Leiden University

IT in Business

Enterprise Architecture
Mapping of BMC, DEMO and ArchiMate

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Date: 20 June 2016

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Master Thesis

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“De taal is het voertuig van de geest - Language is the vehicle of the mind ”

Driek van Wissen

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ABSTRACT

In need of continuous change, many big organisations face a complexity increase in their current information systems portfolio. This often leads to undesirable high IT costs, difficulties in ensuring the reliability of data, and lack of flexibility and agility. One of the resolutions to this complexity increase is the introduction of Enterprise Architecture (EA). For a long time, the Ministry of Defence (hereinafter referred to as MinDef) has been looking into how they can work under architecture. Several initiatives have been launched. At the beginning of 2013, the first architecture was made, named IDA (Integrale Defensie Architectuur – Integrated Defence Architecture). IDA uses different EA methods and techniques. The three main methods are: Business Model Canvas (BMC), Design and Engineering Methodology for Organisations (DEMO), and ArchiMate. It is therefore interesting to know what the relationship is between these methods and how we can translate a component from one method to another. If one component is changed in one place, will the change happen in another place accordingly? And if so, what and where can the consequences be found? Is the relationship based on interpretation or certain rules?

The research objective of this thesis project is to provide a model transformation from BMC to ArchiMate, from BMC to DEMO, and from DEMO to ArchiMate.

To achieve the research objective, we have conducted a theoretical and practical comparative evaluation of BMC, DEMO and ArchiMate. First the three methods were studied and compared according to the analysing framework from Wijers (1991). Then, the mappings between the methods were performed by comparing the concept definition of the methods with each other. The result of this comparison was used as a basis for a survey and was submitted to the leading national and foreign enterprise architecture experts for their opinion. Regrettably, very few replies were received. The founding father of ArchiMate (Lankhorst) was the only one, besides nine Enterprise Architects of MinDef, who filled out the survey completely. Quite unexpectedly however, following the survey, a worldwide debate started between the involved experts. Apparently, the survey touched upon a controversial subject! The community was divided in two groups with different opinions on how enterprise architecture methods are related. After recovering from the shock of the discussion that we started inadvertently, we have applied the three methods on the practical case of ArchiSurance.

The following conclusions are drawn:

(1) The experts are not unanimous in their opinions about how enterprise architecture methods relate;

(2) The mapping between the three methods from our study is not generalizable, as very few replies were received from the survey;

(3) Despite the fact that the EA community is divided by different opinions, we find that:
   a. ArchiMate concepts can be linked to the BMC concepts;
   b. DEMO concepts can be linked to the BMC concepts;
   c. We could not arrive at a conclusion about the relationship between DEMO and ArchiMate. The case of ArchiSurance provided only three concepts, which can be used to link DEMO to ArchiMate. There is too little evidence to conclude anything about the mapping between ArchiMate and DEMO and to validate our proposed rules. Further, the practical comparison between DEMO and ArchiMate did not correspond with the theoretical one. It would be premature and incorrect to conclude that concepts in DEMO and ArchiMate cannot be linked. We rather think that our proposed rules need to be adjusted at this point. More study is needed to provide a reliable result;

(4) Our experience from applying the three methods on the practical case of ArchiSurance shown that working with predefined rules is very easy. It improves the accuracy and consistency between the models involved;

(5) It is very useful to combine all three methods together. In doing so, we can identify the missing or implicit components in order to produce a complete and consistent model;

(6) However, before combining the methods, one first needs to determine why and wherefore it is done, as, depending of the framework, the mapping results can be different.

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1 INTRODUCTION

1.1 RESEARCH BACKGROUND

Enterprise Architecture

In need of continuous change, many big organisations face a complexity increase in their current information systems portfolio. This often leads to undesirable high IT costs, difficulties in ensuring reliable of data, and lack of flexibility and agility. One of the resolutions to this complexity increase is the introduction of Enterprise Architecture (EA). The application of EA is expected to make the information systems portfolio more manageable and to prevent further increase in complexity, thereby freeing much needed resources for development and innovation.

Maes stated that EA is considered as the "missing link" between strategy & implementation, and business operation & IT operation (Maes, Rijsenbrij, & Truijens, 1999). Raymond Slot analyzed a forty-night IT-projects and concluded that EA plays a pivotal role in improving the effectiveness of the use of IT assets within a corporation. EA also improves IT impact on business performance and, consequently, allows IT investments to have measurable effects on business performance (Slot, 2010).

Although organisations are becoming progressively aware that they need EA to manage the complexity of their processes and information systems, there are still many questions to be answered as how to implement an effective EA in practice. Organisations often have trouble in implementing EA in their organisations. The doctoral research "*Research of Maturity and Effectiveness of Enterprise Architecture*" (Van Steenbergen, 2011) reveals a number of weaknesses, notably monitoring projects on compliance and aligning the choices, which were made in the EA with the business strategy and goals. Steenbergen's research also shows that the public government sector received fewer EA benefits than the financial sector and other economic sectors. This might be explained by the finding that projects in the government sector comply less frequently with the EA prescriptions. The financial sector appears to more frequently employ formal EA techniques like the use of instruments.

The paradox between, on the one hand architecture experienced with a complication, on the other the need for reduction in complexity, became the cause of the graduation project of Lieutenant-Colonel Van Dipten. In his graduation project, Van Dipten concentrated on the universal model for the Enterprise Architecture: Basic Enterprise Engineering Map (BEEM) (Van Dipten, 2010).

BEEM proves to be a useful model to have insight in the coherence of activities and results within the area of IT. By making the difference between function and construction on the one side, and specification and design on the other, it is possible to define and approach different aspects of an organisation or a system, and after that we can determine which principles must be incorporated in the architecture (Van Dipten & Mulder, 2011).

BEEM is based on the Generic System Development Process (GSDP) (Dietz, 2008), a component of the Design and Engineering Methodology for Organisations (DEMO) (Dietz, 2006). BEEM is a product that arose when four activity kinds and three system kinds being added to the GSDP. As a result, BEEM provided added value over and above the GSDP. Up to the opinion of the researcher Van Dipten, BEEM should cover the whole IT-area, and BEEM is also useful for any organisation (Van Dipten & Mulder, 2011).

Enterprise Architecture at Ministry of Defence

For a long time, the Ministry of Defence (hereinafter referred to as MinDef) has been looking into how they can work under architecture. Several initiatives have been launched. In 2004 MinDef introduced DIVA (which is the acronym used for the Defensie Informatie Voorziening Architectuur –

Defence Information Service Architecture). The intent of DIVA is offering a framework to incorporate the architecture products, to make an internal coherence transparent and to support working under architecture. DIVA is set up based on the Strategic Alignment Model Enhanced (SAME). SAME is derived from the Strategic Alignment Model of Henderson and Venkatraman, and is closely aligned to the nine-building blocks of MAES. In 2010, after a Master research, van Dipten concluded that DIVA had totally failed. The reasons for this failure are: (a) an ambiguous use, (b) a lack or insufficiency of knowledge in outsiders, suppliers, customers, employees, and (c) a lack of instructions to achieve 'working under an architecture' (van Dipten, 2010). It was also founded that each department had their own method and used their own terminology. There was thus insufficient coordination in this area. It was not clear how the modeling of one department is in line with other business layers (Hinfelaar, 2010).

In 2012, Van Dipten introduced the function and construction perspectives based on the BEEM within the MinDef organisation. At the beginning of 2013, the first architecture was introduced within MinDef, named IDA (Integrale Defensie Architectuur – Integrated Defence Architecture).

IDA's working method can be briefly summarized as follows:

(a) **Business Analysis**. We need to bring matters, which may arise within the organisation and in its surroundings, into sharper focus. These matters include: products, clients, procedures, resources, and main activities which are needed to deliver a product or service to the customer;

(b) **Business Design**. The results of the step Business analysis will be separated from issues that depend on the implementation and on the existing solutions. This offers the possibility to become independent of the choices made in the past, and to work with the new insights. The conceptual architecture is in fact the scale model of the desired situation;

(c) **Solution Direction Architecture**. In this phase the possible solution will be made, based on the requirements, framework, principles and conditions in which the organisation is operating. This is in fact the development plan where the as-is and the to-be situations are described. This provides a practical tool for the roadmaps and related programs. The intent will be laid down in the Project Start Architecture (PSA);

(d) **Solution Architecture.** The solution architecture consists of the specifications and designs for the system, including the required soft- and hardware interfaces. The specifications and designs will be evaluated and assessed prior the realization. The test- and implementation plans will also be described in this phase;

(e) **Realization.** In this phase, the implementation will be prepared, the solution will be realized, tested, and implemented;

(f) **The cohesion within the Enterprise Architecture.** IDA expects that the organisation consists of three layers: Business, Application, and technology, based on three layers of ArchiMate;

(g) **Methods and techniques**. IDA uses the following methods and techniques, which are widely accepted:

- **TOGAF ADM** (The Open Group Architecture Framework - Architecture Development Method) describes a method for developing and managing the lifecycle of enterprise architecture. Architecture process is placed on a prominent place in TOGAF ADM. Dutch government has chosen TOGAF as a standard EA methodology. MinDef is using TOGAF processes as a basis for the design and implementing of their architecture function;
- **DYA** (Dynamic Architecture) is an enterprise architecture framework developed by the consulting company Sogeti. In addition to TOGAF, MinDef uses DYA to get and keep their architecture functions working within their organisation. DYA provides guidelines and instructions to help implementing architecture functions effectively;

- **BMC** (Business Model Canvas) is a powerful method to identify the business model on a transparent and comprehensible manner. Thanks to the visual, practical, and intuitive aspects, Business Model Canvas makes group discussions easier. It supports the involved stakeholders on the coming changes;
- **DEMO** (Design & Engineering Methodology for Organisations). MinDef uses DEMO to make the construction of their department transparent. DEMO offers a number of advantages, such as:
  - '*looking from the outside in*': firstly, we need to address which architecture functions are needed. Then we can examine how to realize these functions, and which actor roles are required;
  - *The essentials fully covered*: The organisational structure is complex. DEMO can help manage the complexity without losing anything;
  - *Visible organisational construction*: DEMO describes work that needs to be done regardless the structure of the organisation. Reorganisation meant a shift or moving into sharing of work;
- **ArchiMate** is used as a modeling language that allows organisations to represent the knowledge that drives their processes.

The following figure shows the three methods together within MinDef

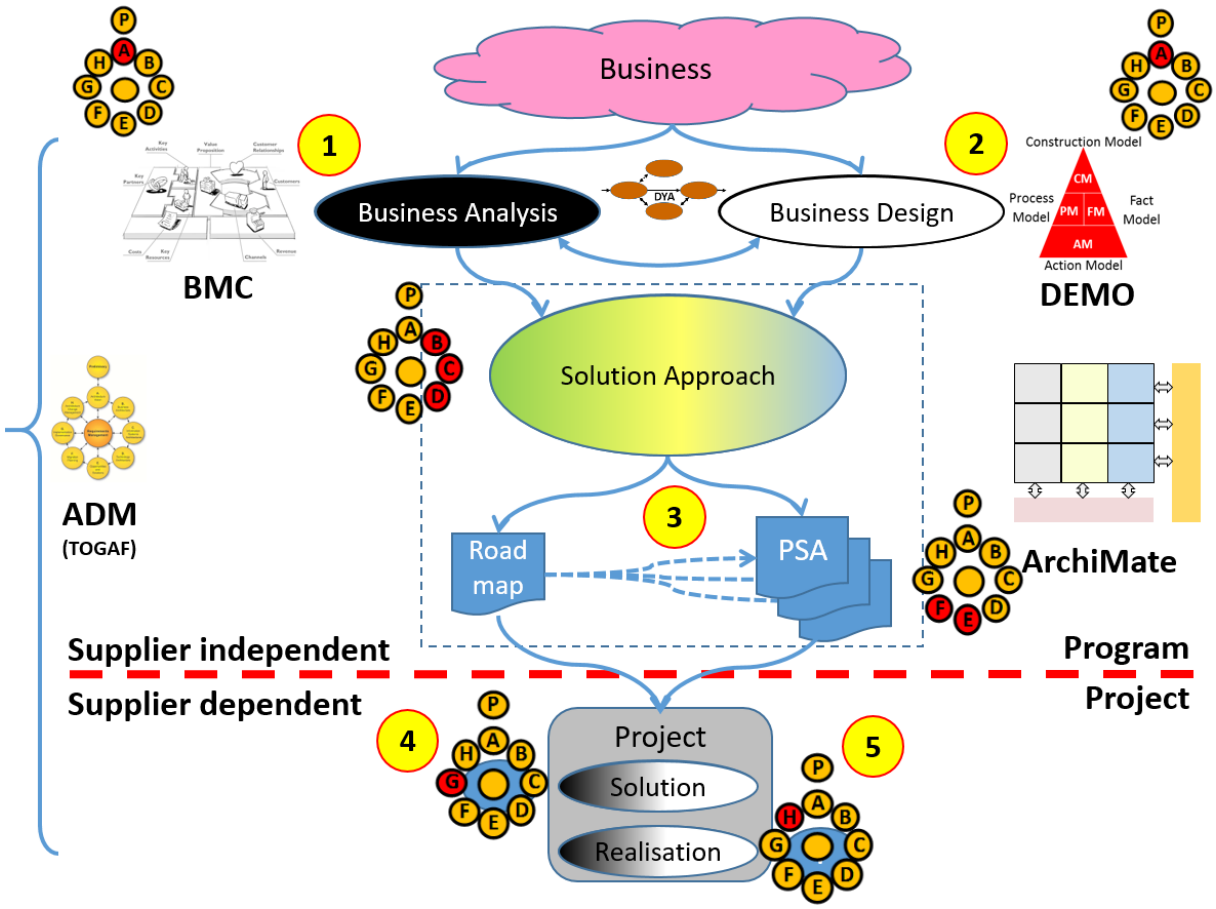


Figure 1.1: Relationship of EA methods within IDA, MinDef

1.2 RESEARCH PROBLEM

Every EA method has its own disadvantage. The method could benefit if we integrate the methods with each other. This is why MinDef needs not only one but four EA methods to make their Enterprise Architecture transparent. MinDef uses TOGAF ADM as an architecture development method and as a guide throughout their organisation. BMC is used in the Business Analysis step to gain insight into the As-Is and the To-Be situations. In the step Business Design, DEMO uses the result of BMC to make the scale model of the desired situation. After this, ArchiMate will pick up the products of DEMO and BMC, and makes the Solution Direction Architecture.

MinDef has integrated the EA methods BMC, DEMO and ArchiMate. It is therefore interesting to know what the relationship is between these methods and how we can translate a component from one method to another. If one component is changed in one place, will the change happen in another place accordingly? And if so, what and where can the consequences be found? Is the relationship based on interpretation or certain rules?

1.3 RELATED STUDIES

A literature search yields the following:

- Iacob (Iacob, M.E.; Meertens, L.O.; Jonkers, H.; Quartel, D.A.C.; Nieuwenhuis, L.J.M.; van Sinderen, M.J., 2012) proposed an approach to relate enterprise models specified in ArchiMate to business models modeled using Business Model Canvas. To define the correspondences, Iacob et al compared concepts defined by BMC (building blocks) to the concepts defined by ArchiMate. The proposed BMC – ArchiMate relations are used to demonstrate how architecture-based cost analysis can be used to provide the necessary quantitative input for the business models based cost/revenue analysis;
- Ettema (Ettema & Dietz, 2009) made a theoretical and practical comparison of ArchiMate and DEMO. His conclusions are: (a) the two approaches are hardly comparable, (b) the business layer of ArchiMate corresponds to all three layers of DEMO, without a possibility to distinguish between them and (c) ArchiMate could benefit from adopting DEMO as its front-end approach, thereby enforcing the rigorously defined semantics of DEMO on the ArchiMate models;
- De Kinderen (De Kinderen, S.; Galoul, K.; Proper, E., 2012) contributed a formal model transformation from DEMO to ArchiMate, and shown how the model transformation can be used to transform DEMO models into ArchiMate models. The model transformation approach is illustrated by a fictitious but realistic case study from the insurance domain;
- Zivkoviv et al. have described a number of metamodel mapping techniques (Zivkovic, S; Kuhn, H; Karagiannis, D, 2007). These techniques can help us to carry out this study.

The above studies will be discussed later in this research, and as far as possible, the results will be used for the comparison with our research results.

1.4 RESEARCH OBJECTIVE

Each individual EA method has its own flaws. Moreover, the individual method is not powerful enough to address sufficiently the whole enterprise architecture. To address this issue, we need to integrate the EA methods.

The research objective of this study is to provide a model transformation from BMC to ArchiMate, from BMC to DEMO, and from DEMO to ArchiMate.

1.5 HYPOTHESIS

On the basis of the research problem as described before, the following hypothesis will be formulated:

Hypothesis: The combination of concepts in the Enterprise Architecture methods BMC, ArchiMate and DEMO is feasible and more powerful than individually applied.

1.6 MAIN RESEARCH QUESTION

Based on the research problem and the hypothesis, the main research question to answer in this study is:

MRQ: To what extent can we compare the Enterprise Architecture (EA) methods BMC, DEMO, and ArchiMate?

To integrate and to use the EA methods in combination, it is a necessity to investigate on the relationship between the aforementioned methods.

1.7 SUB QUESTIONS

The research question is broad and open, that contains a number of underlying themes that need further elaboration. The outcome of each sub question will contribute to the answer of the main research question. The following sub questions are established in order to answer the main question.

- *SQ1: To what extent can the three methods be compared on the way of thinking?*
  The Way of Thinking is one of the most important aspect of the evaluation framework. In response to this sub question, the theoretical foundation of the methods will be analysed and compared to each other.
- *SQ2: To what extent can the three methods be compared on the way of modelling?*
  This sub question helps us to analyse and compare the methods on the second most important aspects of the evaluation framework: the way of modelling. It means that the dominant modelling techniques of the enterprise will be analysed and compared.
- *SQ3: To what extent can the three methods practically be compared?*
  To answer this question, a case study will be chosen and the three methods will be applied on the case. The results will then be analysed in order to validate the theoretical comparison.

1.8 RELEVANCE

As mentioned before, each individual EA method has its own flaws and is not powerful enough to address sufficiently the whole enterprise architecture. To address this issue, we need to integrate and combine the EA methods together. To use the methods in combination, the models need to be linked together.

This study provides a model transformation from one method to another one. The model offers the following benefits:

- The methods can be integrated in a uniform manner;
- Ensure a uniform approach to work and to benefit the architecture;
- On enterprise level, the model can be used for an impact analysis;
- Proper rules make work easier and better for the architects;

- Improve standardized method;
- The idea of using the EA methods in combination is originated at MinDef. However, the lessons learned from this study can be applied in the overall enterprise architecture, which can be used in any environment and/or organisations.

1.9 SCOPE

One of the predefined boundaries is to study the relationship between BMC, DEMO, and ArchiMate. TOGAF and DYA are only used as a way of thinking and are beyond the scope of this research.

The second boundary defined is to execute the research only in the business layer. Reasons for making this choice are:

- there is a demand of a well-defined business domain modeling to provide the requisite information for identifying business components;
- BMC is clearly focused on the Business layer;
- the power of DEMO is primarily on the business layer (O-organisation) where the decisions and judgments are made;
- from a business perspective, the ArchiMate's business layer must be structured in a logical manner to be able to specify the underlying support components or from bottom-up the appropriate assignment from the business layer components.

2 RESEARCH METHODOLOGY

This section will outline the general research methods and plan on carrying out the proposed research.

2.1 QUALITATIVE RESEARCH

The research is based on an explorative approach in which various research methods are used. The research has the characteristic of an empirical research because it is performed by gathering information through literature study, observations, and interviews with colleagues and various EA experts.

This explorative research can be labeled as a qualitative research because (a) it focuses on the possibilities to integrate the EA methods, and (b) it is done through qualitative data gathering and qualitative data analysis.

2.2 RESEARCH PHASES

The research consists of four phases, which are described below:

- **Phase 1**: Firstly, we start with an extensive literature research about the philosophy behind the methods, their advantages and their applications. We are also interested in literature in the field of mapping and comparison of the methods. Drawing on the current literature, DEMO, BMC and ArchiMate are analyzed and compared against five different aspects: These aspects are categorized as: *way of thinking, way of modeling, way of working, way of controlling,* and *way of supporting*. After this, the methods will be compared with each other in the field of the Way of Thinking. This information can be found in chapter three.
- **Phase 2**: In this phase, an attempt will be made to relate the three EA methods. The identified mappings will be used as a basis for a survey. The Enterprise Architects within MinDef will be invited to take the survey. This phase has a twofold objective: on the one hand to assess the mapping between the methods and on the other hand to determine whether the survey is well structured. Their replies and comments will be analysed. If needed, the survey will be adapted. After this, the leading national and foreign enterprise architecture experts will be invited to give an assessment on the accuracy of the mappings. Their replies and comments will be subsequently analysed and evaluated. Conclusions can then be drawn. The information can be found in chapter four.
- **Phase 3**: After the theoretical comparison, a practical case will be chosen on where the methods can be applied. This way, the methods can be compared on a practical base. This information is described in chapter five.
- **Phase 4**: In this phase, the results of previous phases will be combined and definitive conclusions will be drawn. Answer to the main research question will be given. This phase will be completed and followed with a report in the form of a master's thesis report. Chapter six reports the conclusions and findings of this research and answers the research questions of Chapter one. Chapter seven introduces some discussions.

The phase sequence is shown in the following figure:

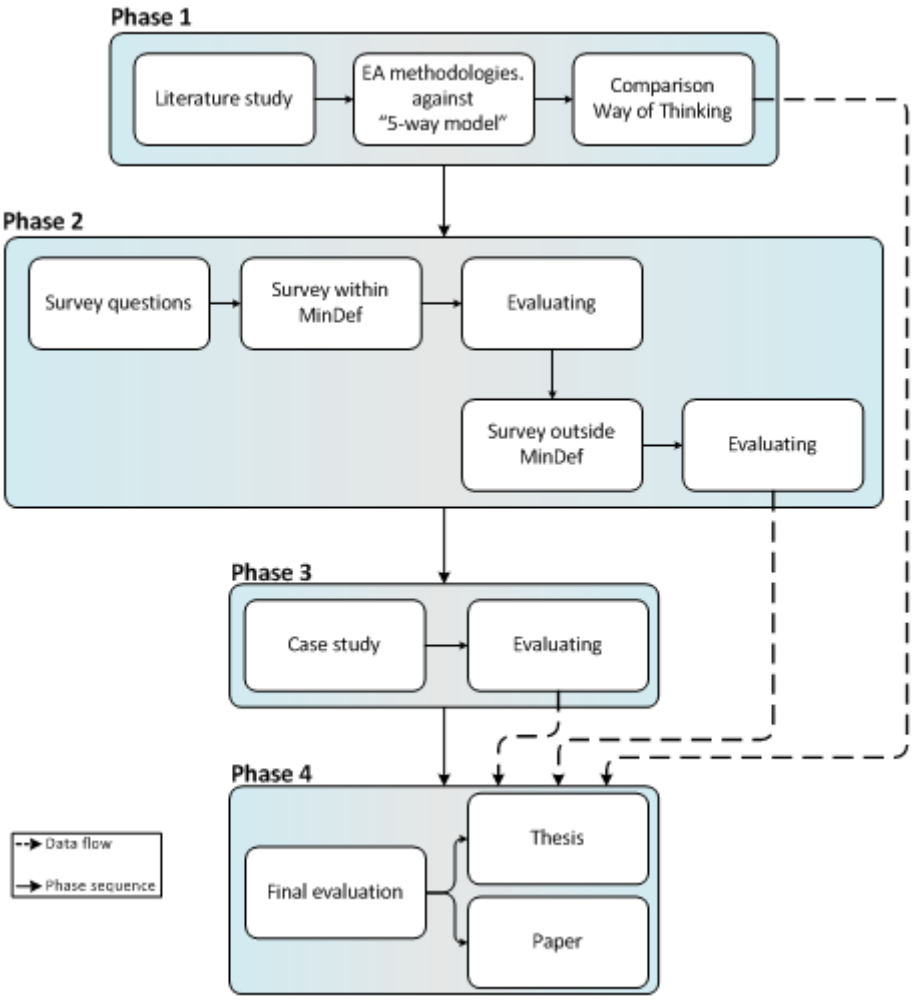


Figure 2.1: Thesis project phases

2.3 SUMMARY

Until now, we have read why and how the research is organised. The next chapter will describe the first phase of the thesis project. The three methods will be analysed and compared against five aspects.

3 THE ENTERENTERPRISE METHODS

In this chapter, the three methods DEMO, Business Model Canvas and ArchiMate will be studied accordingly to the analysing framework from Wijers (1991). Section 3.1 describes the analysing framework. Sections 3.2 to 3.4 show the analytical results of the methods one-by-one. Finally, section 3.5 describes the comparative evaluation of the Way of Thinking between the three methods.

