R. F. (2004) Evolving to a new dominant logic for marketing. Journal of Marketing 68(January), 1–17.
103. Vargo, S. L., Maglio, P. P., & Akaka, M. A. (2008). On Value and value co-creation: A service systems and service logic perspective. European Management Journal, 145-152.
104. Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. MIS quarterly, 425-478.
105. Vidich, A. J., & Shapiro, G. (1955). A comparison of participant observation and survey data. American Sociological Review, 28-33.
106. Wiering, M. J., Bonsangue, M. M., van Buuren, R., Groenewegen, L. P. J., Jonkers, H., & Lankhorst, M. M. (2004). Investigating the mapping of an Enterprise Description Language into UML 2.0. Electronic Notes in Theoretical Computer Science, 101, 155-179.
107. Williamson, O. E. (1975). Markets and Hierarchies - Analysis and Antitrust Implications: A study in the Economics of Internal Organization, Free Press.
108. Zott, C., & Amit, R. (2010). Business model design: an activity system perspective. Long range planning, 43(2), 216-226.

Appendix A

Catalog	Questions	Score
Usefulness	1-1. I would find the method useful in my job.	
	1-2. Using the method in my job would enable me to accomplish tasks more quickly.	
	1-3. Using the method would improve my job performance (how well I do my job).	
	1-4. Using the method in my job would increase my productivity.	
	1-5. Using the method would increase my effectiveness on the job (how successful).	
Ease of use	2-1. Learning to use the method would be easy for me.	

	2-2. I would find it easy to get the method to do what I want it to do.	
	2-3. My interaction with the method would be clear and understandable.	
	2-4. It would be easy for me to become skillful at using the method.	
	2-5. I would find the method easy to use.	
Self-efficacy	I could complete a job or task using the system...	
	3-1. If there was no one around to tell me what to do as I go.	
	3-2. If I had a lot of time to complete the job for which the software was provided.	

	3-3. If I had just the built-in help facility for assistance.	

Open question

Is the proposed value viewpoint a good representation of value creation at both strategy and process level?

Answer A:
Yes, I really like the fact that you created a relatively simple way of combining different viewpoints. I'm not acquainted with ArchiMate tool, but for me it was clear!

Answer B:
Yes, but ArchiMate-like visualizations might not always be the best option for all stakeholders (e.g. Managers).

Answer C:
I like the viewpoints you defined. Especially since every viewpoint maps to a phase of value creation. This makes them complementing to each other and easy to use when operating a strong line. This could be an advantage for the Enterprise Architects when presenting to managers.

Answer D:
ArchiMate does not have suitable graphical representation, you should look into alternative graphical representations, like those used by www. strategyzer.com. The meta-model seems to be fine from my perspective.