3.1 A FRAMEWORK FOR ANALYSING METHODS

This study uses the framework presented by Wijers (1991) to analyse and compare the methods. The framework is invented especially to analyse information system methods. Information System methods can be analyzed and assessed against five criteria that each addresses specific aspects of the intervention process. These components are called "ways" and describe different aspects of a method:

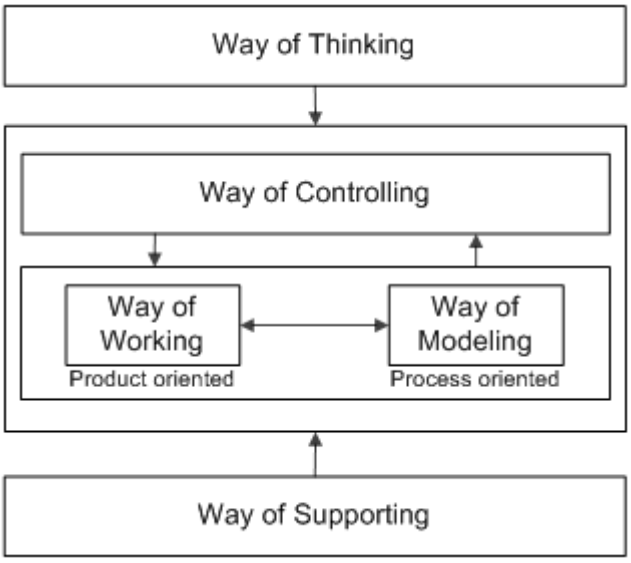


Figure 3.1: Framework for understanding the information system development process

- The *way of thinking* describes the philosophy, principles, and assumptions of a method;
- The *way of modelling* contains the models that are used to represent some aspects of a method;
- The *way of working* describes the process of intervention or developing a solution. It shows the method by which a solution can be achieved. It defines the possible tasks, their sub-tasks as well as the sequence of execution;
- The *way of controlling* describes a manner by which the accuracy, consistency of the obtained solutions can be checked. Since the way of controlling is concerned with the management aspects of the method, it is one level higher than the way of modelling and working;
- The *way of supporting* refers to the ways by which the method is supported by peers, other companies. This includes tools, instructions, tips, courses, trainings, etc.

3.2 DEMO

DEMO (Design and Engineering Methodology for Organisations) a methodology for designing and engineering organisations that has been laid down by Dietz (2006). DEMO focuses on explaining how and why people cooperate and communicate. The main goal of this methodology is to align the design and development processes to the core processes of an organisation. It considers that entering into and complying with commitments is the key principle that operates an organisation.

- **The Way of Thinking.** DEMO has a strong theoretical background. DEMO based on the ψ-theory (PSI theory), is a methodology for designing and engineering organisations. The ψ-theory comprises of four core axioms and one theorem:
  - *Operation axiom*: In this axiom, the actor role has a central place. An actor can perform two kinds of acts: *production acts* (P-acts) and *coordination acts* (C-acts). Production acts are key

activities that deliver values propositions of the enterprise. By performing Coordination acts, the actors enter into and comply with commitments regarding Production-acts. P-acts and C-acts produce results. The result of a production act is a production fact (P-fact) and the result of a coordination act is a coordination fact (C-fact).

- *Transaction axiom* states that a transaction always involves two actors (the *initiator* and the *executor*), and three phases (*order phase, execution phase,* and *result phase*). The actor who starts the transaction is the *initiator*. The executor is the actor who executes the request. In the *order phase* (O-phase), the *initiator* and the *executor* negotiate for achieving consensus about the P-fact that the *executor* is going to bring about. The main C-acts in the O-phase are the *request* and the *promise*. In the *execution phase* (E-phase), the P-fact is brought by the *executor*. In the *result phase* (R-phase), the *initiator* and the *executor* negotiate for achieving consensus about the P-fact that is actually produced (which may differ from the requested one). The main C-acts in the R-phase are the *state* and the corresponding *accepts*.
- *Composition axiom* states that a business process is a collection of causally related transactions. The starting step is a request from an actor outside or within the organisation. The result of a successful transaction is the creation of a *Production fact*.
- *Distinction axiom* states that there are three distinct human abilities playing a role in the operation of actors, called performa, informa, and forma. These abilities regard communicating, creating things, reasoning and processing information.
- *Organisation theorem* states that the organisation of an enterprise is a heterogeneous system that is constituted as the layered integration of three homogeneous systems: (a) the business organisation (B-organisation), which performs ontological transactions, the informational organisation (I-organisation), which performs infological transactions, and the data organisation (D-organisation), which performs datalogical transactions.

  The B-organisation is the essential organisational layer that communicates and produces facts to realize business results. This organisational layer exists out of actors who are producing unique and definitive facts. On this organisational layer the actors interact with other social entities (actors) in the system.

  In the I-organisation layer, data are calculated, processed, and converted into information, and then presented to the business layer.

  The D-organisation layer is responsible for storing, copying, searching, changing and removing of data. The data organisation layer communicates with the informational layer. This means that the data layer provides the data that is required for an informational process and stores the data afterwards.

DEMO characterizes an organisation as a network of actors, each having specific actor roles. They have the ability to interact with each other by performing *coordination acts*. By performing a *coordination act* the performer informs the other party about his intention with respect to a *production*. In coordination acts *actor roles* can request, promise to deliver, question or declare a production. Production is the result of a production act that is performed by one actor role. Production will be delivered to the environment or another actor role inside the system that has requested that production.

- **The Way of Modelling**. The way of modelling can be found in four models: "*Construction model*", "*Process model*", "*Action model*", and "*Fact model*". Models belong to the B-organisation.

  The *construction model* (CM) specifies the construction of the organisation and its corresponding *transactions* and *actor roles*. The *Process model* (PM) describes the basic steps and the relations between them. The *Action model* (AM) represents the action rules for the enterprise and is often referred to as *business rules* and *work instructions*. The *Fact model* (FM) shows all information items in the *production world* and is referred to as *business objects* and *business facts*.

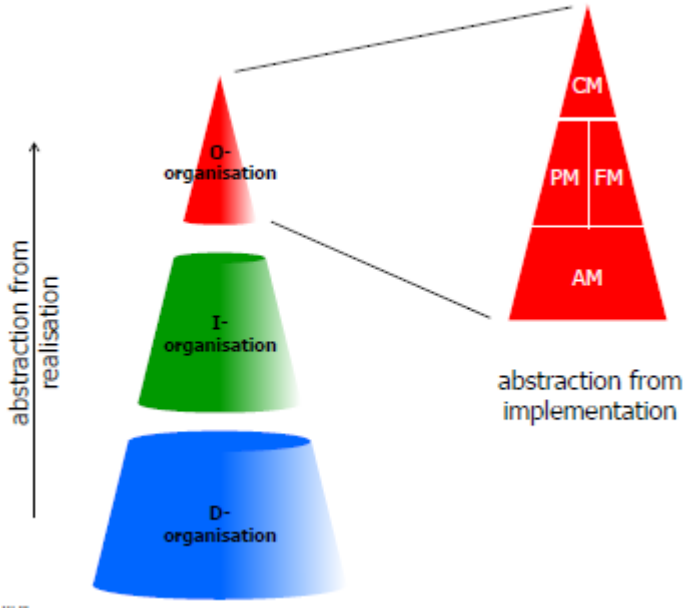


Figure 3.2: The essential model of an organisation

- **The Way of Working**. In the Enterprise Ontology book, Dietz (2006) presented the six-step method to devise ontological models. This way of working is referred as DEMO-2 Way of Working.
  1. **Step one: The Performa-Informa-Forma Analysis**. First of all, we need to reduce the complexity of the organisational model. The analysis can be best done by coloring the appropriate parts of the descriptions: red for Performa (B-organisational) items, green for Informa (I-organisational) items, and blue for Forma (D-organisational) items. The intention of this step is to separate the B-organisational items from other items.
  2. **Step two: The Coordination-Actors-Production Analysis**. In the previous step, the Performa items are identified. In this step, we divide the B-organisational items into Coordination-acts/facts, Production-acts/products, and actor roles.
  3. **Step three: The Transaction Pattern Synthesis**. In this step, we cluster the C-acts/facts and P-acts/products in the B-organisation into transaction types. Then, we formulate the product type for every transaction type.
  4. **Step four: The result Structure Analysis**. The causal and conditional relationship between the identified transactions are determined
  5. **Step five: The Construction Synthesis**. In this step we identify the actor roles that serve as the initiator and/or the executor of the transaction types, which have been found in the previous step.
  6. **Step six: The organisation Synthesis**. Following the previous analysis, we now can make the *Construction Model,* represented in an *Organisation Construction Diagram (OCD)* and a *Transaction Product Table (TPT)*.
  7. After the six-step method, we can produce other aspect models parallel and incrementally, instead of producing one aspect model after the other. This way of working appears to enhance the integrated understanding of an ontological model. In addition, it demonstrates that all aspect models are equally important for understanding the total model.

  The Way of Working (WoW) is in DEMO-3 further accentuated by the OER method (Dietz, 2013) (OER is an acronym for Organisational Essence Revelation. OER is also an acronym for the three

phases in a transaction process: Order phase, Execution phase and Result phase). The core idea of the method is that one has to go to the 'original shape' of a Scope of Interest in order to discover its essence, in which all applied communication, informational technology and implementation issues are removed. The DEMO-3 WoW is quite different from the DEMO-2 WoW. DEMO-3 WoW recommends starting from the outside and working towards the organisation. First of all, we need to know who and which parties outside the organisation are concerned and what is expected from the organisation. The second step is to look into ways the organisation satisfies customer service demands. It is necessary to cover the actors who perform the transactions. The third step is to look at the processes that are necessary in order to support the primary process. In doing so, instead of producing one aspect model after the other, all of them are produced simultaneously and incrementally. This way of working appears to enhance the integrated understanding of the essential model of an enterprise. In addition, it demonstrates that all aspect models are equally important for understanding the whole (Dietz, 2012).

- **The Way of Controlling**. DEMO does not provide a clear method or technique for controlling the execution of the methodology. Some are given for modelling:
  1. It is advisable to consider the kernel of the Scope of Interest (SoI) as one *composite actor role*. It means that you start identifying the so-called border transaction kinds.
  2. A border transaction kind has either an internal actor role as its *executor role*.
  3. If the *executor role* is internal, then there must be at least one environmental *initiator role* (but there may also be an internal initiator roles).
  4. If the *executor role* is environmental, then there must be at least one *internal initiator* role.

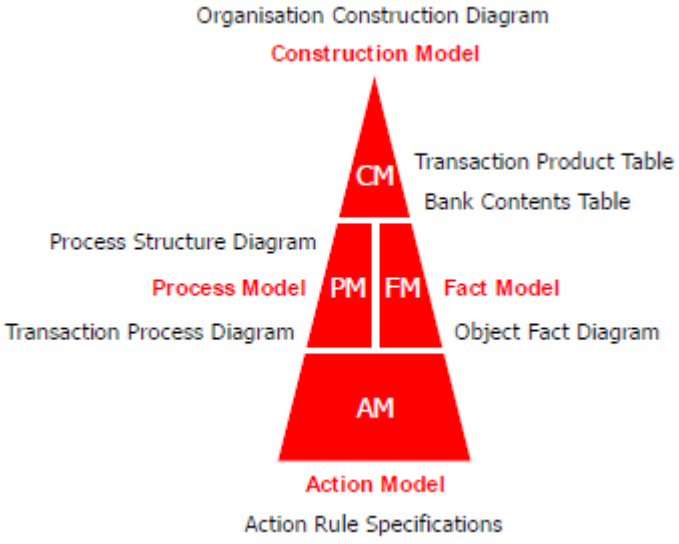


Figure 3.3: Models and representations

  5. Connecting the transaction kind with the initiator actor role(s) by an *initiator link*, and with the executor role by an *executor link*.

After following the *Way of Working*, the following ingredients for enterprise ontology will be delivered:

1. The Construction Model (CM), expressed in in an Organisation Construction Diagram (OCD) and a Transaction Product Table (TPT). It contains:
   a. the internal actor roles,
   b. the environmental actor roles,
   c. the internal and border transaction kinds and the corresponding initiator and executor roles,
   d. the information links from internal actor roles to internal and external, transaction banks;

2. The Action Model (AM), An AM is expressed in Action Rule Specifications (ARS) and Work Instruction Specifications (WIS). The AM contains the action rules that guide actors in dealing with their agenda and work instructions that guide actors in producing the products;
3. The Process Model (PM), expressed in a Process Structure Diagram (PSD), and a Transaction Pattern Diagram (TPD). It contains transaction processes and response- and waiting links between these transactions.
4. The Fact Model (FM), expressed in an Object Fact Diagram (OFD) and Derived Fact Specifications. An FM contains The internal product types, the external product types, and a property type.

- **The Way of Supporting**. DEMO has a strong theoretical background (the PSI theory). Without knowing and understanding the principles of the theory, it would be very hard to create correct DEMO models. Compared with other popular modelling approaches, there are few best practice, and information for application of DEMO.

  DEMO courses are taught by different educators such as SAPIO, Capgemini, NOVI, Antwerp Management school. DEMO education consists of four courses, which are DEMO Awareness, DEMO Bachelor, DEMO Master and DEMO Expert.

  Modelling in DEMO can be performed just with a pencil and an eraser, but good tooling can help. As far as we know, there are a few tools available which support the modeling of DEMO:
  1. A generic image editing software such as **VISIO** can be useful.
  2. **Open Modeling**[1] is an open source web-based tool that models can be drawn in different formats, including DEMO-2 and DEMO-3. *Open Modeling,* allows multiple users to collaborate on a model.
  3. **Xemod**, is a design tool for DEMO, developed by MPrise[2]. The tool is user-friendly and looks professional.
  4. **Modelworld**[3], is based on Google Docs where users can simultaneously make changes to the same model. In addition to DEMO, Modelworld supports ArchiMate, BPMN, UML.
  5. **Online modelling tool for process design and simulation**[4]**,** owned by the Dutch company Formetis. The tool is platform-independent and web based without the need of downloading or installing software.

3.3 BMC

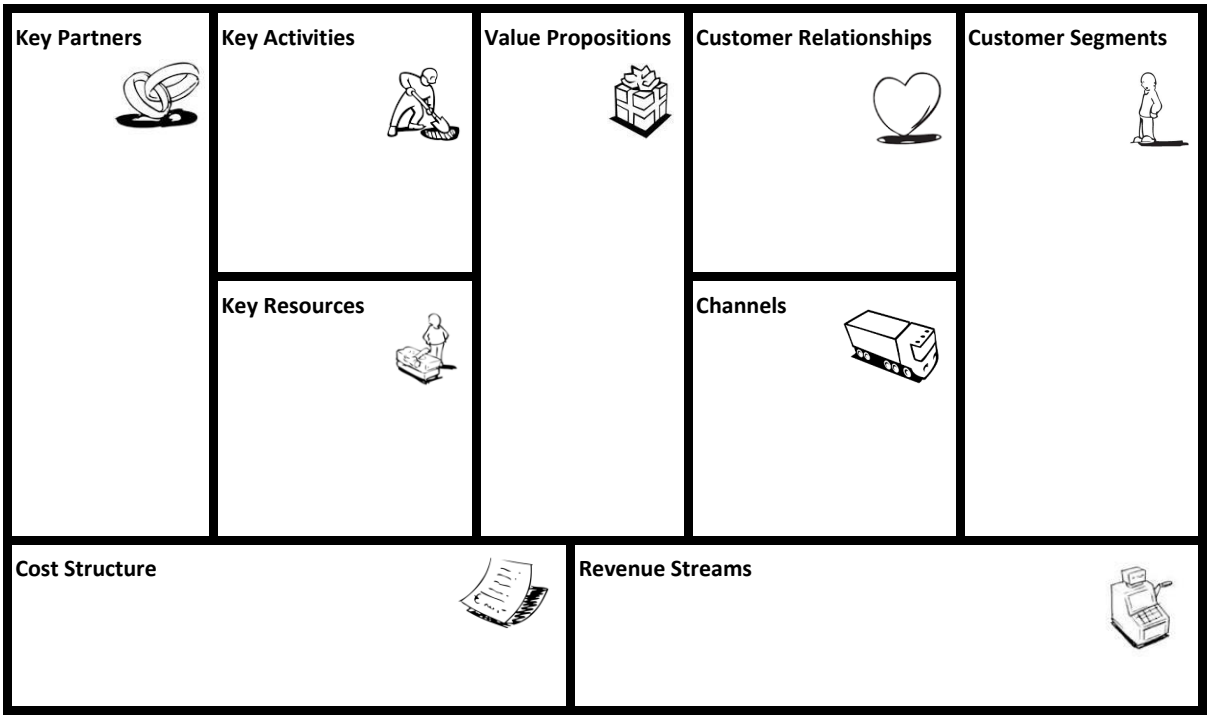
The Business Model Canvas was initially proposed by Alexander Osterwalder based on his PhD thesis and his earlier work on Business Model Ontology (BMO).

- **The Way of Thinking**. The Business Model Canvas (BMC) (Osterwalder & Pigneur, 2009) is a visual tool that aims to represent a business model and to translate it into explicit knowledge. Its focus is close to a strategic perspective. It allows organisations to describe, design, challenge, invent, and pivot their business model. The tool describes a firm's or product's value proposition, infrastructure, customers, and finances. It assists firms in aligning their activities by illustrating potential trade-offs.

[1] http://open-modeling.sourceforge.net/
[2] http://www.mprise.nl/xemod-productoverzicht.aspx
[3] http://www.modelworld.nl/
[4] https://www.demoworld.nl/Portal/Home

Canvas users appreciate the visual, practical, and intuitive aspects of the Business Model Canvas most, leading to better group discussions. Reasons for using the Business Model Canvas are: (a) Development of an entirely new business model (36%), (b) New product/service development within existing business model (21%), (c) Strategic reorientation (19%), and (d) Renovate an old business model (15%)[5].

- **The Way of Modeling**. The Business Model Canvas is composed by nine building blocks that should be filled with relevant information (Osterwalder & Pigneur, 2009):
  1. The Customer Segments Building Block defines the different groups of people or organisations which the enterprise aims to reach and serve;
  2. The Value Propositions Building Block describes the bundle of products and services that create value for a specific Customer Segment;
  3. The Channels Building Block describes how a company communicates with and reaches its Customer Segments to deliver a Value Proposition;
  4. The Customer Relationships Building Block describes the types of relationships a company establishes with specific Customer Segments;
  5. The Revenue Streams Building Block represents the cash a company generates from each Customer Segment (costs must be subtracted from revenues to create earnings);
  6. The Key Resources Building Block describes the most important assets required to make a business model work;
  7. The Key Activities Building Block describes the most important things a company must do to make its business model work;
  8. The Key Partnerships Building Block describes the network of suppliers and partners that make the business model work;
  9. The Cost Structure describes all costs incurred to operate a business model.



[5] http://www.businessmodelsinc.com/why-and-how-organizations-around-the-world-adopt-the-business-model-canvas/#sthash.K9SUZVud.dpuf

Table 3.1: Business Model Canvas building blocks

- **The Way of Working**. The idea is to populate each area of the canvas with answers to key questions:
  1) *Value proposition* (VP). The organisation has to make clear how they distinct themselves from its competitor. What products or services the organisation wants to offer? Do their products or services make any valuable contributions to the customers?
  2) *Customer segments* (CS). The next questions are about the market. To whom does the organisation make the added value? Who is the most important customer? Does the organisation want to reach many segments?
  3) *Key partners* (KP). The third thing we have to make clear is about the key partner. Who is the most important partner/supplier? With whom does the organisation have to collaborate? Which core capabilities of the partner does the organisation want to make use of? What activities do the partners have to perform? Does the organisation have any influence and control over the collaboration and relationship with the partners?
  4) *Customer relationships* (CR). The next question is about the customer relationship. What relationship does a customer expect from us? How can we build and manage these relationships? What kind of relationship have we built? How can we integrate this into our work in term of cost and format?
  5) *Channels* (C). Through which channels can the organisation reach its customer? Which channels work best? Which channels are the most cost- and value-effective? On which way can the organisation integrate the channel with the processes and standard practices of the customer?
  6) *Key activities* (KA). What core activities does the organisation need to create for added value? How can the organisation maintain and manage the customer relationship, the channels?
  7) *Key resources* (KR). What are the core capacities the organisation needs in order to realize the value propositions? What does the organisation have to do to maintain and protect the specific knowledge?
  8) *Cost structure* (CS). What does it cost to realize the value proposition? What are the main costs of the cooperation model in relation to the added value? What are the most expensive core capabilities? What are the most expensive core activities?
  9) *Revenue streams* (RS). How can the organisation get revenue from the value proposition? How much does the cost structure contribute to the success of the organisation? For what value are the customers willing to pay?

- **The Way of Controlling**. Business Model Canvas just offers a framework for asking questions around the business models. Innovation Portal (2016) suggested that Robust models should have plenty of details in each box whereas a sparsely populated canvas probably means we have not thought too hard about how the business is going to start - or be sustainable in the long term.

  A business model is a different way of thinking about our business and where we want it to go. The best way of controlling is to talk with everyone involved, including customers and suppliers (Branson, 2016).

  The business model can be best rapidly tested with clients and then reconfigured. After testing and revising the business model, we can then move on to produce a business plan.

- **The Way of Supporting**. In practice, BMC is often used among other things, by entrepreneurs to set up, verify and modify their business plans. A search on the Internet revealed numerous companies that can help us applying BMC.

  The Business Model Canvas is easy to use. It can be printed out on a large surface so groups of people can jointly start sketching and discussing business model elements with post-it-note notes or board markers.

  The Business Model Canvas is also available in web-based software format.

  Different educators give BMC workshop and training such as Strategyzer, Business Models Inc., Sutorius, AvMM., the Connector, etc. The courses are often suitable for entrepreneurs who want to start their own business or launch new products.

3.4 ARCHIMATE

ArchiMate was developed in the Netherlands by a project team from the Telematica Instituut in cooperation with Ordina, Radboud University in Nijmegen, the Leiden Institute for Advanced Computer Science (LIACS) and the Centrum Wiskunde & Informatica (CWI).

- **The Way of Thinking**. ArchiMate (The Open Group, 2013) is an enterprise architecture modelling language. ArchiMate provides a notation to enable enterprise architects to describe, analyze, and visualize the relationships among business domains. It presents a set of concepts within and relationships between architecture domains. ArchiMate is composed by different layers: (a) the business layer offers products and services to external customers, which are realized in the organisation by business processes performed by business actors and roles; (b) the application layer supports the business layer with application services which are realized by application components and (c) the technology layer offers infrastructural services needed to run applications, realized by computer and communication hardware and system software. In each layer, three aspects are considered and called active structure, behaviour, and passive structure[6]. Ettema (2009) has observed the following: (a) The Business layer in ArchiMate corresponds to the three organisation layers in DEMO (B-, I- and D-) collectively, (b) The Application layer in ArchiMate corresponds to the B-application and the I-application layer in DEMO, and (c) The Technology layer in ArchiMate corresponds to the D-application in DEMO.

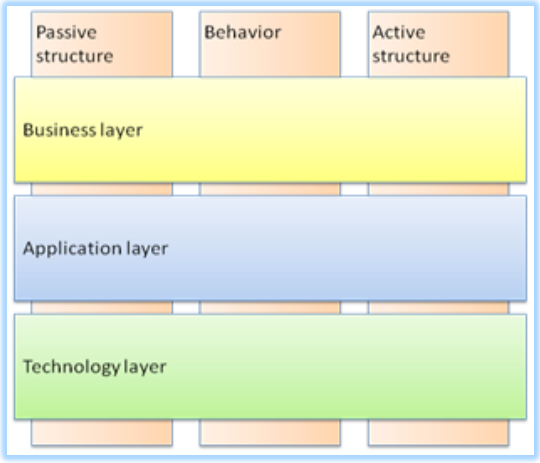


Figure 3.4: ArchiMate Framework

- **The Way of Modelling**. Most aspects are discussed in the way of thinking. The following diagram shows the most important concepts of ArchiMate:

[6] Figure 3.4 was from http://blog.bizzdesign.com/archimate-core-framework

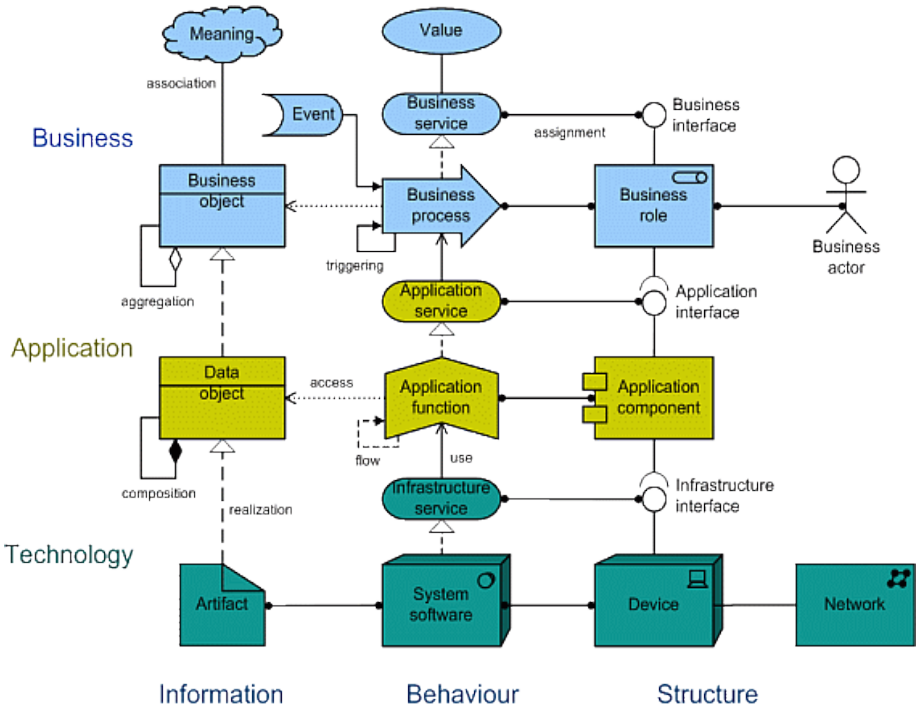


Figure 3.5: ArchiMate key concepts [7]

- **The Way of Working**. ArchiMate is only a language and does not prescribe a way of working (Berrisford & Lankhorst, 2009). Some good practices are published on the Internet to help architects applying ArchiMate in practice such as (Berrisford & Lankhorst, 2009) and (Archimate Foundation, 2007). On the websites of BiZZdesign and ArchiMate, there are many tips and hints available to facilitate the modelling.

- **The Way of Controlling**. ArchiMate does not describe how the models can be checked for correctness. However, it is advisable to make clear agreements within the organisation concerning the way of modelling. Without such agreements there exists a risk that architects model the same issues in different ways, which will lead to confusion.

- **The Way of Supporting**. The ArchiMate basic course will take about two days. The course is available at various institutes such as The Unit Academy, Global Knowledge, BiZZdesign, Capgemini …

  The following applications support ArchiMate models:
  - ABACUS from Avolution is and was one of the first tools certified by The Open Group for TOGAF as well as ArchiMate.
  - Archi is a free and open source-modelling tool to create ArchiMate models and sketches.
  - ARIS for Archimate from Software AG. Besides ArchiMate and TOGAF, ARIS also supports other major frameworks like Zachman or ITIL
  - BiZZdesign Architect from BiZZdesign, certified by the Open Group for ArchiMate 2.1
  - Casewise Modeler from Casewiseby Casewise

[7] (http://www.archimate.nl/en/about_archimate/what_is_archimate.html)

- Corso ArchiMate Plugin for IBM System Architect (certified by the Open Group for ArchiMate)
- Dragon1 (from the software company Dragon 1 Inc.) is an online software for architecture modeling.
- System Architect from IBM
- Metis by Troux Technologies is an open Web-based tool where each object models can be stored on Web-servers and accessed directly over Internet or Intranets.
- QualiWare Lifecycle Manager by QualiWare
- QPR EnterpriseArchitect (AchiMate 2 compliant)
- Sparx Systems Enterprise Architect
- Signavio Process Editor (ArchiMate 2.1 compliant)
- Visual Paradigm

3.5 COMPARATIVE EVALUATION OF THE WAY OF THINKING

In the previous sections, we have considered DEMO, ArchiMate and BMC in accordance with the evaluation framework that is known as the 5-way model. In the following table, we try to make the comparative evaluation of the Way of Thinking between the three methods.

DEMO	ArchiMate	Business Model Canvas
DEMO is an enterprise engineering methodology. DEMO focuses on the essence of the enterprise, in which all applied communication, informational technology and implementation issues are removed. DEMO is particularly useful for identifying elements that IT must support such as *Business Process, Actor role, Responsibility,* etc.	ArchiMate is a visual modelling language and provides a notation to describe, analyse, and visualize the relationships among business domains. ArchiMate captures the operational aspects. ArchiMate tries to describe and visualise the correlation between business and IT domains.	Business Model Canvas is a visual tool that aims to represent a business model and translate it into explicit knowledge. In practice, BMC is often used, among other things, for sketching and brainstorming to easily gain the necessary information. The information can then be used to set up, verify and modify the business plans. BMC captures mostly the strategic aspects.
DEMO distinguishes between three enterprise layers: *Ontological*, *Infological* and *Datalogical*.	In ArchiMate, three enterprise layers are distinguished: business, application and technology.	BMC concerns only the Business layer.
DEMO has a strong theoretical background.	ArchiMate lacks a theoretical foundation.	BMC lacks a theoretical foundation. BMC has neither a meta model, nor a graphical notation. BMC is informal (Iacob, 2012)

Table 3.2: Comparative Evaluation of the Way of Thinking between DEMO, ArchiMate and BMC

3.6 SUMMARY

This chapter has described phase one of the thesis research. Based on literature review, we analysed DEMO, ArchiMate and BMC on five aspects as way of thinking, way of modeling, way of working, way of controlling and way of supporting. After that, we reflected on the issues surrounding the way of thinking and then we compared the methods in the field of the way of thinking with each other.

Next chapter will describe all the concerning activities and results of phase two and three. This means that the three methods will be compared to each other in the field of the Way of Modelling. After that, the experts will be asked for their opinion.

Picture from http://twittermania.nl, complemented with text from the discussion

4 THEORETICAL COMPARING

In this chapter, the methods will be analysed and compared based on the Way of Modelling. First of all, the mappings between the methods are made by comparing the concept definition of the methods with each other. The underlying basic principles of the enterprise architecture methods have been taken into account.

In this research, metamodels are used as a transformation approach. To define the mappings, the concept definition of ArchiMate, DEMO and BMC are analysed and compared. The study is restricted on attribute matching and does not cover the matching on relationships between interconnected attributes. The second defined boundary is to execute the research in the business layer of ArchiMate, the ontological layer of DEMO, and in the nine building blocks of BMC.

The metamodels of the relating Enterprise Architecture methods are chosen based on the followings:

- ArchiMate is broadly applied in practice. Documentation and information about ArchiMate are easily found on the Internet. This study uses the ArchiMate metamodel of The Open Group (2013).
- The metamodel of DEMO is harder to find. However, Dietz, founding father of DEMO, has been willing to make the DEMO metamodel, suitable for this research.
- Osterwalder, founding father of BMC, did not provide the metamodel. Hauksson (2013), Iacob et al. (2012), and Malik (2012), each individual, suggested a metamodel for BMC. The disagreement between these metamodels can be found in the Appendix 3. This research uses the BMC metamodel proposed by Iacob (2012).

Our method is as following: the result of this comparison is used as a basis for a survey. The survey is submitted to the Enterprise Architects within the MinDef, who work frequently with the aforementioned methods, for review. We incorporated their suggestions by adjusting the survey textually and halving the number of questions. Subsequently, we invited the leading national and foreign enterprise architecture experts to fill out the survey.

More about the mapping and the survey result can be found in the first section of this chapter. The second section contains the discussion between the leading enterprise architecture experts worldwide. The last section contains the conclusions of the research and our own opinion.

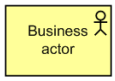
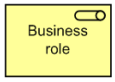
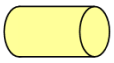
4.1 RELATIONSHIP BETWEEN DEMO, BMC, AND ARCHIMATE

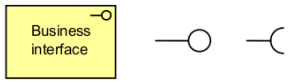
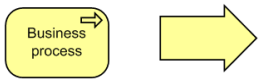
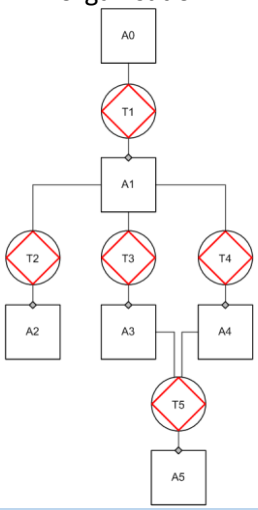
This section describes the mappings between ArchiMate – DEMO, BMC – DEMO, and BMC – ArchiMate successively. The mappings are made by comparing the concept definition of the methods with each other.

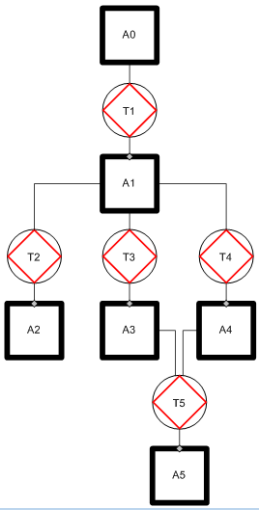
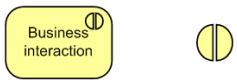
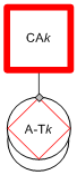
Concept definition plays a crucial role in assessing and testing the mapping. To prevent interpreting mistake, the concept definition was taken verbatim from the books ArchiMate 2.1 Specification (The Open Group, 2013), The Essence of Organisation - An Introduction to Enterprise Engineering (Dietz, 2013), and Business Model Generation (Osterwalder & Pigneur, 2009). The concept definitions are displayed between double quotation marks. The concept name is printed in Italic. If there is no equivalent, the corresponding cell will be shaded brown. The survey results are shown in the right-hand column. Where applicable, Lankhorst's comments will be shown in the right-hand column.

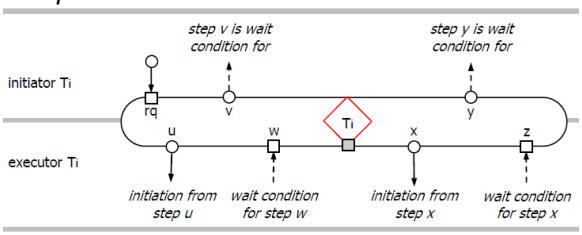
The list of invited survey respondents can be found in Appendix 2.

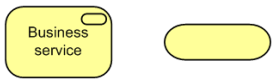
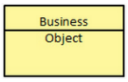
4.1.1 RELATION BETWEEN ARCHIMATE AND DEMO

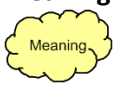
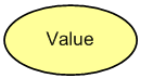
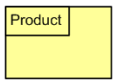
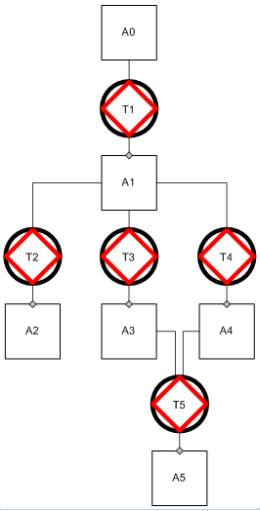
ArchiMate (Survey question#)	**DEMO**	**Justification**
Active Structure Concepts		
Business Actor  **Survey question: 1**	Composite Actor B-organisation 	Initially, we can map the *business actor* of ArchiMate to the *composite actor* of DEMO in the B-organisation. However, because ArchiMate does not make a distinction between infological and datalogical issues in the business layer (Ettema & Dietz, 2009), we can also map the *business actor* to the *composite actor* in the D-, and I-organisation. Lankhorst, who is involved with the development of ArchiMate, confirmed, on an interview with Van Dipten on 2 July 2015, that actors and roles in the business layer in ArchiMate corresponds to the three organisation layers in DEMO (B-, I- and D-) collectively. Survey result: Agree: 33% Slightly agree: 58% Neutral: 8% Slightly disagree: - Disagree: - No opinion: -
Business Role   **Survey question: 2**	Elementary Actor B-organisation 	We can map the *business role* to the *elementary actor*. This applies to all layers in DEMO, based on the same arguments as those given in the *business actor* above. Survey result: Agree: 25% Slightly agree: 67% Neutral: 8% Slightly disagree: - Disagree: - No opinion: -
Business Collaboration **Survey question: 3**	Composite Actor B-organisation 	It is a matter of a corporation of two or more actors which results in collective behaviour. We can map *business collaboration* to *composite actor* in DEMO, because DEMO presents *actors*, who work together to perform *business collaboration,* as *composite actor.* This applies to all layers in DEMO, based on the same arguments as those given in the *business actor* above. Survey result: Agree: 25% Slightly agree: 50% Neutral: 17% Slightly disagree: - Disagree: - No opinion: -

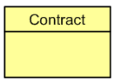
ArchiMate (Survey question#)	DEMO	Justification
Business Interface  **Survey question: 4**	-	*Business interface* is a matter of implementation. It exposes a way in which the organisations offer their products and services to their customers. Since DEMO is independent of any implementation issues, there is no equivalent concept in DEMO that can be mapped to *Business Interface*. Survey result: Agree: 25% Slightly agree: 50% Neutral: 8% Slightly disagree: 17% Disagree: - No opinion: -
Location **Survey question: 5**	-	Like *business interface, location* relates to the matter of implementation. In DEMO there is no equivalent concept that can be mapped to *Location*. This is because DEMO is independent of any implementation issues. Survey result: Agree: 33% Slightly agree: 42% Neutral: 8% Slightly disagree: 17% Disagree: - No opinion: -
Behavioural Concepts		
Business Process  **Survey question: 6**	Process in B-organisation 	On the basis of these definitions, we can map *Business Process* in ArchiMate to *Process* in B-organisation in DEMO. Survey result: Agree: 33% Slightly agree: 50% Neutral: 8% Slightly disagree: 8% Disagree: - No opinion: -

ArchiMate (Survey question#)	DEMO	Justification
Business Function **Survey question: 7**	First transaction in the chain B-organisation 	The first *transaction* in the chain (T1, in the example as shown in the column next to this one) represents the *business function* that performs within the kernel. Usually, the *business function* gets the name of the first *transaction* in the chain. Survey result: Agree: 8% Slightly agree: 42% Neutral: 17% Slightly disagree: 25% Disagree: 8% No opinion: -
Business Interaction  **Survey question: 8**	Composite Actor + Aggregate Transaction 	If the definition of *business interaction* is translated literally in the situation of DEMO, then the *business interaction* in ArchiMate relates to the *composite actor* and the *aggregate transaction* in DEMO: "A *Composite Actor Role* consists of two or more *elementary actor roles* and the *transaction kinds* between them". *"Aggregate transaction kind* is a collection of *transaction kinds. Aggregate transaction kind* would be useful if one does not (need to) know exactly the constituent *transaction kinds".* Survey result: Agree: 17% Slightly agree: 50% Neutral: 17% Slightly disagree: 8% Disagree: 8% No opinion: - Lankhorst: "*a business interaction represents behavior, but an actor+transaction also contains the actor carrying out that behavior*"

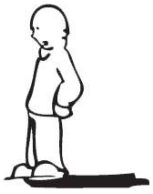
ArchiMate **(Survey question#)**	**DEMO**	**Justification**
Business Event **Survey question: 9**	Coordination Event waiting event initiation event	ArchiMate: "A *Business Event* is defined as something that happens (internally or externally) and influences a *Behavior*. A *Business Event* may trigger or be triggered (raised) by a *business process*, *business function*, or *business interaction*". DEMO*: "Coordination Event* indicates an *event* in the *coordination world.* The occurrence of a *coordination event* is identical to the becoming of a *coordination fact".* There are two kinds of *Coordination Event: initiation* and *waiting.* *Initiation event* initiates a *request act* to start a new *transaction*. In the Process Structure Diagram, a dashed arrow is used to indicate a waiting link. The waiting link starts from a *Coordination fact* and ends in a *Coordination act.* *Waiting event means* that the performance of the *coordination act has to wait until* the *Coordination fact* has been created. In the Process Structure Diagram, a solid arrow is used to indicate an initiation link. The initiation link starts from a *Coordination fact* and ends in a *request act* of some transaction.  Legend of the Process Structure Diagram Survey result: Agree: 25% Slightly agree: 50% Neutral: 8% Slightly disagree: 17% Disagree: - No opinion: -

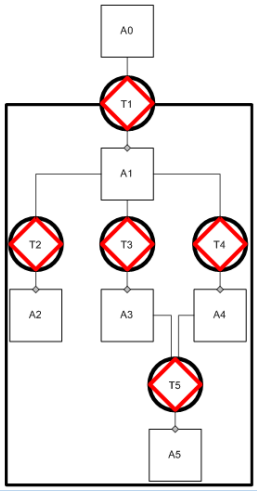
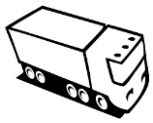
ArchiMate (Survey question#)	DEMO	Justification
Business Service  **Survey question: 10**	Transaction with a stronger emphasis on executor than initiator in B-organisation 	A service has many similarities with a transaction in the Ψ-theory, but they are not equal. While the transaction includes all acts of the initiator and the executor, the service concept emphasizes more on the executor than the initiator side. Terlouw and Albani (2013) defined *service* as following: "*A service is a universal pattern of coordination and production acts, performed by the executor of a transaction for the benefit of its initiator, in the order as stated in the standard pattern of a transaction*". Survey result: Agree: 25% Slightly agree: 58% Neutral: 8% Slightly disagree: 8% Disagree: - No opinion: -
Passive Structure Concepts		
Business Object  **Survey question: 11**	Entity Type 	*"Entity type* is an *independent* unary *production fact"*. Survey result: Agree: 17% Slightly agree: 42% Neutral: 33% Slightly disagree: 8% Disagree: - No opinion: -
Representation **Survey question: 12**	-	*Representation* is implementation-dependent. There is therefore no equivalent concept in DEMO that can map to *Representation*. Survey result: Agree: 33% Slightly agree: 58% Neutral: 8% Slightly disagree: - Disagree: - No opinion: -

ArchiMate **(Survey question#)**	**DEMO**	**Justification**
Meaning  **Survey question: 13**	-	*Meaning* is implementation-dependent. There is therefore no equivalent concept in DEMO that can map to *meaning*. Survey result: Agree: 25% Slightly agree: 50% Neutral: 17% Slightly disagree: 8% Disagree: - No opinion: - Lankhorst: "*could perhaps be mapped to entity types at the highest DEMO level. It is certainly not "implementation-dependent" as you argue in the explanatory document*".
Value  **Survey question: 14**	-	*Value* is implementation-dependent. There is therefore no equivalent concept in DEMO that can map to *value*. Survey result: Agree: 17% Slightly agree: 50% Neutral: 17% Slightly disagree: 17% Disagree: - No opinion: -
Product  **Survey question: 15**	Result of transaction as in the TPT  	Product can be mapped to the result of *transaction* as in the *Transaction Product Table.* The focus here is on the correlation between the transactions. To point out the role played by transactions in the *construction model,* the transactions are shown with the thick lines. Survey result: Agree: 8% Slightly agree: 50% Neutral: 17% Slightly disagree: 25% Disagree: - No opinion: -

ArchiMate (Survey question#)	DEMO	Justification
Contract  **Survey question: 16**	-	*Contract* is a matter of implementation. *Contract* does not directly derive from DEMO. Negotiation about such aspects is covered in the *order* phase of a *transaction*. In the order phase the *initiator* and the *executor* discuss and negotiate in order to come to an agreement about the product to be brought about by the *executor*. However, DEMO does not mention any form in which a *contract* is laid down. Survey result: Agree: 8% Slightly agree: 50% Neutral: 17% Slightly disagree: 25% Disagree: - No opinion: -

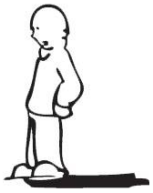
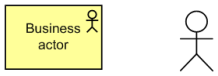
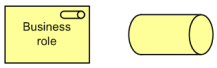
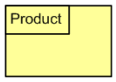
4.1.2 RELATION BETWEEN BMC AND DEMO

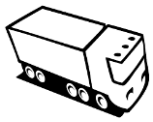
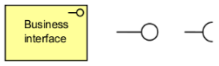
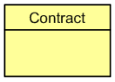
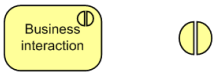
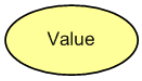
BMC (survey question#)	DEMO	Justification
Customer Segments  **Survey question: 17**	Composite actor 	Co-creators or customers are the initiators of the transactions on the organisation boundary. As Demo uses *composite actor* to present environmental actor, therefore, *composite actor* can be mapped to *customer segments.* Survey result: Agree: 17% Slightly agree: 67% Neutral: 17% Slightly disagree: - Disagree: - No opinion: -

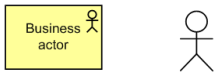
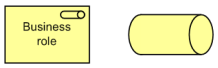
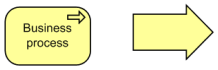
BMC (survey question#)	DEMO	Justification
Value Propositions **Survey question: 18**	Transaction on the organisation boundary 	The *Value Propositions* are related to the *transactions* on the organisation boundary where the organisation is responsible as an executing actor. Survey result: Agree: 17% Slightly agree: 50% Neutral: 17% Slightly disagree: 17% Disagree: - No opinion: -
Channels  **Survey question: 19**	-	The *Channel* aspect does not derive from DEMO, because this aspect is related to an implementation topic. Survey result: Agree: 17% Slightly agree: 75% Neutral: 8% Slightly disagree: - Disagree: - No opinion: -
Customer Relationships **Survey question: 20**		DEMO: The *Customer Relationships* aspect does not derive from DEMO, because this aspect is related to an implementation topic. Survey result: Agree: 17% Slightly agree: 58% Neutral: 8% Slightly disagree: 17% Disagree: - No opinion: -
Revenue Streams **Survey question: 21**	-	DEMO is limited to enterprise ontology. There is therefore no equivalent component that can be mapped to *Revenue Streams* in BMC. Survey result: Agree: 17% Slightly agree: 50% Neutral: 25% Slightly disagree: 8% Disagree: - No opinion: -

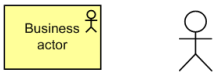
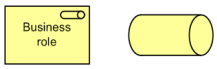
BMC (survey question#)	DEMO	Justification
Key Resources **Survey question: 22**	Elementary Actor B -organisation 	*Key Resources gives the actors responsible for the internal transactions of the organisation.* *Actor,* which represents staff within an organisation, can be mapped to the *Key Resources* Survey result: Agree: 17% Slightly agree: 50% Neutral: 17% Slightly disagree: 8% Disagree: 8% No opinion: - Lankhorst: "*many key resources (e.g. money...) would not map onto elementary actor*".
Key Activities **Survey question: 23**	Transaction B -organisation 	Key Activities gives the transaction within the organisation boundary necessary to realize the value proposition. *Transaction* can be mapped to the *Key Activities* in BMC. Survey result: Agree: 25% Slightly agree: 50% Neutral: 17% Slightly disagree: 8% Disagree: - No opinion: -
Key Partnerships **Survey question: 24**	Composite actor 	*Key Partners* gives the transactions on the organisation boundary where the organisation is responsible as an *initiating actor*. DEMO uses *Composite Actor* to present environmental actors. *Composite Actor* can therefore be mapped to *key partnership* in BMC. Survey result: Agree: 33% Slightly agree: 50% Neutral: 8% Slightly disagree: 8% Disagree: - No opinion: -
Cost Structure **Survey question: 25**	-	In DEMO there is no equivalent component that can be mapped to *Cost Structure* in BMC. Survey result: Agree: 42% Slightly agree: 42% Neutral: 17% Slightly disagree: - Disagree: - No opinion: -

4.1.3 RELATION BETWEEN BMC AND ARCHIMATE

BMC (survey question#)	ArchiMate	Justification
Customer Segments  **Survey questions: 26, 27, 28**	Business Actor  Business Role  Stakeholder 	Concepts in ArchiMate that have a connection with customers is: *Business Actor, Business Role* and *Stakeholder ("is defined as the role of an individual, team, or organisation (or classes thereof) that represents their interests in, or concerns relative to, the outcome of the architecture").* These concepts can be mapped to *Customer Segment* in BMC. Customer segment – Business actor. Survey result: Agree: 8% Slightly agree: 75% Neutral: 17% Slightly disagree: - Disagree: - No opinion: - Customer segment – Business role. Survey result: Agree: 8% Slightly agree: 67% Neutral: 17% Slightly disagree: - Disagree: - No opinion: 8% Customer segment – Stakeholder. Survey result: Agree: 8% Slightly agree: 58% Neutral: 25% Slightly disagree: - Disagree: - No opinion: -
Value Propositions **Survey question: 29**	Product  	*Product* is suitable to model the *Value Proposition.* The mentioned concept represents products, which should solve customers' problems or satisfy a customer need. Survey result: Agree: - Slightly agree: 58% Neutral: 33% Slightly disagree: 8% Disagree: - No opinion: -

BMC (survey question#)	ArchiMate	Justification
Channels  **Survey question: 30**	Business Interface 	*Business Interface* exposes the channel where the business service is available to the environment. In ArchiMate we can use the *Business Interface* concept to model *Channel.* Survey result: Agree: 25% Slightly agree: 58% Neutral: 8% Slightly disagree: - Disagree: 8% No opinion: -
Customer Relationships **Survey questions: 31, 32**	Contract  Business Interaction 	Organisation can use *Contract* to record appointments, demands and requirements of both sides to retain customers. Organisation can also use *business interaction* to describe the behavior of business collaboration and how the organisation maintains the business relationship. Customer relationships – Contract. Survey result: Agree: - Slightly agree: 50% Neutral: 17% Slightly disagree: 25% Disagree: 8% No opinion: - Lankhorst: "*not all customer relationships are contractual in nature*". Customer relationships – Business interaction. Survey result: Agree: - Slightly agree: 67% Neutral: 17% Slightly disagree: 17% Disagree: - No opinion: -
Revenue Streams **Survey question: 33**	Value 	*Value* in ArchiMate can be mapped to *Revenue Streams* in BMC because *Value* applied to what a party gets by selling or making available some product or service Survey result: Agree: - Slightly agree: 67% Neutral: 8% Slightly disagree: 17% Disagree: - No opinion: 8%

BMC (survey question#)	ArchiMate	Justification
Key Resources **Survey questions: 34, 35**	Business Actor  Business Role 	Theoretically, all *Active Structure concepts* are important assets an enterprise uses to create value proposition, to reach markets, to maintain relationships with Customer Segments and to earn revenues. The *Active Structure concepts* in the Business layer are: *Business Actor, and Business Role* Key Resources – Business Actor. Survey result: Agree: 17% Slightly agree: 58% Neutral: 25% Slightly disagree: - Disagree: - No opinion: - Lankhorst: "*only some key resources map to business actors*". Key Resources – Business Role. Survey result: Agree: 17% Slightly agree: 50% Neutral: 25% Slightly disagree: 8% Disagree: - No opinion: - Lankhorst: "*only some key resources map to business actors*".
Key Activities **Survey question: 36**	Combination of Business Process  and Business Service 	Combination of *Business Process* and *Business Service* shows the *key activities* of the organisation. Survey result: Agree: 8% Slightly agree: 58% Neutral: 25% Slightly disagree: 8% Disagree: - No opinion: -

BMC (survey question#)	**ArchiMate**	**Justification**
Key Partnerships **Survey questions: 37, 38, 39**	Business Actor  Business Role  Stakeholder 	Like *customer segments, business actor*, *business role* and *Stakeholder* are components who are directly involved in a partnership. These components are the important links between the organisation and the partners. Key Partnerships – Business Actor. Survey result: Agree: 17% Slightly agree: 67% Neutral: 17% Slightly disagree: - Disagree: - No opinion: - Key Partnerships – Business Role. Survey result: Agree: 17% Slightly agree: 58% Neutral: 25% Slightly disagree: - Disagree: - No opinion: - Key Partnerships – Stakeholder.Survey result: Agree: 17% Slightly agree: 67% Neutral: 17% Slightly disagree: - Disagree: - No opinion: -
Cost Structure **Survey question: 40**	-	In ArchiMate, there is no equivalent component that can be mapped to *Cost Structure* in BMC. Survey result: Agree: 25% Slightly agree: 50% Neutral: 8% Slightly disagree: 8% Disagree: 8% No opinion: -

4.2 DISCUSSION AMONG ENTERPRISE ARCHITECTURE EXPERTS WORLDWIDE

The survey was submitted to the experts of the enterprise architecture community in the Netherlands and abroad. Regrettably, very few replies were received. The founding father of ArchiMate (Lankhorst) was the only one, besides nine Enterprise Architects internal to MinDef, who filled out the survey completely.

Apparently, the survey has touched on a controversial subject! For a short while after sending the survey, a heated but very interesting debate started quite unexpectedly between the involved experts. The community is not unanimous in their opinions on how the methods can be related.

Those, who are against the theoretical comparison, support strongly the idea of comparing ArchiMate, BMC and DEMO. However, the way to do it would not be a theoretical comparison, but a

practical one. With this, DEMO, ArchiMate and BMC will be applied on a study case. After that, the results obtained can be compared together. They welcome the idea to start the discussion.
Arguments against the theoretical comparison are:

- Mapping between EA methods requires a conceptual framework. There is not a justifiable common conceptual basis for comparing the methods. So, linking DEMO and ArchiMate at the syntactic level is impossible;
- From the three approaches, DEMO is the only one that is built on a solid constructed conceptual foundation: the coordination act - the atomic element of human cooperation. Both ArchiMate and BMC rely on the assumed validity of intuitive concepts;
- A language comes from 'correct use', some languages may be very precise, and others may be more vague. Mapping languages onto each other in some syntactical way is therefore an impossible task;

Arguments of experts who agree with this study are:

- If the goal is to investigate "alignment" between the three approaches, then there are different avenues of research that can be undertaken. One avenue would be to study the phenomena in the real world and how they are represented in each of these approaches (as suggested, using cases). Another would be to use more qualitative methods and ask for expert opinions. A more theoretical analysis should also be possible. Hope the researchers will keep an open mind in their exploration.
- The domains and purposes of language, both natural and engineered, evolve over time and trigger the change in language. People bring languages to life and different groups together. People have good reasons to use languages differently and on the way they want to, and sometimes do not act in accordance with the rules. Too bad? Let's not be arrogant to declare these practitioners dumb. They would mould/erode/tune the language. We, language engineers, must try to support others, with different views, theories, opinions, as good as we can. We should enable people make better models. So, both theoretical and practical comparisons must be possible. They are therefore very interested in the results and hope the chosen path will lead to useful results.

All experts recommended the following:

- The idea of comparing ArchiMate, BMC and DEMO is strongly supported;
- People need to know that languages have been invented to use in different situations. For example, BMC is more for sketching and brainstorming. Its syntax and semantic are therefore quite free and easy. Once at the level of identifying precise transactions, we need a bit more precision and rigour than the BMC style. So, we need a precise syntax, semantics and theoretical grounding, such as e.g. offered by DEMO;
- The need for a linking language and the goal or domain of concern we are addressing must be clear before the approaches can be compared together;
- Make sure to comply the following ontological quality criteria: Comprehensiveness, Conciseness, Coherence and Consistency.

The e-mail discussion between EA experts is literally shown in appendix 1. Appendix 2 presents the list of survey respondents.

4.3 SUMMARY & OWN OPINION

In this chapter, an attempt has been made to link ArchiMate, DEMO and BMC together. The leading national and foreign enterprise architecture experts were invited to give their views on the

outcomes. However, the experts enter into a discussion about the plausibility of relating the methods. After a heated but interesting discussion, the experts are not unanimous in their opinions.

This study agrees with the experts that each method has its own field of works and activities. The methods look at the same matter but with different perspectives, angles and through different lenses. However, we believe that it is possible to link the methods together.

To clarify this, let us take a look at this simple example. Looking at a pipe (Figure 4.1), the image of the pipe is dependent on from where we stand and which angle we look at it. From position A, we see a rectangle, but from position B, it gives us a circle. The same object is producing different images (situation 1 in Figure 4.1). In the first place, the rectangle cannot be compared to the circle. But the rectangle and the circle are the images from the same pipe. These images are somehow related to each other, namely at the intersection of the rectangle and circle. From a different stand, when looking at the same point on the contact zone, the image will be the same or roughly the same (situation 2 in Figure 4.1). Therefore, it shows that we cannot compare the circle with the rectangle, but we can link certain parts of the circle with certain parts of the rectangle. And to completely understand the pipe, both images are required and both images must be linked together. Let us take the natural languages as another example. Certainly, a direct translation from Vietnamese to Dutch without losing meaning cannot be made. This is because the languages are so different. However, both languages can still be compared because there are some words with similar meanings.

The same thought of thinking applies to the EA methods pictures. If we take pictures of an Insurance Company with different methods, the picture from BMC is a business proposition, while the picture from ArchiMate is an architecture. It is well known that a business proposition is not an architecture. The experts are right when they say that it is nonsense to compare a business proposition with an architecture. However, the images are of the same business, and of the same organisation. So, the images must have somethings in common that can be served as an anchor for linking the models together.

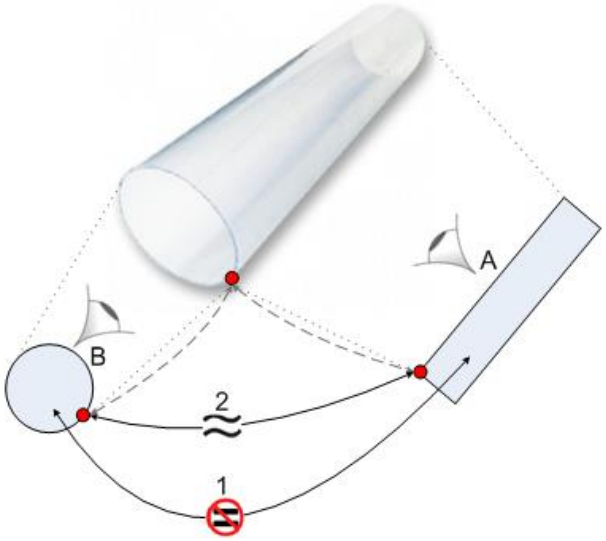


Figure 4.1: Different images from the same thing

Additionally, it is believed the entire problem area of the Enterprise Architect cannot be covered with one method. Actually, more methods are needed. In practice, the methods are used together. This study expects some works in one method are consistent and do not contradict in another. Therefore, it is important to identify the common concepts to link the methods together. For example, *Customer* in BMC should correspond to *Business Actor* in ArchiMate or *Composite/Elementary Actor* in DEMO who can initiate a transaction.

Having said this, this study proceeds with the experts' advice. In the next chapter, a new attempt will be submitted to link the methods with the use of a practical case. The results will be examined and reassessed in conjunction with the proposed rules in this chapter.

5 CASE STUDY ARCHISURANCE

As shown in the previous chapter, some EA experts find that EA models could not be related, at least not in the theoretical way. But there is still a need of relating ArchiMate, DEMO and BMC.

In this chapter, we will make a new effort to relate the three methods in a practical way. To do that we apply the three methods to an example case, after that the obtained results will be compared with each other, in conjunction with our proposed rules in the previous chapter. To save time and workload, we have searched in the literature database and on the Internet whether a similar study was carried out before.

The remainder of this chapter is organized as follows:

- Section 1 describes the example case of ArchiSurance (Lankhorst, 2004) and the motivation why we have chosen ArchiSurance as a case;
- Section 2 contains results after applying the methods to the case of ArchiSurance;
- Section 3 is a consistency analysis on the correspondence between DEMO, ArchiMate, and BMC;
- Section 4 describes the conclusion after making the theoretical and practical comparison.

5.1 ARCHISURANCE – DESCRIPTION

During an Internet search, we found out that ArchiSurance is the most appropriate case for our study. The choice for ArchiSurance is justified because of following reasons:

- The case is widely known to the Enterprise Architects;
- The matter is simple, realistic, and understandable for everyone;
- The case is often used in the enterprise architecture community. A concrete example is the study of Iacob et al (2012). Their results should be used to compare with our result;
- ArchiSurance is a big case with many objects. The comparison between the methods would therefore be easier;
- The experts advise the case.

The original narrative description of ArchiSurance (Iacob, 2012) is presented below:

> *ArchiSurance is a fictitious company that provides home, travel, and car insurances. It sells its services through a network of intermediaries. ArchiSurance's primary operations are (1) maintaining customer relationships and intermediary relationships, (2) contracting, (3) claims handling, (4) financial handling, and (5) asset management. These operations are similar for most insurance companies. To support these operations, the company has several departments and is running a collection of applications on various hardware platforms.*
>
> *As for all insurance companies, ArchiSurance offers "security" in the form of risk reduction to its customers. In return for a premium, customers are covered in the case of incidents. The goal of the customers is to "be insured". Insurance can be considered as a case of the upside-down business model freemium pattern; many paying customers cover the costs of a few claimants.*
>
> *The problem ArchiSurance is facing is that lately the customer support at ArchiSurance was confronted with more complaints than usual. Customers complain about almost everything: lack of clarity of their claim status, the inconvenient manner for submitting claims, long waiting times when calling customer support, claims take forever to be processed and paid, etc. Moreover, as a result, they are leaving.*
>
> *In the Claim handling process, ArchiSurance offers essentially three services to the customer: (1) **claim submission** for which regular mail is used (incoming claims are first sorted by the*

mail room employee and then scanned and registered in the Document Management System), (2) ***customer information service*** *that is used to inform customers about the status of their claims (again via regular mail or by telephone via the call center), and (3)* ***claim payment*** *to compensate damages suffered by customers whose claims have been accepted. ArchiSurance has no control over the sales of insurance products. They work with intermediaries, who mediate the sales and marketing activities, on ArchiSurance's behalf, against a commission.*

5.2 APPLYING EA METHODS ON ARCHISURANCE

5.2.1 ARCHISURANCE – ARCHIMATE

Iacob et al. (2012) founded that financial impacts are often not considered when organisations make expensive architectural changes in their systems. Questions such as "who benefits from the product?", and "who will pay for it?" are not included in the design of the change. To avoid these situations, Iacob argued that any changes in the architecture must be first assessed against the financial cost-effectiveness. To do that, a business model must be built and analysed before any implementation decision is made about the (new) architecture design. Therefore, relating enterprise architectures to business models is needed. Hence, the architecture change could be mirrored by a business model change, and thus, the impact of architecture change for the business becomes explicit.

Iacob et al. proposed an approach to relate enterprise models using ArchiMate and Business Model Canvas. In their study, ArchiSurance is used to demonstrate the relationship between ArchiMate and BMC. Iacob et al. chose ArchiMate in their study just because ArchiMate plays a leading role in the area of enterprise architecture. It is also due to its expressive power above other methods and its rapid acceptance in the industrial community as well.

This section shows briefly the results Iacob et al. obtained when applying ArchiMate on ArchiSurance. Results with BMC will be shown in the next section.

Figure 5.1 shows ArchiMate model of ArchiSurance's Claim handling. The model is limited to the business layer and contains all primary business processes, services, and products. It shows three services to a customer: *Claim submission* for which regular mail is used, *Customer information* to inform the customer about the status of their claims, and *Claim payment* to compensate damages. The model also shows the actors involved in the claim handling process.

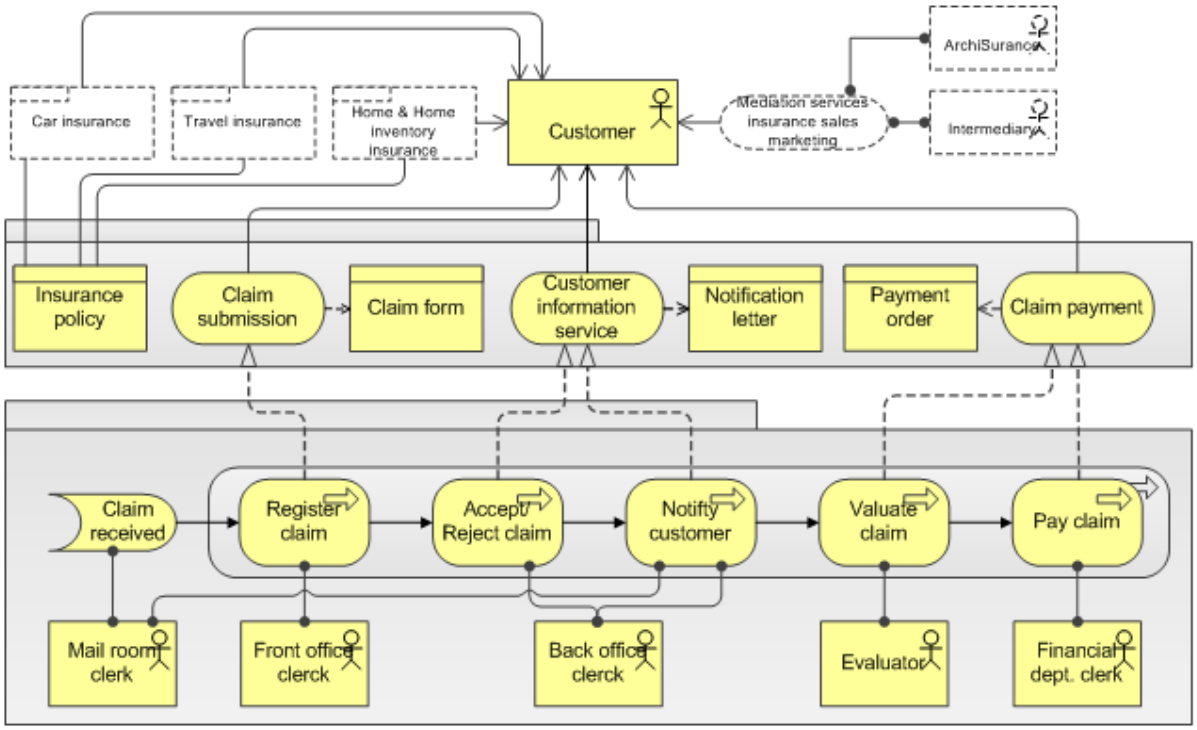


Figure 5.1: Business layer ArchiMate model ArchiSurance Claim Handling (Iacob, 2012)

5.2.2 ARCHISURANCE – BMC

In this section, we use the rule we proposed in section 4.1.3 and Iacob's ArchiSurance ArchiMate model shown in Figure 5.1 to fill out the BMC model. Then we lay the resulting BMC model alongside the ArchiSurance's narrative description to check the accuracy and completeness. After that, the result will be compared with the Iacob's ArchiSurance BMC model shown in Figure 5.3. Findings will be discussed in section 5.3.1.

Each area of the Business Model Canvas will be populated by answering to the key questions, using the Iacob's ArchiSurance ArchiMate model shown in Figure 5.1 and the narrative description of the case of ArchiSurance. The results will be controlled, using our proposed rules. We limit the model to activities relating to the Claim Handling in the business layer. The result is shown in Figure 5.2.

KQ1 'Value Proposition' (VP): What do the customers expect from ArchiSurance in the Claim Handling process?
AQ1: Damage Compensation

KQ2 `Customer Segments` (CS): what are the most important customers of ArchiSurance?
AQ2: Customers

KQ3 'Key partners' (KP): Who does ArchiSurance need to work with?
AQ3: ArchiSurance works with intermediaries, who mediate the sales and marketing activities, on ArchiSurance's behalf, against a commission.

KQ4 `Customer Relationships` (CR): How can ArchiSurance build relationship with its customers?
AQ4: Intermediaries mediate the sales and marketing activities.

KQ5 `Channels` (C): Which channel can ArchiSurance use to reach its customers?
AQ5: ArchiSurance reaches through mail and telephone

KQ6: `Key Activities` (KA): what are the key activities that ArchiSurance needs to carry out to deliver its value proposition?
AQ6: ArchiSurance key activities relating to the Claim Handling are:

- Claim submission
- Customer information service
- Claim payment

KQ7: `Key Resources` (KR): what are the key resources which ArchiSurance needs to create and deliver its offering?

AQ7: To create and deliver the key activities, ArchiSurance needs the following key resources: Mail room clerk, Front office clerk, Back office clerk.

KQ8: `Cost Structure` (CS): what are the main costs ArchiSurance has to make?
AQ8: Not exposed through the case

KQ9: `Revenue Streams` (RS): what are the incomes?
AQ9: Not exposed through the case.

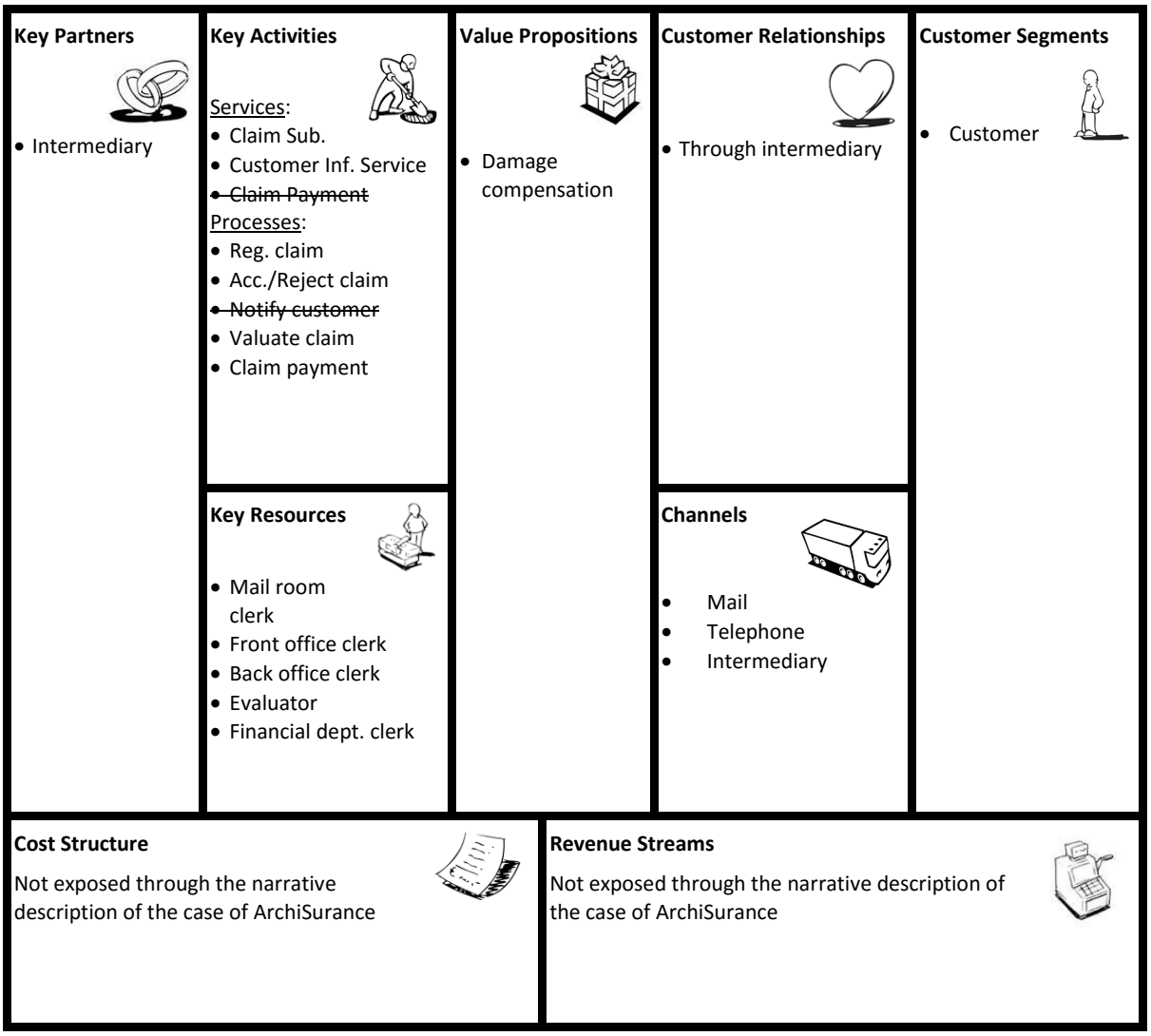


Figure 5.2: BMC model ArchiSurance Claim Handling

After applying our proposed rules, the building block *Key Activities* in the above table presents a number of double activities such as *Notify customer* and *Claim payment*. These double activities are therefore crossed out.

Iacob (2012) has also made a BMC model for ArchiSurance. The model is shown in Figure 5.3.

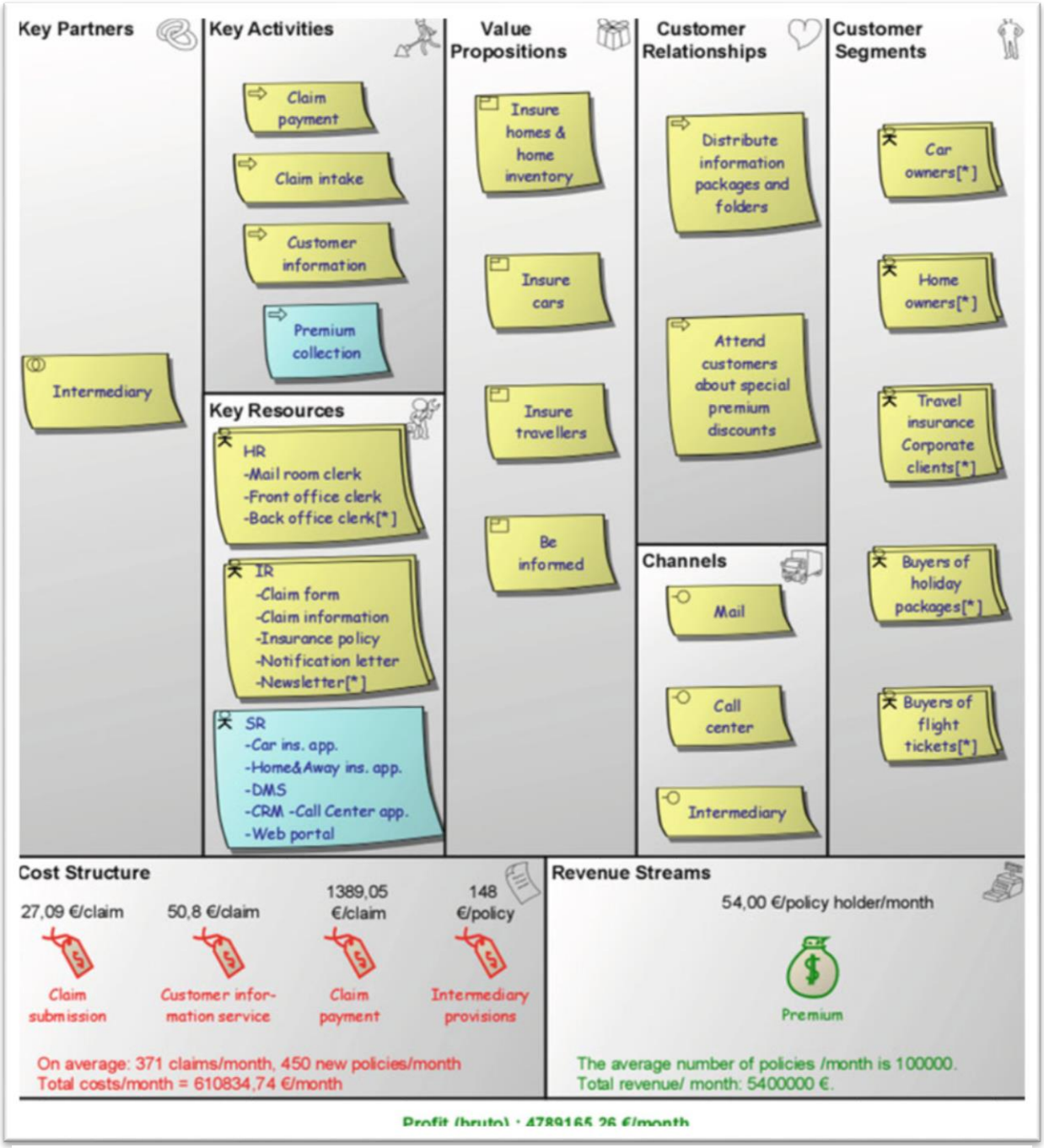


Figure 5.3: BMC model ArchiSurance Claim Handling (Iacob, 2012)

5.2.3 ARCHISURANCE – DEMO

Before we identify the enterprise ontology of ArchiSurance's Claim handling, we need to rectify the used denomination of the components, which is used in ArchiSurance's ArchiMate model. The chosen keywords in ArchiMate model do not cover the (associated) subject matter of the underlying insurance: one takes out insurance, not to be insured but to secure payment of the damage incurred.

We believe that 'damage compensation' is a better denomination than 'claim submission'. This is because 'claim submission' just means a request to take the claim processed while 'damage compensation' expresses the entire set of activities, the transactions, and the associated support to realise the claim compensation. Doing so, we prevent one only looks to a small part instead of the whole transaction. Further, the denomination used in DEMO looks from the outside in, it means that the customer comes first. The denomination in ArchiMate is inside out, and is chosen from the ArchiSurance's perspective and not from the customer. The following table shows the terminologies we used in accordance with the terminologies that are used by Iacob (2012).

ArchiSurance terminologies used in DEMO	ArchiSurance terminologies used in ArchiMate
Damage compensation	Claim submission
Claim validation	Accept/reject claim
Damage valuation	Valuate claim
Damage compensation payment	Claim payment
Customer	Customer
Damage compensation handler	Front office clerk
Claim validator	Back office clerk
Damage valuator	Evaluator
Damage compensation payer	Financial dept. clerk

Table 5.1: ArchiSurance terminologies used in DEMO and the corresponding in ArchiMate

To identify the complete set of the enterprise ontology of ArchiSurance's Claim handling, we apply the six-step method for the development of the ontological aspect model of an enterprise (Dietz, 2006). In order to provide a better comprehension, we apply the method direct on the ArchiMate model of the ArchiSurance's Claim handling. The figure below shows the business layer of the ArchiSurance's Claim handling (Iacob et al., 2012). Components with broken lines fall outside the scope.

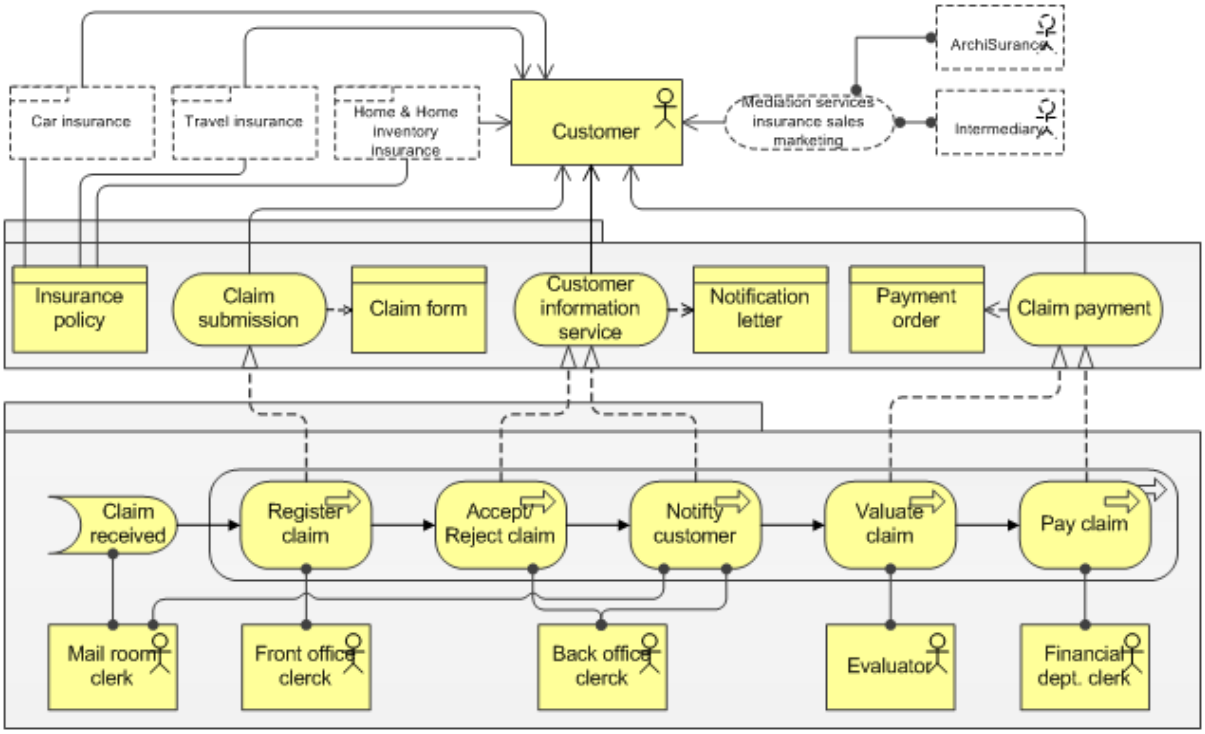


Figure 5.4: Initial situation of six-step method (Business layer ArchiSurance's Claim handling)

The six-step method shall be applied as follows:

1. **Step one: The Performa-Informa-Forma Analysis**. First of all, we need to reduce the complexity of the organisational model. The analysis can be done best by coloring the appropriate parts of the descriptions: red for Performa (B-organisational) items, green for Informa (Informational) items, and blue for Forma (D-organisational) items. The intention of this step is to separate the B-organisational items from other items.
   a) The B-organisational model of the claim handling consists of the following items:
      - Damage compensation (Claim submission)
      - Claim validation (Accept/reject claim)
      - Damage valuation (Valuate claim)
      - Damage compensation payment (Claim payment)

   b) The I-organisational model of the claim handling consists of the following components:
      - Customer information
      - Customer notification

   c) The D-organisational model of the claim handling consists of the following components:
      - Insurance policy
      - Claim registration
      - Letter notification
      - Order payment
      - Claim receiving

The ArchiSurace Claim Handling's ArchiMate model after applying the first step is shown in Figure 5.5. The red, green and blue items correspond respectively to the Performa (B-organisational)-, Informa (Informational)-, and Forma (D-organisational) items. Items within the scope but not

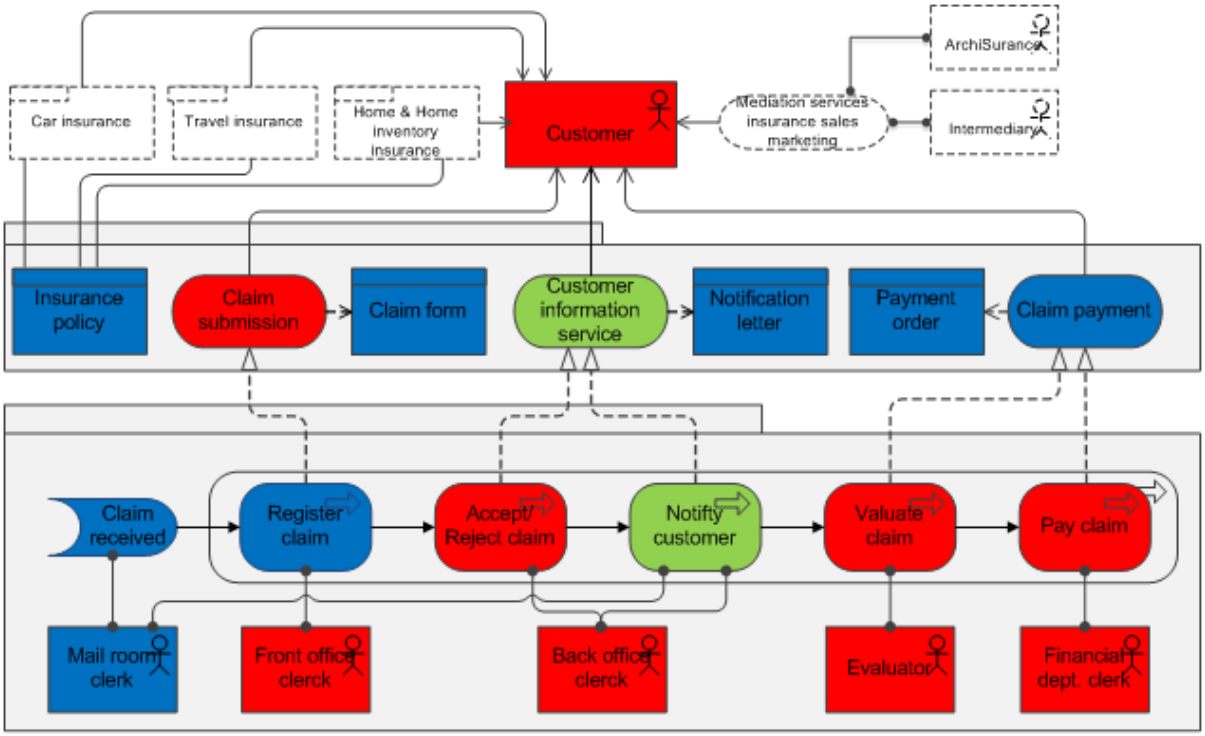


Figure 5.5: ArchiSurance Claim handling's ArchiMate model after applying first step of the six-step method

2. **Step two: The Coordination-Actors-Production Analysis**. In the previous step, the Performa items are identified. In this step, we divide the red marked Performa items into Coordination-acts/facts, Production-acts/facts, and actor roles.

   In the case of ArchiSurance's Claim handling, all the Performa items are coordination acts:
   - Damage compensation (Claim submission)
   - Claim validation (Accept/reject claim)
   - Damage valuation (Valuate claim)
   - Damage compensation payment (Claim payment)

   The following items are actor roles:
   - Customer
   - Damage compensation handler (Front office clerk)
   - Claim validator (Back office clerk)
   - Damage valuator (Evaluator)
   - Damage compensation payer (Financial dept. clerk)

   Figure 5.6 below shows the results after applying the second step of the six-step method. In the figure, the Performa items are filled with red color. They are indicated by the text *Actor* and *C-act* for respectively *Actor Role* and *Coordination-act*. Items within the scope but not within the B-organisation remain yellow, the color of *Business layer* of the ArchiMate framework. Items with broken line fall outside the scope.

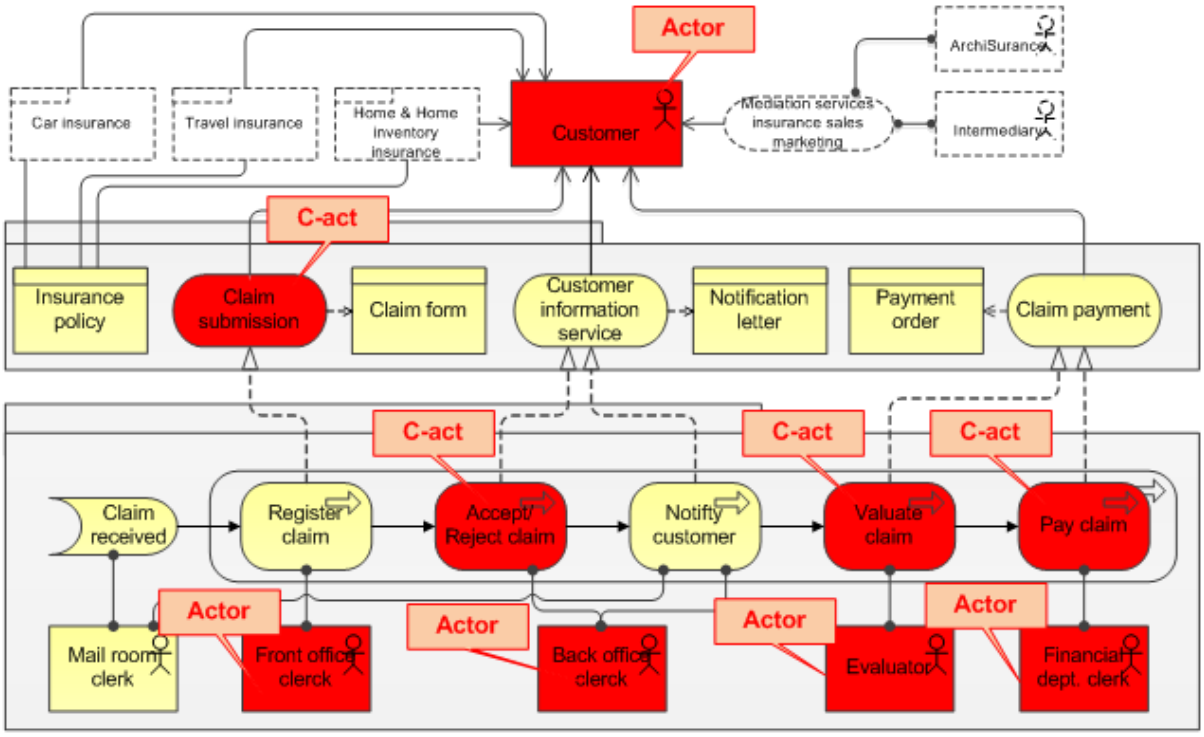


Figure 5.6: ArchiSurance Claim handling and the Coordination-Actors-Production

3. **Step three: The Transaction Pattern Synthesis**. In this step, we cluster the C-acts/facts and P-acts/products in the B-organisation into transaction types. After that, we formulate the result type for every transaction type. The resulted Transaction Product Table is as follows:

Transaction kind	Product kind
T01 Damage compensation	P01 Damage Compensation has been completed

Transaction kind	Product kind
T02 Claim validation	P02 Claim has been validated
T03 Damage valuation	P03 Damage has been valuated
T04 Damage compensation payment	P04 Damage compensation has been paid

Table 5.2: Transaction Product Table ArchiSurance Claim Handling

Figure 5.7 shows the results after applying the third step of the six-step method: the coordination-acts are identified by transaction number (T01 ... T04) and transaction phase.

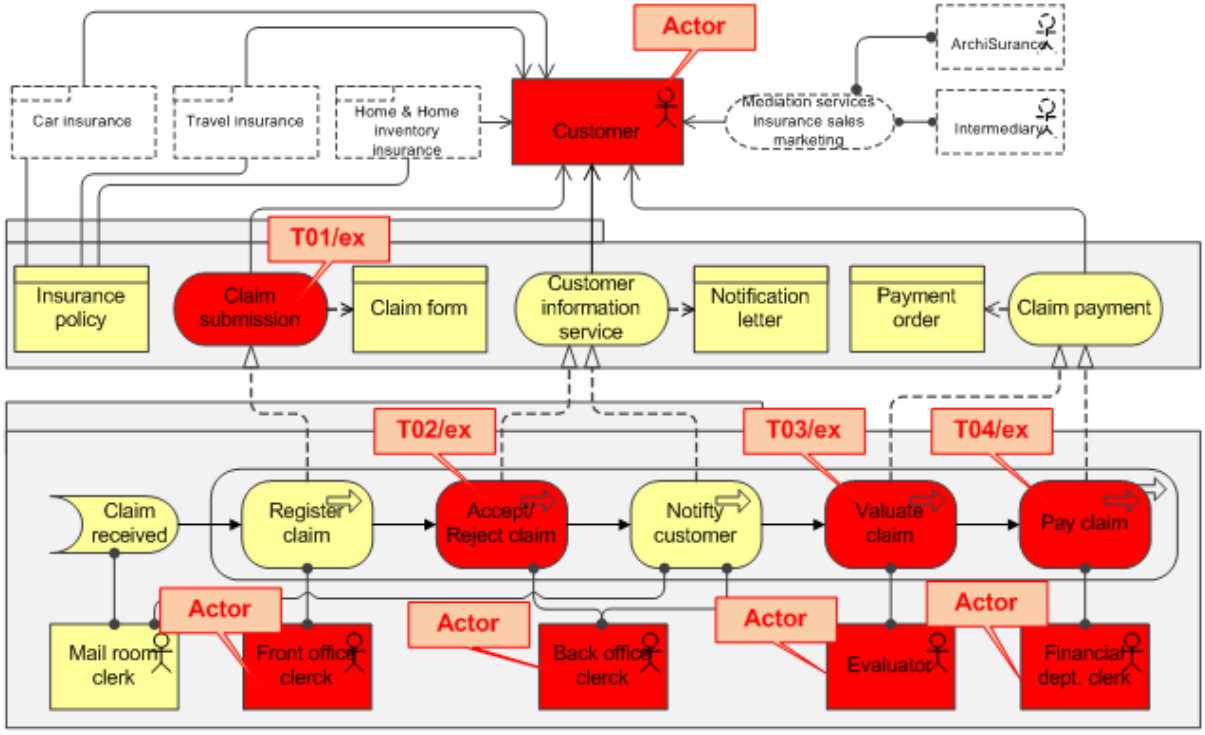


Figure 5.7: ArchiSurance Claim handling and the Transaction Pattern

4. **Step four: The result Structure Analysis**. In this step we determine the causal and conditional relationship between the identified transactions. In the ArchiSurance, three dependencies are identified:

a. The first one is that the *T01 Damage Compensation* will just be promised after the *T02 Claim Validation* has been accepted. It means that the damage compensation can only be considered after the claim was declared admissible;

b. The second dependency is that the *T03 Damage valuation* can only start after the *T01 Damage Compensation* has been promised. It means that the damage valuation can only start after the claim was declared admissible;

c. The third relationship is between the ending of *T03 Damage valuation* and the start of *T04 Damage compensation payment*. It means that the damage compensation can be paid after having valuated the damage.

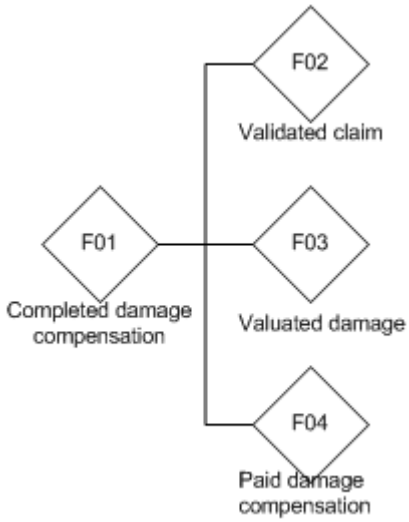


Figure 5.8: Fact Structure Chart of ArchiSurance Claim handling

5. **Step five: The Construction Synthesis**. In this step we identify the actor roles that serve as the initiator and/or the executor of the transaction types that have been found in the previous step.

Actor roles B-Organisational

- CA01 Customer
- A01 Damage compensation handler
- A02 Claim validator
- A03 Damage valuator
- A04 Damage compensation payer

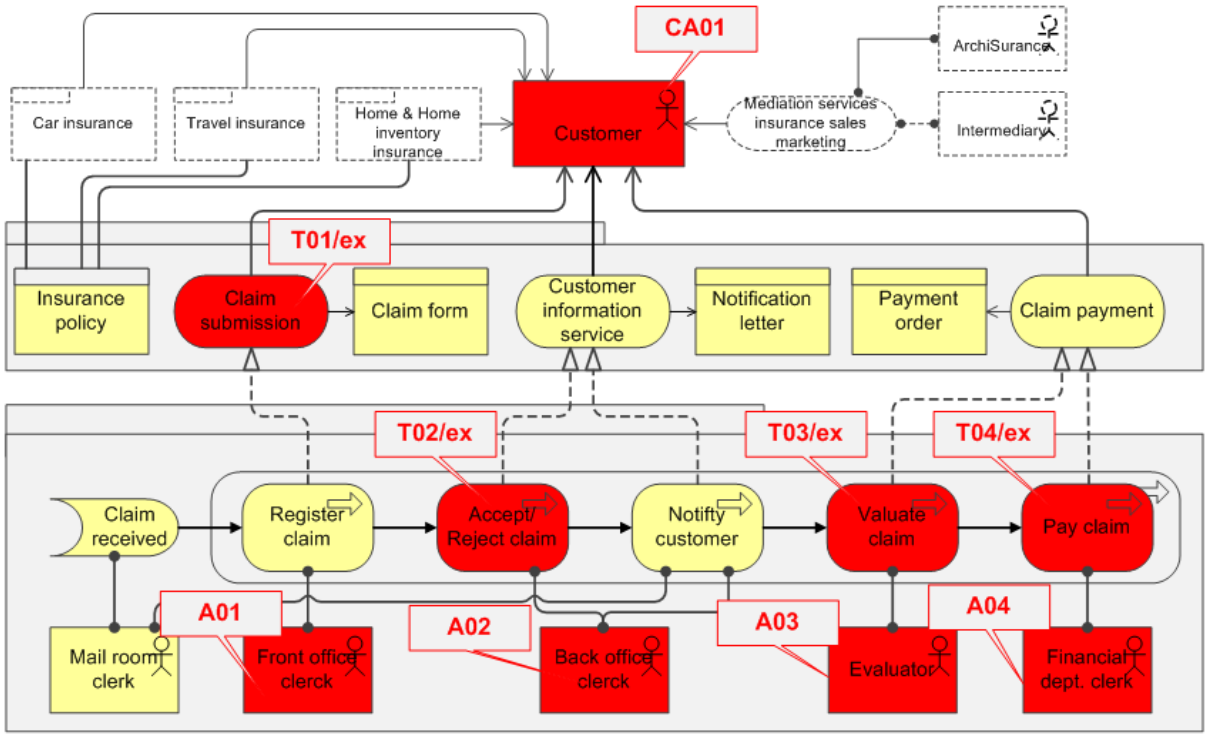


Figure 5.9: ArchiSurance Claim Handling after Construction synthesis

The actor roles are further elaborated in Figure 5.9: They are identified by actor number. The corresponding functions are shown in the following table:

Actor	Function
CA01 Customer	Initiator of T01
A01 Damage compensation handler	Executor of T01 and initiator of T02 up to and including T04
A02 Claim validator	Executor of T02
A03 Damage valuator	Executor of T03
A04 Damage compensation payer	Executor of T04

Table 5.3: Actor roles and the corresponding functions in ArchiSurance Claim Handling

6. **Step six: The organisation Synthesis**. Following the previous analysis, we now can make the *Construction Model,* represented in an *Organisation Construction Diagram (OCD)* and a *Transaction Result Table (TRT)*. They are exhibited in Figure 5.10 and Table 5.4.

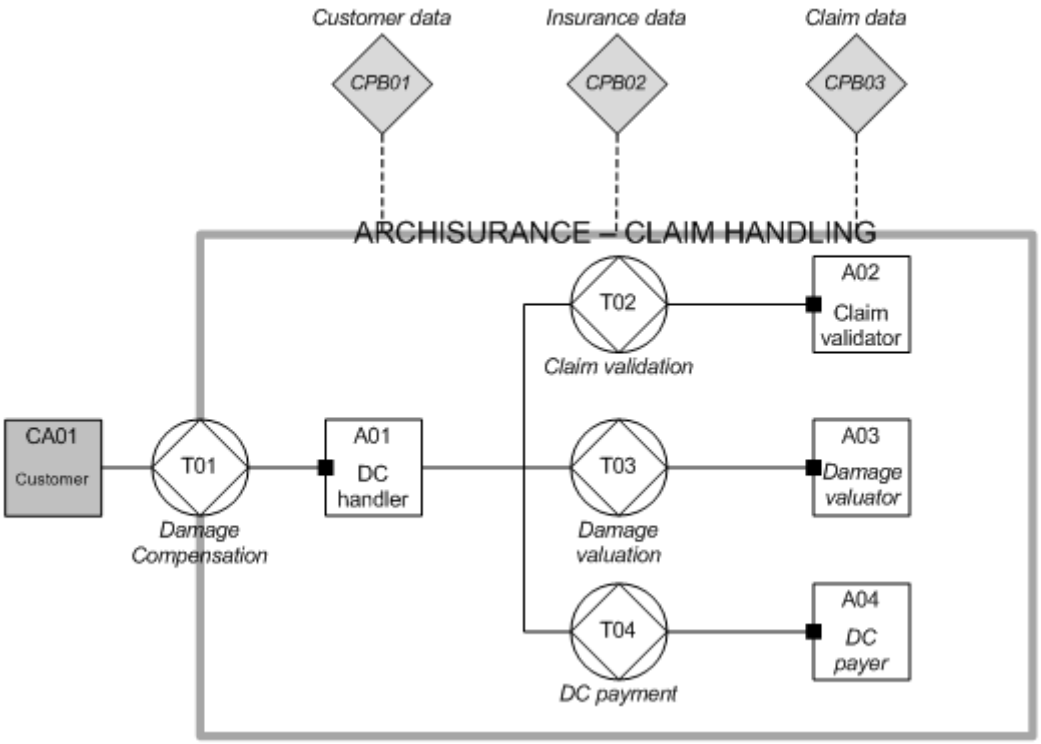


Figure 5.10: Organization Construction Diagram (OCD) of ArchiSurance Claim Handling

Transaction kind	Product kind
T01 Damage compensation	P01 Damage Compensation has been completed
T02 Claim validation	P02 Claim has been validated
T03 Damage valuation	P03 Damage has been valuated
T04 Damage compensation payment	P04 Damage compensation has been paid

Table 5.4: Transaction Result Table (TRT) of ArchiSurance Claim Handling

The Organisation Construction Diagram shows that after receiving damage compensation request from CA01 customers, actor role *A01 Damage compensation handler* initiates the transaction *T02 Claim validation*. The executor *A02 Claim validator* checks whether the claim is admissible and reports this to the A01. If the damage compensation is admissible, actor role A01 promises to the *CA01* Customer that the compensation will be considered and initiates subsequently the transaction *T03 Damage valuation. A03 Damage valuator* assesses the damage and reports this to the A01. A01 initiates then the transaction *T04 Damage compensation payment*. While *A02 Damage compensation payer* executes the payment, A01 concludes the process.

Sequences and interdependencies of the claim handling are exhibited in Figure 5.11:

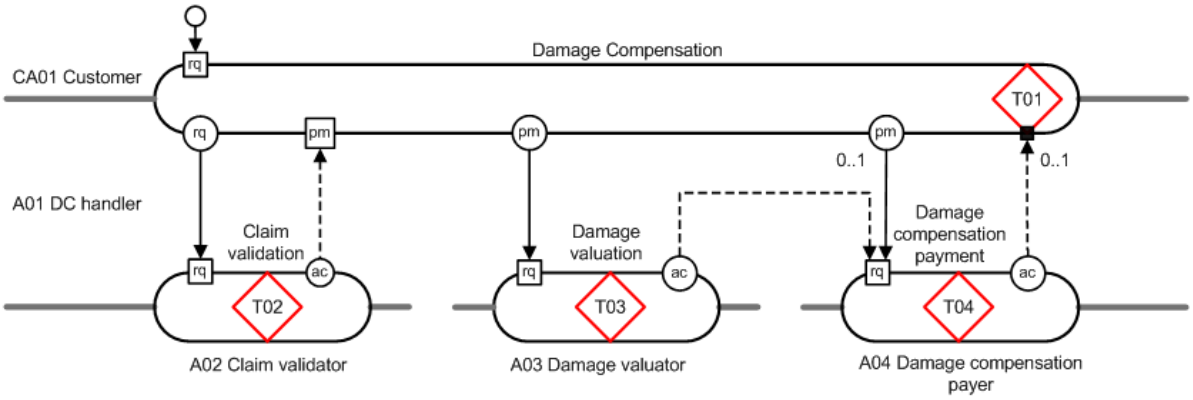


Figure 5.11: Process Structure Diagram of Claim handling

5.3 CONSISTENCY ANALYSIS

In this section we are going to compare the relationship obtained from the practical comparison in section 5.2.

5.3.1 CORRESPONDECE BETWEEN ARCHIMATE AND BMC

In this section, the relationship between ArchiMate and BMC will be examined: the relationship founded based on the case of ArchiSurance in section 5.2.2 will be compared with the relationship we proposed in section 4.1.3.

For the practical comparison between ArchiMate and BMC, we also made use of the Iacob's research results (2012). They studied the relationship between ArchiMate and BMC. The relationship is made by comparing the concept definition of BMC to the concepts definition of ArchiMate. Based on this theoretical comparison Iacob had fill out the BMC model.

The following table shows the correspondence between BMC and ArchiMate. The first column is the BMC concepts. The second column shows the corresponding ArchiMate concepts, according to our proposed relation between BMC and ArchiMate in section 4.1.3. The third column shows the corresponding ArchiMate concepts using our proposed relationship in section 4.1.3. The fourth column shows the corresponding concept proposed by Iacob (2012).

BMC	**Corr. ArchiMate** (section 4.1.3)	**Corr. case of ArchiSurance**	**Corr. Iacob's case of ArchiSurance** (2012)
Customer Segments	Business Actor, Business Role, Stakeholder	Customer	• Car/Home owners, • Travel insurance corporate clients, • Buyers holiday packages • Buyer flight tickets
Value Propositions	Product	Claim handling	• Insurances (car, home, travel) • Be informed
Channels	Business Interface	Mail, Telephone, Intermediary	Mail, Call center, Intermediary

BMC	**Corr. ArchiMate** (section 4.1.3)	**Corr. case of ArchiSurance**	**Corr. Iacob's case of ArchiSurance** (2012)
Customer Relationships	Contract Business Interaction	Through Intermediary	Distribute information packages and folders Attend customer about special premium discount
Key Resources	Business Actor Business Role	• Mail room clerk • Front office clerk • Back office clerk • Evaluator • Financial dept. clerk	Human Resource: • Mail room clerk • Front office clerk • Back office clerk Informational Resource, Software Resource
Key Activities	Combination of Business Process and Business Service	Services: • Claim Submission • Customer Information Service • Claim Payment Processes: • Acc./Reject claim • Valuate claim	• Claim payment, • Claim intake, • Customer information, • Premium collection
Key Partnerships	Business Actor Business Role Stakeholder	Intermediary	Intermediary
Revenue Streams	Value	Not exposed through the case	Is calculated based on the average number of new policies per month
Cost Structure	-	Not exposed through the case	Is calculated based on the average number of claims per month and new policies per month

Table 5.5: Correspondence between BMC & ArchiMate

Finding:

- If we compare the last two columns with each other, we see that the Iacob's BMC model is wider than ours. This is because we limit our model to activities relating to Claim Handling;
- On the other hand, we find that the Iacob's model in column four is not complete at some concepts, such as *Key activities,* and *Key resources* (In the above table, the components highlighted in green are omitted in Iacob's BMC model). This would imply that working in accordance with pre-agreed rules improve the consistency between the model;
- Finding the correspondences using the rules we proposed in section 4.1.3 is fast and easy;
- The correspondence between BMC and ArchiMate founded in the case of ArchiSurance (column three) seems to be in line with the theoretical comparison (column two).

Our conclusion is twofold:

(a) ArchiMate concepts can be linked to BMC concepts;

(b) Finding correspondences using the pre-agreed rules improve the consistency between the models. It is furthermore fast and easy.

5.3.2 CORRESPONDENCE BETWEEN DEMO AND BMC

Section 4.1.2 shows the result of theoretical comparison between DEMO and BMC. In section 5.2.3 we have shown the result of applying DEMO on ArchiSurance.

The table below combines the theoretical comparison results with the practical comparison one. The first two columns show the results of theoretical comparison between the two methods (summary of section 4.1.2). The third column shows the correspondence, using the case of ArchiSurance.

BMC	DEMO	Case of ArchiSurance
Customer Segments	Composite actor (initiator, outside the organisation)	CA01 – Customers
Value Propositions	Transaction on the organisation boundary	T01 – Damage compensation
Channels	-	-
Customer Relationships	-	-
Revenue Streams	-	-
Key Resources	Elementary actor (within the organisation)	A01 – DC Handler A02 – Claim validator A03 – Damage valuator A04 – DC payer
Key Activities	Transaction in B-organisation	T02 – Claim validation T03 – Damage valuation T04 – DC payment
Key Partnerships	Composite actor (provides support to organisation)	Not exposed through the case
Cost Structure	-	-

Table 5.6: correspondence between DEMO and BMC

Figure 5.12 below visualises the identified correspondence between BMC and DEMO:

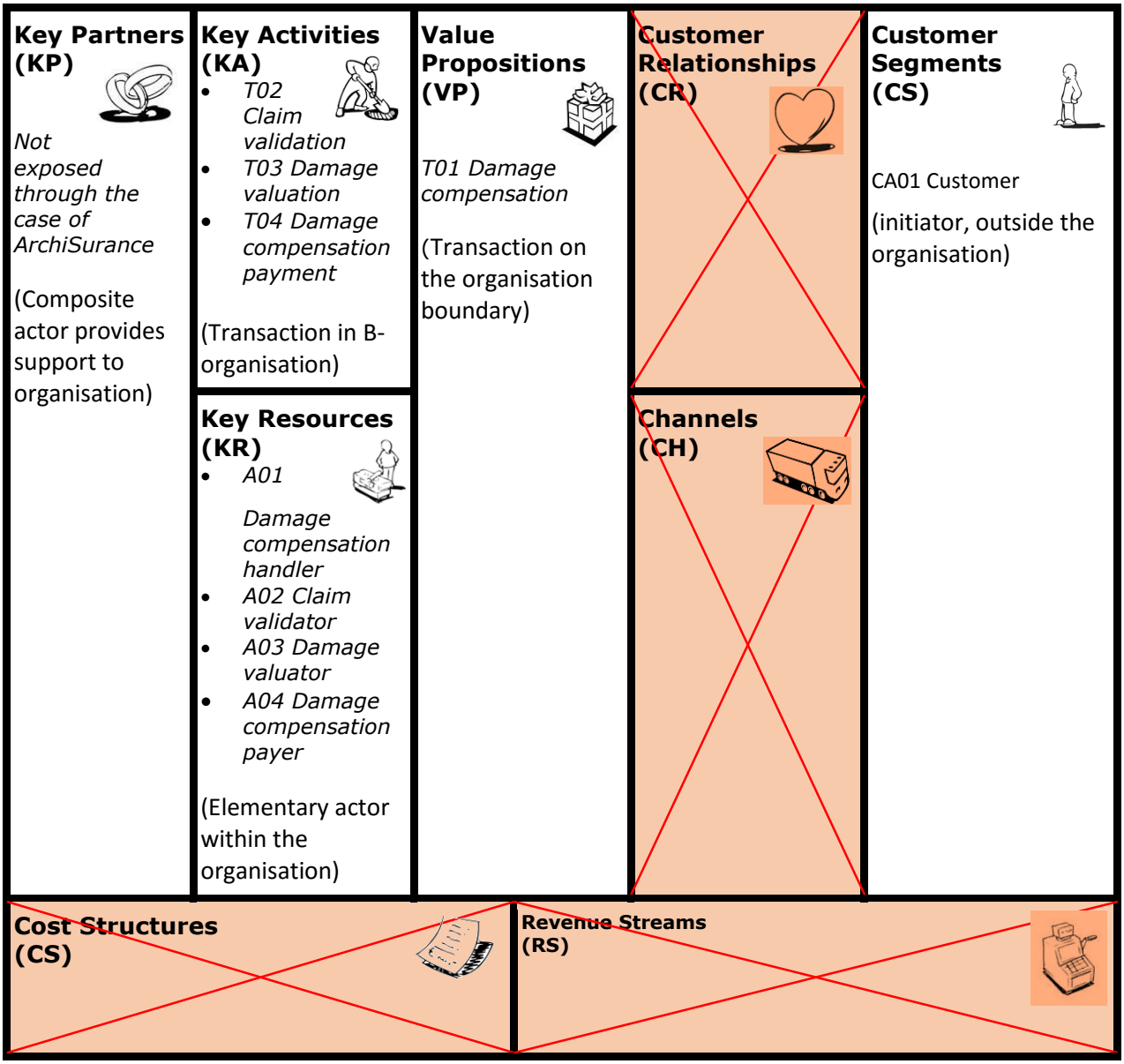


Figure 5.12: Correspondence between DEMO & BMC

Finding:

From Table 5.6 and Figure 5.12, we can see that the results are essentially the same in both comparisons. If we compare Figure 5.2 (Correspondence between ArchiMate & BMC) with the above figure, we see that the two models are pretty consistent, with the exception of deviation in denomination used in ArchiMate and DEMO.

Our conclusion is therefore: DEMO concepts can be linked to BMC concepts.

This means that we can use BMC in the Business Analysis step to gain insight. After that, we use the BMC result to identify the parties outside the organisation (*Customer Segments, Key Partners* vs *Composite actors*), customer's expectation and our right to exit (*Value Proposition* vs *Transaction* on the organisation boundary), transactions necessary in order to support the primary process (*Key Activities* vs *Transactions* in B-organisation), and human *Key Resources* (*composite / Elementary Actors)* needed to perform the *Transactions*.

5.3.3 CORRESPONDENCE BETWEEN DEMO AND ARCHIMATE

In previous sections we have analysed the business process of ArchiSurance's Claim Handling. From that analysis the actor roles, the production acts/facts and the coordination acts/facts are identified. This enables us to produce the DEMO process model and to check whether the ArchiMate model complies with the DEMO model.

The mentioned relationships between DEMO and ArchiMate, the case of ArchiSurance's claim handling are exhibited in the following table. The first two columns show the results of theoretical comparison between the two methods (summary of section 4.1.1). The third column shows the correspondence, using the case of ArchiSurance.

ArchiMate	DEMO	Case of ArchiSurance
Business Actor	Composite actor in B-organisation	CA01 - Customer A01 - Damage compensation handler (Front office clerk) A02 - Claim validator (Back office clerk) A03 - Damage valuator (Evaluator) A04 - Damage compensation payer (Financial dept. clerk)
Business Service	Transaction with an emphasis on executor	T01 - Damage compensation (Claim Submission)
Business Process	Process in B-organisation	T02 - Claim validation (Accept/reject claim) T03 - Damage valuation (Valuate claim) T04 - Damage compensation payment (Claim payment)

Table 5.7: correspondence between DEMO and ArchiMate in case of ArchiSurance Claim Handling

Using the ArchiMate model (Figure 5.13), the similarities are marked as following:

- Red, green, and blue components correspond, respectively, with components in the B-, I-, or D organisation of DEMO;
- Actors with red or blue gnome's hats correspond with, respectively, actors in the B- or D-organisation of DEMO;
- Components which have additional texts such as CA01, A01, T01 … correspond with DEMO components in the Organisation Construction Diagram in Figure 5.10;
- Components with broken line fall outside the scope;

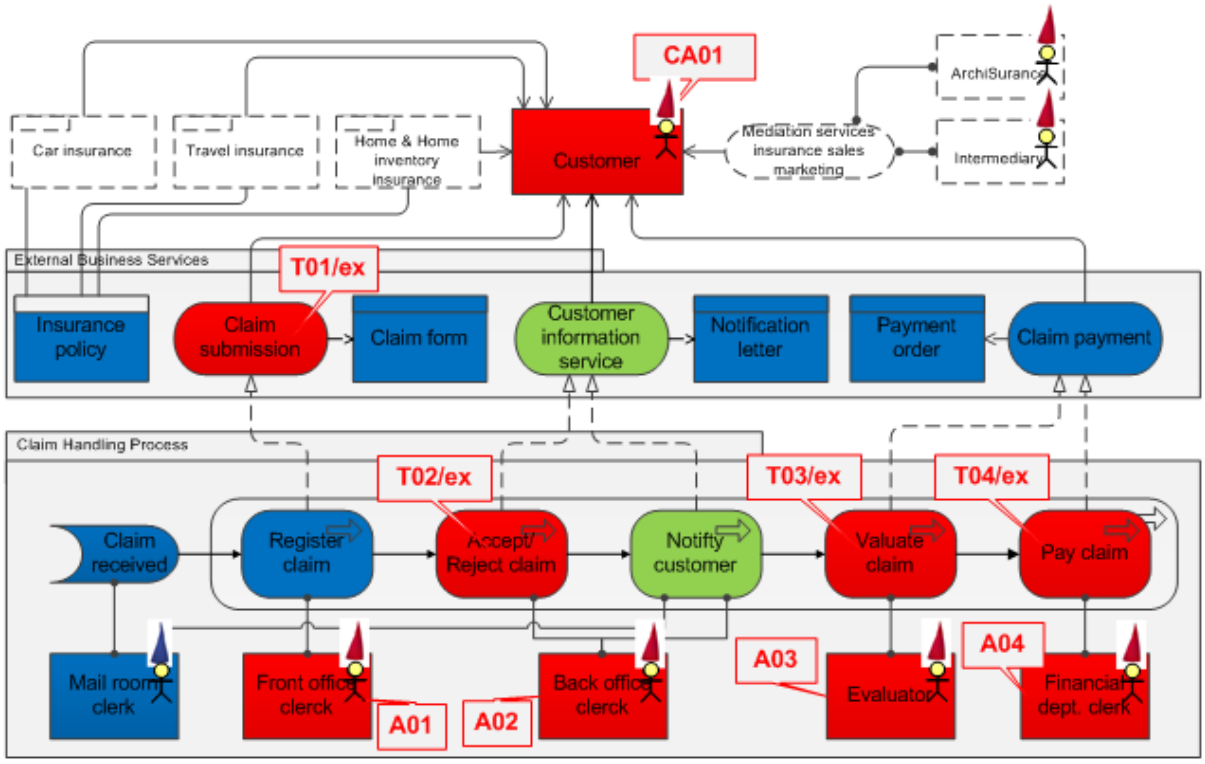


Figure 5.13: the correspondences between ArchiMate and DEMO

Studying the DEMO and ArchiMate models, we notice the following details:

- If we compare the ArchiMate model (Figure 5.4) and DEMO model (Figure 5.10 and Figure 5.11) of Achisurance Claim Handling, we see that the ArchiMate model is totally different from the DEMO model. DEMO model is much simpler than that of ArchiMate. This is because all the datalogical and infological items are removed.
- In the ArchiMate process model, it seems that if one process is finished, the next process can simply start automatically. It is thus not clear who is competent to initiate a process and who has the power to coordinate the whole process;
- The function and the role of every actor are clearly visible in DEMO model. For example, the actor *A01 - DC Handler* is the coordinator of the whole process. The actor *A01 - DC Handler* has the power to request for starting next transaction. The actor *A01 - DC Handler* has also the responsibility to communicate with and inform the customer. We can thus see clearly who is competent to initiate and execute a transaction and who may coordinate the whole process;
- In the ArchiMate process model, we see that various transactional steps such as promising, stating or accepting a result are implicit or incompletely specified. This means that the business process model is not consistent and not complete (Caetano, Assis, & Tribolet, 2015).

  We use the DEMO model produced in the previous step as input to check the compliance of the ArchiMate process model. The results of this assessment are then used to revise the original model so that it becomes complete and consistent with the DEMO model (Caetano, Assis, & Tribolet, 2015). Figure 5.14 shows the complete and consistent business model of ArchiSurance Claim Handling. Compared with the ArchiMate model (Figure 5.9), we see that only the activities T01 Execute (Damage Compensation Handling), T02 Execute (Claim Validation), T03 Execute (Damage Validation), and T04 Execution (Damage Compensation Payment) are explicitly described in the ArchiMate model. These transactions are highlighted red in Figure 5.14. Non-coloured items are the missing or implicit transactions. To keep things clear and simple, only the

transaction T01 is elaborated with a complete pattern. Other transactions are elaborated with standard patterns;

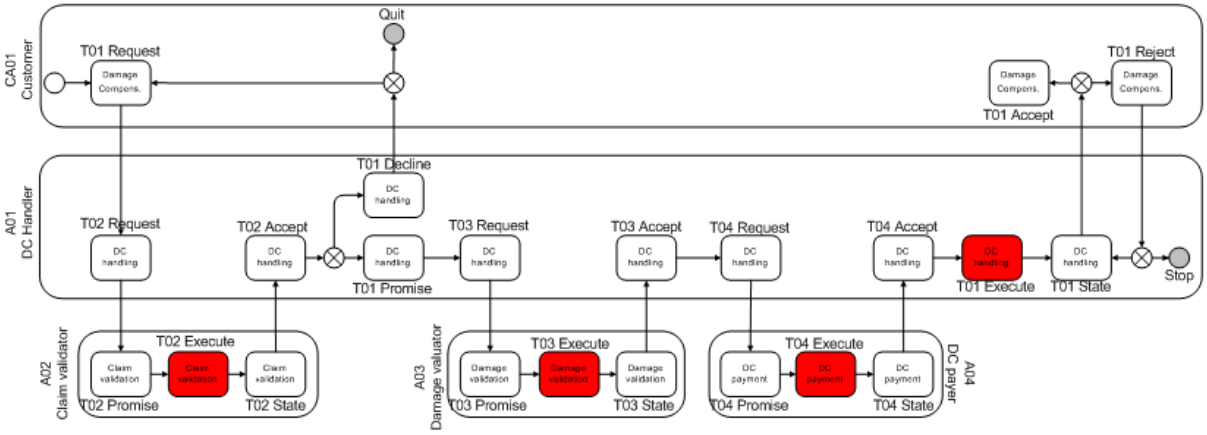


Figure 5.14: The final Business Model of ArchiSurance Claim Handling

- As mentioned before, there are only three ArchiMate concepts founded in the case of ArchiSurance that can be compared with DEMO: *Business Actor, Business Service* and *Business Process*. This is not enough to conclude anything about the relationship between ArchiMate and DEMO and to validate the results of theoretical comparison from chapter four;
- Two of the three founded relationships in the case of ArchiSurance do not correspond to the theoretical comparison in chapter four:
  - the concept *Business* Actor matches to two concepts in DEMO: *Composite* Actor and *Elementary* Actor, while the theoretical comparison shows that *Business Actor* only has a relationship with *Composite Actor* in DEMO;
  - the concept *Business Process* has a relationship with *Transaction* in DEMO, while the theoretical comparison shows that *Business Process* matches to *Process* in the *B-organisation* in DEMO;
- We have seen that using ArchiMate and DEMO together could bring benefits to process modelling. The combination shall complement and reinforce each other. It shows the missing activities and point out both the responsibilities and the delegations on the overall process. The combination can also highlight the transaction requirements: when, by whom and in which order the transaction can be carried out;
- Using those methods together should also cover each other's mistakes. As mentioned before, the denomination used in ArchiMate can lead people only to look at small parts instead of the whole transaction.

5.4 SUMMARY

At the beginning of this chapter, we showed the ArchiMate and BMC models of ArchiSurance Claim Handling. After that we used the ArchiMate model to identify the C-acts/facts, P-acts/facts and actors in order to produce the DEMO model of ArchiSurance Claim Handling. The acquired DEMO model is subsequently used to check the compliance of the ArchiMate process model and to produce a complete and consistent process model for ArchiSurance Claim Handling. The acquired model may be not perfect but it could identify the missing or implicit activities from the original model. So, the acquired model can be used to discuss with all stakeholders.

We notice the following:

- The case of ArchiSurance provides only three concepts that have a relationship with DEMO. It is still questionable the mapping between ArchiMate and DEMO and to validate the results of theoretical comparison from chapter four;
- In addition, the relationships between DEMO and ArchiMate concepts, which mentioned in the above bullet point, do not correspond to the result of theoretical comparison;
- We found that ArchiMate concepts can be linked to BMC concepts. This confirms the Iacob's finding (2012);
- We also found that DEMO concepts can be linked to BMC concepts;
- Comparing the Iacob's BMC model with ours, we see that Iacob's BMC model is not complete at some points. It contains also some mistakes. This would imply that our method of working with predefined rules improve the accuracy and consistency between the models;
- Apparently, BMC can and should make its contribution towards the dialogue between the interested parties. BMC is often used for sketching and brainstorming to easily gain the necessary information. The information can then be used to make models in DEMO and ArchiMate. We have also seen that using ArchiMate and DEMO together can help identifying missing or implicit components. The combination can also identify the responsibilities as well as the delegations on the overall process. The hypothesis as described in chapter one is therefore accepted.

6 CONCLUSION

In this research we tried to relate the three methods DEMO, ArchiMate and BMC. Our purpose was to provide a model transformation from one EA method to the other. The methods were analysed and compared on three means: (a) theoretical foundation comparison, (b) theoretical concept definition comparison, and (c) practical comparison, based on a case study. In addition, the lead Enterprise Architecture experts from both home and abroad were asked to give their views on the results and working method.

6.1 ANSWERING THE RESEARCH SUB QUESTIONS

SQ1: To what extent can the three methods be compared on the Way of Thinking?

The Way of Thinking is one of the most important aspects of the evaluation framework. In response to this sub question, the theoretical foundation of the methods was analysed and compared to each other. In the following table, the comparative evaluation of the Way of Thinking are made for the three methods.

DEMO	ArchiMate	Business Model Canvas
DEMO is an enterprise engineering methodology. DEMO focuses on the essence of the enterprise, in which all applied communication, informational technology and implementation issues are removed. DEMO is particularly useful for identifying elements that IT must support such as *Business Process, Actor role, Responsibility,* etc.	ArchiMate is a visual modelling language and provides a notation to describe, analyse, and visualize the relationships among business domains. ArchiMate captures the operational aspects. ArchiMate tries to describe and visualise the correlation between business and IT domains.	Business Model Canvas is a visual tool that aims to represent a business model and translate it into explicit knowledge. In practice, BMC is often used, among other things, for sketching and brainstorming to easily gain the necessary information. The information can then be used to set up, verify and modify the business plans. BMC captures mostly the strategic aspects.
DEMO distinguishes between three enterprise layers: *Ontological*, *Infological* and *Datalogical*.	In ArchiMate, three enterprise layers are distinguished: business, application and technology.	BMC concerns only the Business layer.
DEMO has a strong theoretical background.	ArchiMate lacks a theoretical foundation.	BMC lacks a theoretical foundation. BMC has neither a meta model, nor a graphical notation. BMC is informal (Iacob, 2012)

Figure 6.1: Comparative Evaluation of the Way of Thinking between DEMO, ArchiMate and BMC

SQ2: To what extent can the three methods be compared on the Way of Modelling?

In this study, we made the mappings between the methods by comparing the concept definition of the methods with each other. Then, the comparison result is converted into a survey. The survey is submitted to the Enterprise Architects within the Ministry of Defence, who work frequently with the aforementioned methods, for review. We incorporated their suggestions by adjusting the survey textually and halving the number of questions. Subsequently, we invited the leading enterprise architecture experts in the Netherlands and abroad to fill out the survey.

Completely unexpected, besides nine Enterprise Architects within MinDef, Lankhorst (founding father of ArchiMate) is the only one who has filled out the survey completely. Other invited experts have produced a very interesting debate about the plausibility of comparing the methods.

The discussion has shown that, the experts are not unanimous in their opinions whether a syntactic model can be compared to a semantic model.

Those, who are against the theoretical comparison, support strongly the idea of comparing ArchiMate, BMC and DEMO. However, the way to do it, would not be a theoretical comparison, as this study is aiming to achieve, but a practical one. However, they welcome the idea to start the discussion. One of the arguments against the theoretical comparison is: Mapping between EA methods requires a conceptual framework. There is not a justifiable common conceptual basis for comparing the methods. So, linking DEMO and ArchiMate at the syntactic level is impossible.

Other experts say that people bring languages to life. People had good reasons to use languages differently and on the way they want to, and sometimes did not act in accordance with the rules. They will mould/erode/tune the language. Both theoretical and practical comparisons must be possible. Next to that, it is interesting to look at actual scenarios in which people produce BMC, DEMO and ArchiMate models, and see the needs to integrate/link them.

In short, the mapping between the three methods from our study is not generalizable representative as very few replies were received, and the unanimity of the experts in their opinions. More about the mapping and the survey result can be found in section 4.1. Where applicable, Lankhorst's comments are also included. The discussion between the leading enterprise architecture experts worldwide can be found in Appendix 1.

SQ3: To what extent can the three methods practically be compared?

Our study has shown the following:

- The correspondence between BMC and ArchiMate founded in the case of ArchiSurance is in line with the theoretical comparison;
- The same applies to the relationship between DEMO and BMC: The correspondence between DEMO and BMC founded in the case of ArchiSurance is in line with the theoretical comparison;
- The case of ArchiSurance provided only three concepts that can be used to link DEMO to ArchiMate. It is too little to say anything about the mapping between ArchiMate and DEMO and to validate our proposed rules in chapter four. Further, the practical comparison between DEMO and ArchiMate did not correspond with the theoretical one. It would be premature and incorrect to conclude DEMO and ArchiMate are not suitable to link together. We rather think that our proposed rules need to be adjusted;

6.2 ANSWERING THE RESEARCH QUESTIONS

MRQ: To what extent can we compare the Enterprise Architecture methods?

In this study, we have compared the three methods on a practical way. To do that we applied the three methods to the example case of ArchiSurance, after that the obtained results are compared with each other, and with our proposed rules in the chapter four.

As mentioned earlier, we have tried in this study to relate the three EA methods in order to provide a model transformation from one EA method to the other. Our study has shown the following:

- ArchiMate and BMC: ArchiMate concepts can be linked to BMC concepts;
- DEMO and BMC: DEMO concepts can be linked to BMC concepts;
- We could not arrive at a conclusion about the relationship between DEMO and ArchiMate. The case of ArchiSurance provided only three concepts that can be used to link DEMO to ArchiMate. It is too little evidence to conclude anything about the mapping between ArchiMate and DEMO and to validate our proposed rules in chapter four. Further, the practical comparison between DEMO and ArchiMate did not correspond with the theoretical one. It would be premature and incorrect to conclude that concepts in DEMO and ArchiMate cannot be linked. We rather think that our proposed rules need to be adjusted;
- Opinions of prominent experts differ about relating enterprise architecture methods.

After all, each EA method has its own individual objective. It distinguishes itself by elements that are very suited in some situation. The methods are therefore not an alternative for each other. They complement rather than replace, one another. Our study has shown that, it is very useful to combine all three methods together in order to produce a complete and consistent model.

However, before we combine the methods, we need to determine why and wherefore we want to do that first. Depending of the framework, the mapping result can be different. The result of applying DEMO and ArchiMate to the case of ArchiSurance does not match those of the theoretical comparison.

6.3 EVALUATING THE HYPOTHESIS

Hypothesis: *The combination of concepts in the Enterprise Architecture methods BMC, ArchiMate and DEMO is feasible and more powerful than individually applied.*

Our study shows that it is very useful to combine all three methods together. Through the case study ArchiSurance, we can use, for example, ArchiMate and DEMO together to identify the missing or implicit components in order to produce a complete and consistent model. They point out both the responsibilities and the delegations on the overall process. The models can be combined like for example in the following manner: at first, we can use BMC in the step *Business Analysis* to easily gain the necessary information. Besides the information direct from the business, DEMO is grateful for the information BMC has generated in order to make its models. In turn, ArchiMate uses the information from BMC and the models from DEMO to make its model. The following figure shows the combination of the methods.

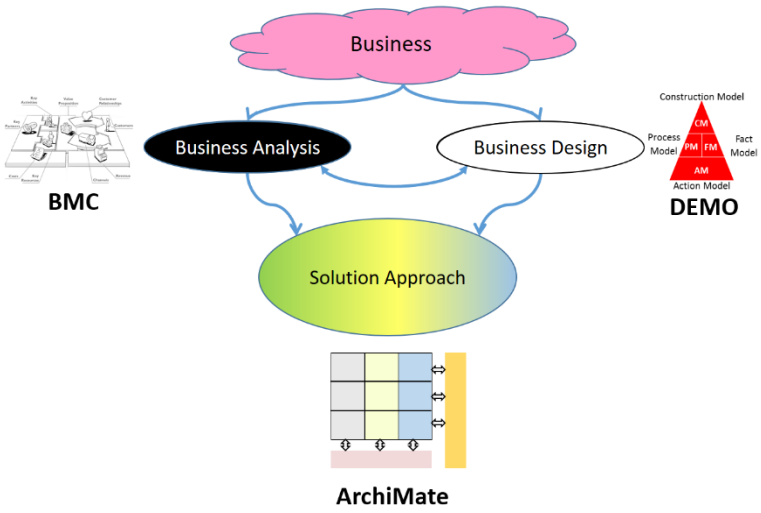


Figure 6.2: Combination of BMC, DEMO and ArchiMate

However, when combining the methods, the following must be observed:

- Each method has either its own scope of application. For example, BMC is more for sketching and brainstorming, ArchiMate tries to describe and visualise the correlation between business and IT domains while DEMO is particularly useful for identifying business processes that IT must support;
- The need for combining the methods must be clear. Why and what for do we want to combine the methods? This is because the mapping between three methods requires a conceptual framework that allow for an accurate mapping of the concepts.

The hypothesis is therefore accepted.

6.4 SUMMARY

In this study, we have demonstrated the following:

1. Every method has its own domain and purpose. The method distinguishes itself by elements that are very suited in some situation. The methods are therefore not an alternative for each other. They complement rather than replace one another. For example, BMC is more for sketching and brainstorming; ArchiMate is used to describe and visualise the correlation between business and IT domains while DEMO is particularly useful for identifying elements that IT must support such as Business Process, Actor role, Responsibility, etc.; Further information on these can be found in chapter 3 (The enterprise methods) or in section 6.1 (Research Sub Question 1);
2. We have proposed a set of rules to link ArchiMate, DEMO and BMC together. The leading national and foreign enterprise architecture experts are invited to give their views on the outcomes. However, the experts enter into a discussion about the plausibility to compare the methods. After a heated but interesting discussion, the experts are not unanimous in their opinions. This point is elaborated in section four (Theoretical comparison) or in section 6.1 (Research Sub Question 2);
3. However, we believe that concepts of the methods can be linked. We cannot cover the entire problem area of the Enterprise Architect with one method. We actually need more methods. We expect things working in one method are consistent and do not contradict in another.

Therefore, we need to identify the common concepts to link the methods together. More on this subject can be found in section 4.3;

4. To proceed with the experts' advice, we have populated the ArchiSurance BMC model by applying our proposed rules direct on Iacob's ArchiMate model. Then we laid the resulting BMC model alongside the ArchiSurance's narrative description to check the accuracy and completeness. *We found that ArchiMate concepts can be linked to the BMC concepts*. See further chapter 5 (Case study ArchiSurance) or section 6.2 (Research Sub Question 3);
5. The same is done for the relationship between DEMO and BMC: The ArchiSurance BMC model is populated by applying directly our proposed rules onto the ArchiSurance DEMO model. We found that *DEMO and BMC can be linked*. Read more on this in chapter 5 (Case study ArchiSurance) or in section 6.2 (Research Sub Question 3);
6. However, applying DEMO Way of Modelling direct on Iacob's ArchiMate model yield a different result:
   a. The case of ArchiSurance only provided three concepts that can link DEMO to ArchiMate. There is too little evidence to conclude anything about the mapping between ArchiMate and DEMO and to validate our proposed rules in chapter four;
   b. The practical comparison between DEMO and ArchiMate did not correspond with the theoretical one. It would be premature and incorrect to conclude that concepts in DEMO and ArchiMate cannot be linked. We rather think that our proposed rules need to be adjusted at this point;

   More study is needed to provide a reliable result. Chapter 5 (Case study ArchiSurance) or section 6.2 (Answering Main research question) provides more information on this subject;
7. Our experience from applying the three methods on the practical case of ArchiSurance shown that working with predefined rules is very easy. It improves the accuracy and consistency between the models involved. However, before combining the methods, one first needs to determine why and wherefore it is done, as, depending of the framework, the mapping results can be different;
8. BMC should make its contribution towards improving modeling in DEMO and ArchiMate. Using ArchiMate and DEMO together can help identifying missing or implicit components. The combination can also identify the responsibilities as well as the delegations on the overall process. The hypothesis as described in chapter one is therefore accepted. See section 6.3 (Evaluating hypothesis) for more information on this subject.

7 DISCUSSION & FUTURE WORK

1. In this study, we used the survey to ask the Enterprise Architecture experts for their opinions about the suggested mappings. Regrettably, very few replies were received and the results have been excluded from the survey as it is considered that the response is too low to be representative. Possible reasons for the low response rate:
   - Our survey asks in-depth knowledge about three different methods. Not every EA experts has that knowledge;
   - There are differences of opinion whether a syntactic model can be compared to a semantic model;
   - Participation in a survey that takes a few minutes is more likely to happen than a survey that requires a minimum spent of an hour, like ours. The Enterprise Architecture experts surveyed are top scientists that have busy schedules and it is hard for them to free up time to take the survey.

   An interview could be a better alternative to gain the experts opinion.

2. In this study, we used the case of ArchiSurance to make a practical comparison between BMC, DEMO and ArchiMate. In retrospect, ArchiSurance provided just three concepts that have a relationship with both DEMO and ArchiMate. This is not enough to say anything about the relationship between the methods. Future work such as applying this research on a real case comprises a sufficient number of interesting aspects. In doing so, we can provide more reliable results and have a better understanding when combining the methods.

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9 GLOSSARY OF TERMS

ABD	Actor Bank Diagram
ATD	Actor Transaction Diagram
BCT	Bank Contents Table
BMC	Business Model Canvas
DEMO	Design and Engineering Methodology for Organisations
EA	Enterprise Architecture
FM	Fact model
IAM	InterAction Model
ISM	InterStriction Model
IUT	Information Use Table
MinDef	Ministry of Defence
OCD	Organisation Construction Diagram
OFD	Object Fact Diagram
OPL	Object Property List
PM	Process Model
PSD	Process Structure Diagram
PSI ψ theory	Performance in Social Interaction
SM	State Model
TPT	Transaction Product Table
TRT	Transaction Result Table

10 APPENDIX 1 – DISCUSSION AMONG EA EXPERTS

- **Mulder** (University of Antwerp, 15-09-2015)
  Het resultaat is juist geweldig! Let op het kwalitatieve commentaar: 'Linking DEMO and ArchiMate at the syntactic level (this is what you simply try) is probably fundamentally impossible.' of neutraler gesteld : "A mapping between three methodologies requires a conceptual framework which allow for an accurate mapping of the concepts. In this survey therefor my answers are neutral, depending on the framework the answers can range from similar to different."
  Ik vind dat een interessante en correcte uitkomst van deze verkenning (let op deze survey is dus geen toets). Vervolg stap is enkele expert-interviews laten afnemen door Minh. De namen heeft hij :-)
  Kortom mooi dat de verrassing uit het onderzoek komt,
  Hans

- **Dietz** (Founding father of DEMO, 25-09-2015):
  Dear Minh Lê,
  I didn't fill out the survey on Archimate, BMC and DEMO, although you have sent reminders already, because I couldn't find the time, until now, to study the document in which you correlate the various terms/concepts in the three methods, as the basis for comparison. The result of my study is that although the document suggests that there is a common conceptual basis for comparing the three methods, my conclusion there is not a justifiable common conceptual basis, only a terminological one. So, what the survey attempts to achieve, is in my view unachievable. It is not even a matter of comparing apples, pears, and bananas, because it is just unsure whether one can call all three of them fruit.
  Consequently, I have to revoke my initial promise to participate in the survey, for the reason explained above, which I regret, and for which I apologise. At the same time, I strongly support the idea of comparing Archimate, BMC and DEMO. However, the way to do it, would not be a theoretical comparison, as you currently are trying to do, but a practical one. By this I mean that you select a practical case, comprising a sufficient number of interesting aspects (like organisational change, business process problems, information provision problems, etc.), and that the promotors of the methods tackle the case to the best of their knowledge, after which a discussion takes place between experts in each of the methods, preferably supported by a GDSS.
  I am happy to join such an endeavor
  Kind regards,
  Jan Dietz

- **Tribolet** (Technical University of Lisbon, 25-09-2015):
  I must say I am 100% in agreement with Prof Jan Dietz.
  This is the research path that is solid and promises to give evidences from which solidariedade conclusões can be taken

- **Van Gils** (Bizzdesign, 25-09-2015):
  Hi all,

I am afraid I must respectfully disagree: if the goal is to investigate "alignment" between the three approaches then there are different avenues of research that can be undertaken. One avenue would be to study the phenomena in the real world and how they are represented in each of these approaches (as suggested, using cases). Another would be to use more qualitative methods and ask for expert opinions. A more theoretical analysis should also be possible I am sure.

Having said that: I started the questionnaire and also had some issues with it. It would take more time to complete than I currently have, so I will also have to withdraw my promise to complete it. I am very interested in the results and hope the chosen path will lead for useful results.

Regards
Bas

- **Dietz** (Founding father of DEMO, 26-09-2015):
Dear Bas,

You seem to miss the point, even if the goal is restricted to investigating 'alignment'.

From the three approaches, only DEMO (more specifically: the PSI theory), is based on a solidly constructed conceptual foundation, built around just one assumption, which is the validity of the coordination act as the atomic element of human cooperation. This coordination act is a specialisation of the communicative act in Habermas' Theory of Communicative Action, which on its turn must be understood as a refinement and an enhancement of the Speech Act Theory (Austin, Searle and others). To my knowledge, this validity has never been refuted.

Both Archimate and BMC don't have a solidly constructed conceptual foundation. Instead, they rely on the assumed validity of at least 5 to 10 intuitive concepts: actor, role, process, function, event, service, product, object, value, etc. That's why a theoretical comparison makes no sense.

However, one can always compare the practical effects of, for example, two detergents, even if one of them has been developed in a scientific laboratory, and the other has been brewed on a Friday afternoon by an alchemist. This is what I proposed to do in comparing Archimate, BMC and DEMO. There are only two possible disclaimers. One is the insufficient representativeness of the selected case, the other is the statistical uncertainty regarding the reliability of the outcomes.

Regarding your claim that a more theoretical analysis must be possible, I refer to the quote of Thé Lau in the signature below.

Kind regards,

Jan Dietz

- **Van Gils** (Bizzdesign**,** 26-09-2015):
Jan and others,

Apparently we disagree about the possibility of a sound theoretical comparison of the mentioned approaches. Throwing greek letters around feels like a troll for a heated debate which, in my view, is neither productive nor professional.

A comparison of the approaches - whether theoretical, or based on insights gained by respected academics and professionals - would be valuable. I hope the researchers will keep an open mind in their exploration.

Since we are quoting, I'd like to cite Yogi Berra: You can observe a lot by watching.

Kind regards

Bas

- **Proper** (Radboud University / Henri Tudor Institute**,** 26-09-2015):
  Dear all,

  Let me start with an apology. When I pressed the reply button, I was confronted with a long list in the Cc: field. Not sure if all of us are interested in the discussion … so apologies for that.

  Languages lead their own lives. Even "engineered" languages, such as UML, ArchiMate, BMC, and even DEMO.

  I remember an old quote from Driek van Wissen: De taal is het voertuig van de geest. (Language is the vehicle of the mind.).

  Languages are shaped (eroded/molded/…) by their use. One can see that in natural languages, and there is also evidence to be found that this happens with "our" languages.

  Work on DSMLs also shows the need to create purpose/domain/situation specific languages. Of course, these purposes/domains/situations evolve over time. And are thus likely to trigger changes of a language, once defined.

  Of course. We, as language engineers, might be annoyed by this. We have good reasons to want to:
  - Standardise icons/notations
  - Standardise syntax
  - Standardise semantics
  - Underpin the language on top of theory.

  We have good reasons. Or at least think we do, to want this. After all … it is our work ;-)

  But what happens in practice? I don't mean the practice of the "Tool Builders" and "Standard designers". I mean the practice of people who use the language.

  People who interact with/round/on the models created. They bring the language to life. They will mold/erode/tune the language.

  They will use the symbols/icons of the language the way they want to. Not according to the theory? Too bad. Let's not be arrogant to declare these practitioners dumb. They might (so let's investigate!) have a good reason to use things differently.

  I think the DSMLs experiences also show that the need for precise syntax, semantics, and even rigorous theoretical grounding, differs per situation. BMC is intended as a sketching language. So, it should "by design" have a liberal syntax and semantics. It's used for brainstorming! Once at the level of identifying precise transactions, we need precision and rigour. So, there we need a precise syntax, semantics and theoretical grounding, such as e.g. offered by DEMO. When doing EA, one seems (so we assume) a need for more course grained concepts to "talk"/ "map" structures. Then one needs a bit more rigour than a BMC style "canvassing" language, but the rigour and conceptual precision of DEMO would be too detailed.

  *The last paragraph is partially hypothesising. I'm only trying to make clear that we need more insight from actual *use* of the languages and the expressed models in particular.*

  When comparing/positioning languages such as BMC, DEMO and ArchiMate, I think one can indeed take at least two approaches:

  1) *Compare the theoretical foundations (as far as they are present), and possibly based on that position/relate the languages.*
  2) *Look in practice, to discover:*
     - *What models are actually produced in the language?*
     - *What are they used for? Is the language actually a useful vehicle for that?*

     Here, one might use the notion of "affordance" in connection to a language.

Next to that, it would be interesting to look at actual scenarios in which people produce BMC, DEMO and ArchiMate models, and see the need to integrate/link them. Why? What for?

I have a suspicion that Bas is arguing along the lines of approach 2, and Jan along the lines of approach 1.

Taking the perspective that "Language is the vehicle of the mind", I would be in favour of first better understanding the needs for the three types of models, and the desire to connect them, before diving into 1.

Regards,
Erik

- **Van Kervel** (ForMetis, 26-09-2015**):**
Dear All, notably Bas and Minh,

I react in line with my comments to the CIAO! community after the CBI conference in Geneva last year.

I mentioned these three issues as serious criticism on our CIAO! community.

1. *We may have confidence in the empirical scientific foundations (alpha, beta, gamma etc :-)) of enterprise engineering.*

   In my view there is now defendable room for "quite some" confidence.

   Not nearly as much confidence (yet) as in the Newtonian laws of physics, which are nice for daily life but break down when things become too small or too fast. Nowhere as much confidence as justified for the GREAT Maxwell laws of electromagnetism. Without these laws we would not have electrical engineering, and we would not be able to see planets around other suns.

   The same for Navier-Stokes laws, and many other theories that deserve VERY GOOD but not infinite confidence. The EE theories may become GREAT, but after much work and validation.

   Plenty of reasons for great modesty here!
2. *Since we try to be serious scientists, we must be skeptical and supportany attempts to debunk or challenge our theories.*

   Popper and his black swans etc. One case if enough.
3. *We must also try to support others, with different views, theories, opinions, as good as we can. We serve others.*

So we must help to make better Archimate models, better TOGAF models etc, if people want to use these.

Since we, Formetis, are one of the few who do real world professional things with enterprise engineering, we must take this job.

I propose to do the following:

A. *A functional assessment.*
   How well does it work for some functional purpose and compare the 2 approaches? Criteria like functional appropriateness and truthfulness to be applied. After all, since there is so much failure in this domain, this is an important criterion.
B. *Capturing the world of phenomena*
   Enterprise are phenomena in the real world, like electromagnetic waves, forces & mass etc. Theories, methods that claim to do something useful for enterprises must 'capture' that part of the world of phenomena. Otherwise it is all about "nothing".

I propose to apply the work of Guizzardi, the best work I know, to asses this: Guizzardi, G.: Ontological Foundations for Structural Conceptual Models. Ph.D. thesis, University of Twente. (2005).

C. *Theories, methods that claim to do something useful for enterprises "say" - propositions in some language - something useful about these enterprises. What can be said about the quality of these propositions in itself? It is what Erik Proper says below about the quality of languages and propositions. Therefore, I propose to apply the following ontological quality criteria, provided by various researchers: Comprehensiveness, Conciseness, Coherence and Consistency. Also related criteria such as minimized expressiveness, zero entropy in expression, lucid and ontological clarity, construct overload, construct excess, plus some more.*

So a very strict rigorous assessment here of the languages used.

We - Formetis - are willing to take this task, and work happily with Bas and Minh. Our goals:

1. *A pursuit of truth, Socrates told us already much about the value of this.*
2. *Scientific skeptics is our best tool for progress*
3. *No need for consensus*
4. *A clear inventory of various opposing defendable stances is a very good result.*

@Minh, you have a big fish on the hook. :-)

Let's do this.

Finally, who wants to join us, it should be a joint effort?

Kind regards to you all,
Steven van Kervel
Formetis BV

- **Wierda** (APG, 27-09-2015):
  Dear all,

  Now that we're discussing this in public, I reacted (I think in the Survey form itself, but I don't remember) along the same lines as Jan Dietz, especially when encountering equations that seem to be made on the fact that the same phrase/word is used. I think I related to Wittgenstein's "bewitchment by language".

  I'm with Wittgenstein that meaning in a language comes from 'correct use' (this is how Hacker phrases LW) and some languages may be very precise, others may be more vague. Mapping languages onto each other in some syntactical way is in my opinion an impossible task, especially when these languages have to cover (part of) human behavior (such as EA languages must). The only workable option there is, is to create relations between certain patterns in the language, e.g. one can design patterns in ArchiMate and link them to patterns in BPMN (as I have done in my Mastering ArchiMate book).

  All in all, I found the attempt rather 'simplistic'.

  Yours,
  Gerben Wierda
  Team Coördinator Architectuur & Design

  APG ICT IS/Change

- **Tribolet** (Technical University of Lisbon, 27-09-2015):
  Dear all,

  I hope you don´t mind some "latino bullshiting" from Portugal!

  I find this interchange most relevant!

In fact, we are addressing one of the most critical issues: human communication aiming at shared understanding of the given context where they are immersed.

From my professional experience in the field, the most difficult thing to achieve in a given community of interest is the have a common language, in fact, as Erik rightly pointed out, to share in a given context, ONE Domain Specific Language.

This implies that the Names used by each in the language must represent to all precisely the same entity. Also that the verbs used in the language, are associated with precisely the same type of state changes of the names they refer to and of their interrelations. And so on as we all know from our human experience.

Discussing any subject at all without dynamic alignment of the core concepts of the shared DSL – as is done every day, everywhere, by all of us, about everything - introduces a lot of "noise" which not makes us waist a lot of time, but worse, leads to "consensus" and agreements on things that in fact are not the same to all involved, they are indeed different.

In my opinion, this "natural explanation" on why language is at the core of everything, does not need very fancy theories not Greek letters! Is just plain obvious for any human with a thinking unbiased mind.

When doing scientific and theoretical work like the one we are discussing here, it is best to start from the beginning so that its foundations are solid indeed.

When comparing the different approaches, when comparing "models" and "methods" it would be wise to make sure that the language that is intrinsically associated with them has common concepts, that are understood the same way by all using them.

For example, the "simple" notions of Activity, Role or Process are used in such a diverse form by everybody that it is indeed baseless to make comparison attempts on a rigorous scientific basis, if these issues are not clarified.

If course the field of social sciences is full with such "ethno-studies", and their conclusion are certainly valid for the "tribe" studied. Btu they are not amenable to generalizations…

So, the "experimental" approach of first concentrating on a precise Specific Domain, and on concrete cases applying the different approaches and then taking objective conclusion from the results observed would provide solid workbenches for theoretical reasoning, much in the same way as it is routinely done in the hard sciences.

In summary, we all should discuss this "basis issue" in depth, not as a contest between PSI versus the rest of the word but as a joint effort to tackle the difficult question of providing good artefacts to improve human communication. And that´s what models are for!!

Because, after all, we humans as information processing and communications hubs, we are carbon based servers and form a huge internet called Humanity.

And our inner architecture has a semantic design. We are language processors, language creators, we are ONE with our language capabilities.

Any technology that does not take this at its basis is doomed to fail.

Jose Tribolet

- **Sanz** (Institute of Systems Science, 28-09-2015)**:**
I fully agree with your detailed account, Erik, and your clarifications. I also think the importance of doing 2. is paramount.

Dear Bas, why not to organize a mini-Dagstuhl in IEEE CBI 2016 in Paris? It would be nice to hear about the understanding of the foundations of Archimate from the Archimate leaders, delight us with many key examples, and discuss comparisons. I am Program Co-Chair there

and I will be happy to support it. I am including some of our colleagues in S-BPM for obvious academic and practical interest reasons from them and their community as well.

I would also need to encourage all of us to bring cases as a condition for hosting a Session, i.e., specific examples where people have used anything we will be comparing. The reason I am saying it is because in order for me to be able to compare things, I need first to know about the goal or domain of concern we are addressing. In the language of "comparing apples with apples", before I can compare I need to know whether we are showing these fruits or vegetables to eat them, paint them on a canvas or carve a Halloween mask. Usually, I see a lot said on item 1. (following Erik's two-item email) but VERY FEW examples where I can appreciate the purpose to even worry about it beyond a nice scientific exercise (which is absolutely great but after a while, a bit annoying because I see fruits recurrently announced as food and then, I see them used as a Halloween mask instead).

A final word to ALL, on our communion of spirits. Let's always keep a nice and respectful exchange. No matter how taste of the soup of letters or fruit salad may be, in the end, we all live somehow as cooks, so I hope we all take an easy and relaxed moment of communication in sharing our ideas. As everyone is quoting a saying, my favorite is "If any activity brings tension that cannot be managed nicely and in a constructive tone, I do not want to participate" (cannot remember the author, but I think it is from me :-).

Warm regards and let's not give up!
Jorge

- **Ferrante** (Dutch Ministry of Defense, 28-09-2015):
  Dear all,

  As a practitioner starting with BMC-Archimate-DEMO (after a learning a lot of other formal (e.g. relational datamodels, petrinets for workflow, UML, etc.) and non-formal methods (Yourdon analysis and design, AO, EPC's, etc.) I was happy with the initiative of Minh Lé to help me to get some order.

  Notice 1: All these methods (also the earlier one) are communicated to me as must-do, winning the war in IT for me!

  Notice 2: My customers does not want to see them too much and certainly want not verify the results. Especially when the decision makers are confronted with formal methods: They don't want to have to admit that they don't understand them and that they evolved to political managers who take intuitive decisions. It is better to catch these decisions with e.g. the non-formal method BMC in such a way that these stakeholders can accept them with a smile on their face, once confronted again with them.

  Notice 3: The software builders (somehow also customers from me) want the decisions in a more exact, formal way (e.g. in DEMO).

  Notice 4: I am responsible to keep this perceptions consistent. When I was much younger my older experienced IT-manager told me so, and he was right, wasn't he? So I must make a translation. Daily practice, neglecting all your theoretical discussions. As it must be possible for other practitioners to take over my work it is essential that we have the same idea of "these translations".

  So I am happy with the working hypotheses form Minh ……which can evolve to a theory by the big shots in science (let's encourage them).

  Please, help Minh helping me, practitioner and in this way my customers.

  Kind Regards
  Benno

- **Van Gils** (Bizzdesign, 28-09-2015):
  Jorge,

  Thank you very much for the invitation to organize a session. As always, timing is everything (Q1-2 of 2015 will be extremely busy for me due to personal and professional challenges). Shall we discuss this separately? Perhaps you can send me some more details about when the event is to take place?

  I also support your note on the tone of the conversation: only constructive discussion will get us where we want to go.

  Kind regards
  Bas

- **Dietz** (Founding father of DEMO**,** 28-09-2015):
  Dear all,

  My message to Minh Lê has evoked many and various discussions, interesting ones indeed, but this should not distract us from the problem that I pointed at, namely the mission impossible that he wants to undertake: a theoretical comparison of Archimate, BMC and DEMO.

  I think we meanwhile agree that it is impossible to perform such a comparison on a common conceptual basis (semantics), while doing it on a terminological one (syntactics) is just fooling ourselves. Indeed, we are at the core of one of the hardest problems of the human mind: communicating with other minds by means of the imperfect instrument of language (for which there is unfortunately no alternative). And the only way I see to master the drawbacks of communicating through language is the way that Wittgenstein paved for us. In the Tractatus Logico-Philosophicus, he clarifies and emphasises the importance of (first order) logic in formalising the thoughts we want to communicate, and in expressing these formalisations in language. The 'late' Wittgenstein Philosophical Investigations) is by no means a denial of the 'early' one, but a recognition that logic is not sufficient, that the meaning of language expressions is something we, communicating human beings, continuously shape, in communication.

  So, the only feasible way for Minh Lê that I see, as I have said already, is to conduct an investigation of Archimate, BMC and DEMO by applying them to one or more practical cases, and to assess the outcomes with 'open minded' experts. He is in charge to propose to us how he wants to set this up.

  All issues that are brought to the front in the various contributions to the current discussion, have to be addressed somehow, because they are all utterly relevant, in particular the practical issues of surviving as theoretical truth promotors in the current 'professional' environment of quakers and bunglers. However, I think this cannot be done properly in a discussion over e-mail. Within the community of enterprise engineering (the Ciao! community), we seek to address them by building a solid root system of theories for our so-called Ciao! tree. This root system is subject to continuous refinement and extension. Every year, during our EE week, we have though discussions about these theories. I invite everyone to take part and to join us! Next year, we gather in Funchal, Madeira, most probably in the first week of May.

  Kind regards,
  Jan Dietz

  Wierda (APG, 28-09-2015):
  Dear all,

I was busy writing a reply, but Jan Dietz came first and I agree with most of what he says, so I'll second that.

Where I do differ is that (and bear with me, this has consequences for our field) 'late' Wittgenstein's is indeed not a denial of 'early' Wittgenstein, but it is work that makes 'early' Wittgenstein even less relevant for the real world than already hinted at in TLP. 'Early' Wittgenstein is valid still, but as a foundation for semantics that is situated in the 'real' world it is mostly ineffective and with it all thoughts of universal, precise languages that are built on top of 'early' Wittgenstein.

Enterprise Architecture as a field is marooned between the rational (logical) world of (digital) IT and the real world of human behavior. Just like Wittgenstein was 'marooned between the ice and the roughness' (see one of my favorite quotes, reproduced below, also quoted in my book "Chess and the Art of Enterprise Architecture"). One difficulty of the field is precisely that, it must cater both to the world that requires exactness as well as the world that cannot work based on exactness. A single exact language that spans both is by definition impossible. How we handle complexity (and not to forget: unpredictability) of modern Business-IT landscapes is a key issue.

In my view, though well-written languages (definitions, uses and so forth) can be a tremendous help, they are by themselves not able to solve the issues.

Yours,
Gerben Wierda
Team Coördinator Architectuur & Design
APG ICT IS/Change

11 APPENDIX 2 – LIST OF INVITED SURVEY RESPONDENTS

#	Name	Organisation
1	Prof. Dr. ir. Dietz (Emeritus)	Sapio (Founding father of DEMO)
2	Dr. Ir. Hoogervorst	University of Antwerp
3	Prof. dr. Op 't Land	Professor Enterprise Engineering, Antwerp Management School, Global Architect Capgemini
4	Prof.dr.ing. Mulder MScBA	University of Antwerp
5	Dr. De Jong	Mprise
6	Pluijmert	Director INQA, Quality manager, Project manager
7	Dr. ir. Van Kervel	ForMetis Consultants BV, Enterprise Engineers
8	Theo Severien	DGA Doenrade Inviseurs BV en Business Fundamentals BV, Organisatieadviseur / Projectleider vakkennismanagement
9	Dr. ir. Linda Terlouw	ICRIS
10	Drs. Ing Ettema	Open University
11	Ir. Geskus	University of Antwerp
12	Prof. Dr. Caetano	Technical University of Lisbon
13	Ing. Pergl, Ph.D.	Czech Technical University in Prague
14	Dr. Jorge Sanz	Institute of Systems Science
15	Dr. De Vries	University of Pretoria
16	Dr. Frantisek Hunka	University of Ostrava
17	Prof. Dr. Albani	University of St Gallen
18	Prof. Dr. Tribolet	Technical University of Lisbon
19	Dr. Lankhorst	Founding father of ArchiMate
20	Dr. Jonkers	University of Delft
21	dr. Hoppenbrouwers	University of Nijmegen
22	Gerben Wierda MSc	Team Coordinator Design & Architecture at APG, auteur book Matering ArchiMate
23	Dr. Van den Berg	Bizzdesign
24	Dr. Van Gils	Bizzdesign
25	Remco Blom MSc	Bizzdesign
26	Prof. Dr. Proper	Radboud University / Henri Tudor Institute
27	Bjekowisz	Henri Tudor Institute
28	Dr. Sousa	Professor of Information System, IST, Lisboa
29	Vieira	University of Madeira
30	Huysmans	University of Antwerp
31	Prof. Dr. Winter	University of St Gallen
32	Junici Iljima	University of Tokio
33	Verelst, PhD	University of Antwerp

#	Name	Organisation
34	Aveiro, PhD	University of Madeira
35	Prof. Babkin	University of Novgrod
36	Meijer	Ministry of Defence
37	T. Binnekamp	Ministry of Defence
38	M. Frenk Msc.	Ministry of Defence
39	Ir. Marlon Chin Kwie Joe	Ministry of Defence
40	Ir. De Vreede	Ministry of Defence
41	B. Ferrante Msc.	Ministry of Defence
42	T. Verdijk	Ministry of Defence
43	Drs. M.T.C. (Christine) Tyl CMC	Ministry of Defence
44	Mozer	Ministry of Defence

Table 11.1: list of invited survey respondents

12 APPENDIX 3 – BMC METAMODELS

This section describes the three BMC metamodels currently available (Hauksson (2013), Iacob et al. (2012), and Malik (2012), and the motivation for the choice of Hauksson's BMC metamodel.

The first BMC metamodel is from Malik (2012). Amongst nine existing building blocks, Malik adds six new sub-blocks to the metamodel. The relationships between the blocks are placed according to the text in the Business Model Generation book (Osterwalder & Pigneur, 2010). The addition of extra elements makes the model somewhat different from the Business Model Canvas. Malik's model is therefore more complicated, and has less 'ease of use' for the end user. Malik's resulting BMC metamodel is shown below.

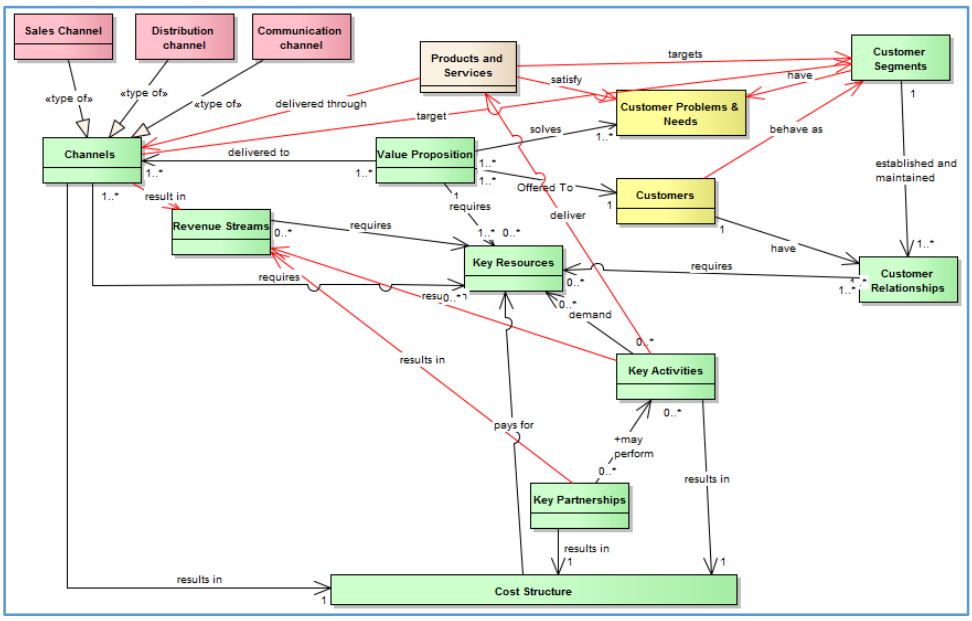

Figure 12.1: BMC metamodel proposed by Malik (2012).[8]

The second BMC metamodel is created by Iacob et al. (2012). Iacob et al. used Business Model Ontology (BMO) metamodel as the foundation to build the BMC metamodel. They added some relationships to compensate the resulting issues. Unlike Malik's BMC metamodel, the resulting Iacob's metamodel just has nine building blocks, no more but also no less. Iacob's model is therefore very familiar to Business Model Canvas. The resulting metamodel is exhibited below:

[8] The green boxes are the nine building blocks. The red elements are subtypes but not modeled. The yellow boxes are referred to by the elements, but are never actually captured in Osterwalder's Business Mode

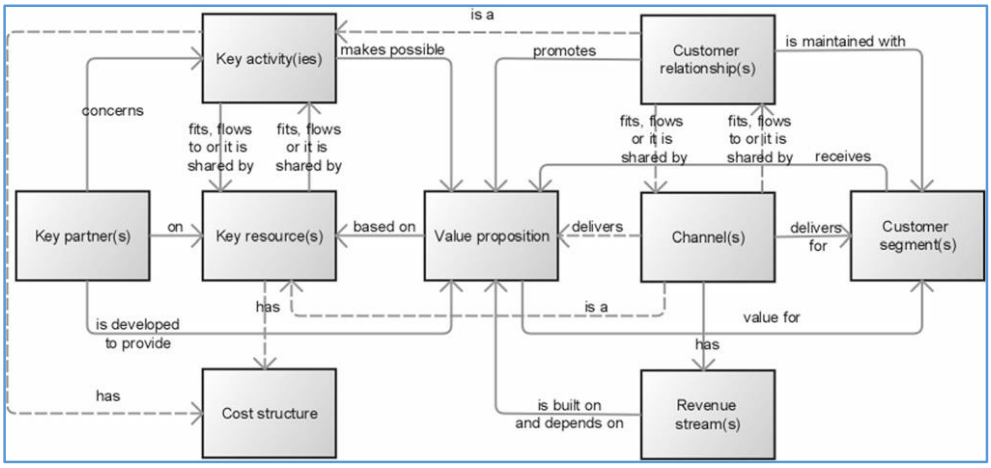

Figure 12.2: BMC metamodel proposed by Iacob et al. (2012).

The last BMC metamodel is from Hauksson (2013). The metamodel is mainly based on the BMC definitions in the Business Model Generation book of Osterwalder & Pigneur (2010). The drafted metamodel is then refined and updated, using input from other researches, such as (Osterwalder A. , 2004), (Iacob, et al., 2012), and (Malik, 2012). After that, the model is simplified where possible to increase the readability and easiness of the implementation. The Hauksson's BMC metamodel can be seen below.

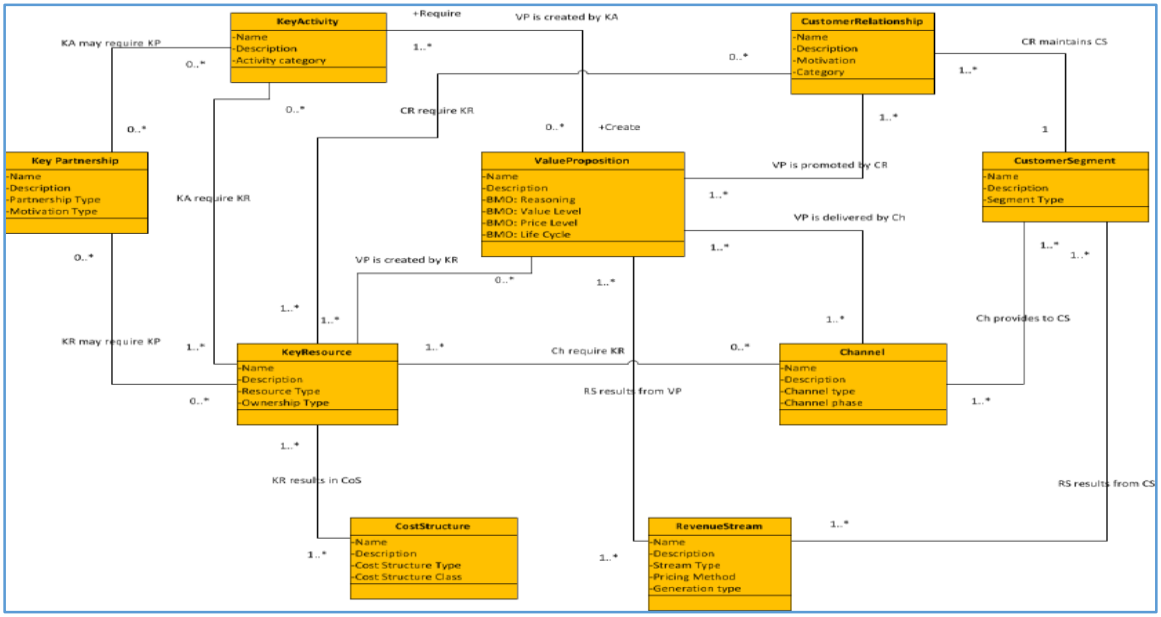

Figure 12.3: Hauksson's BMC metamodel (2013)

From the review above, we cannot choose the Malik's model because the model is too complicated. The Business Model Canvas is therefore not instantly recognizable. Iacob's and Hauksson's models have the same attributes. Iacob's model shows more relationships between attributes and therefore has more details, making it rather complex. Hauksson's model has fewer relationships, consequently Hauksson's model could lose some details but at the same time it would be more suitable and usable.

For simplicity's sake, we choose the Iacob's model.

13 APPENDIX 3 – DEMO METAMODEL

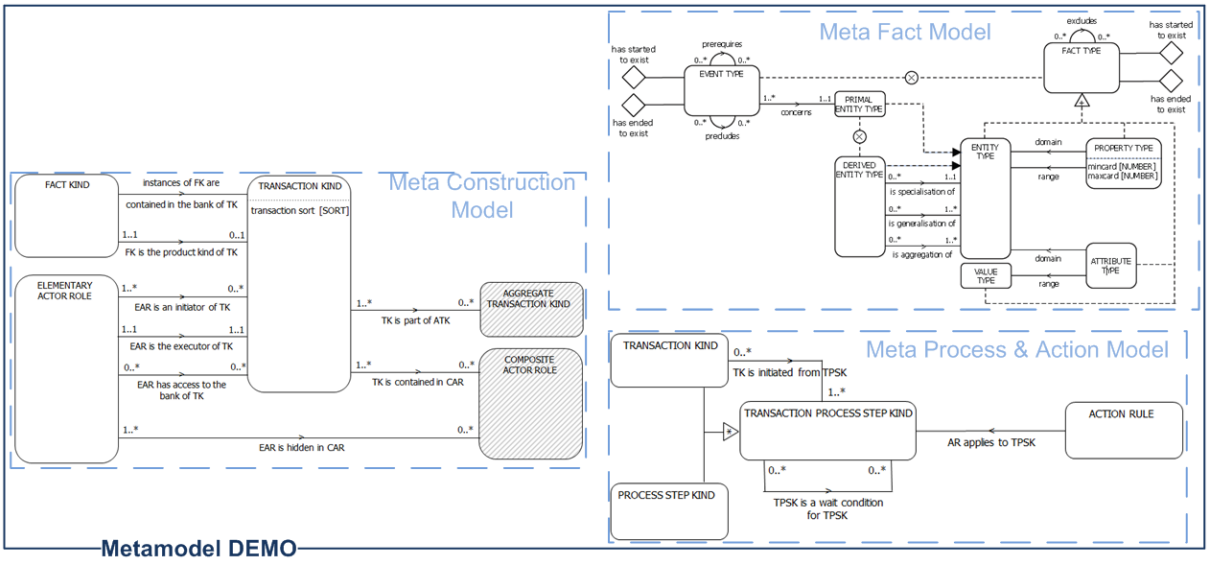

Figure 13.1: DEMO metamodel

14 APPENDIX 4 – ARCHIMATE METAMODEL

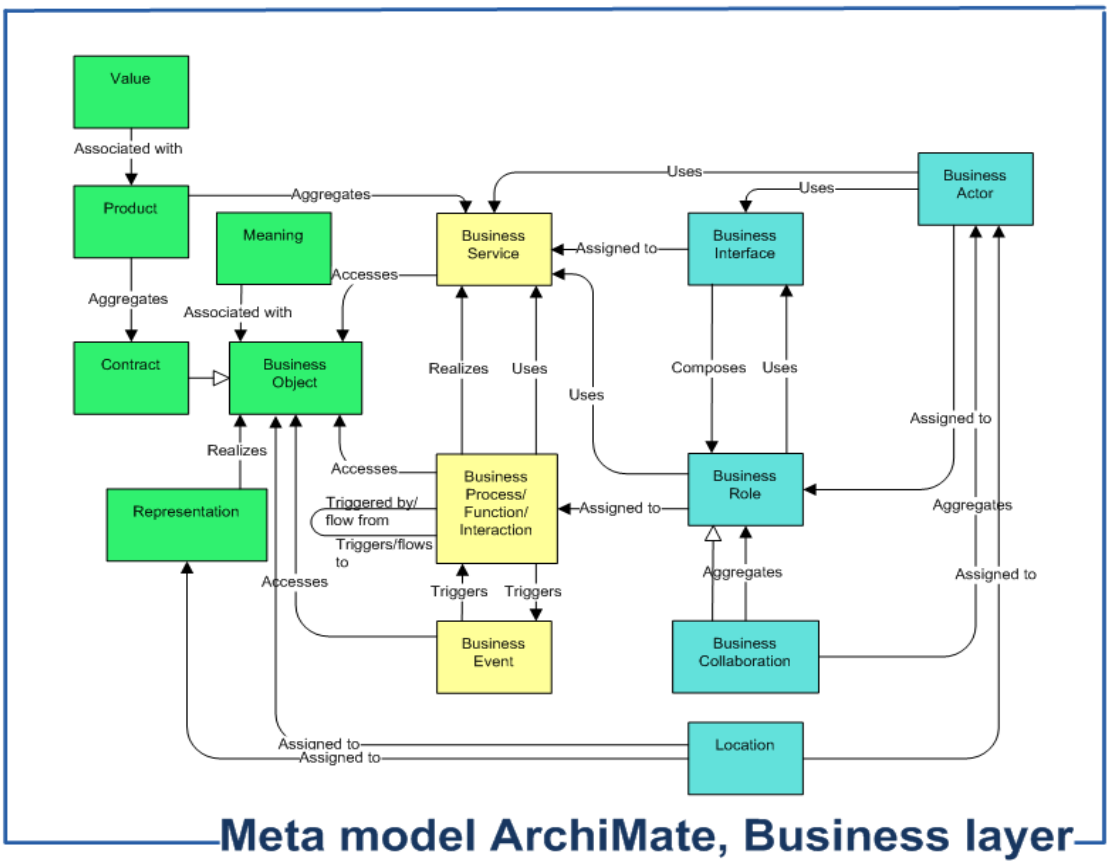

Figure 14.1: ArchiMate metamodel, Business layer

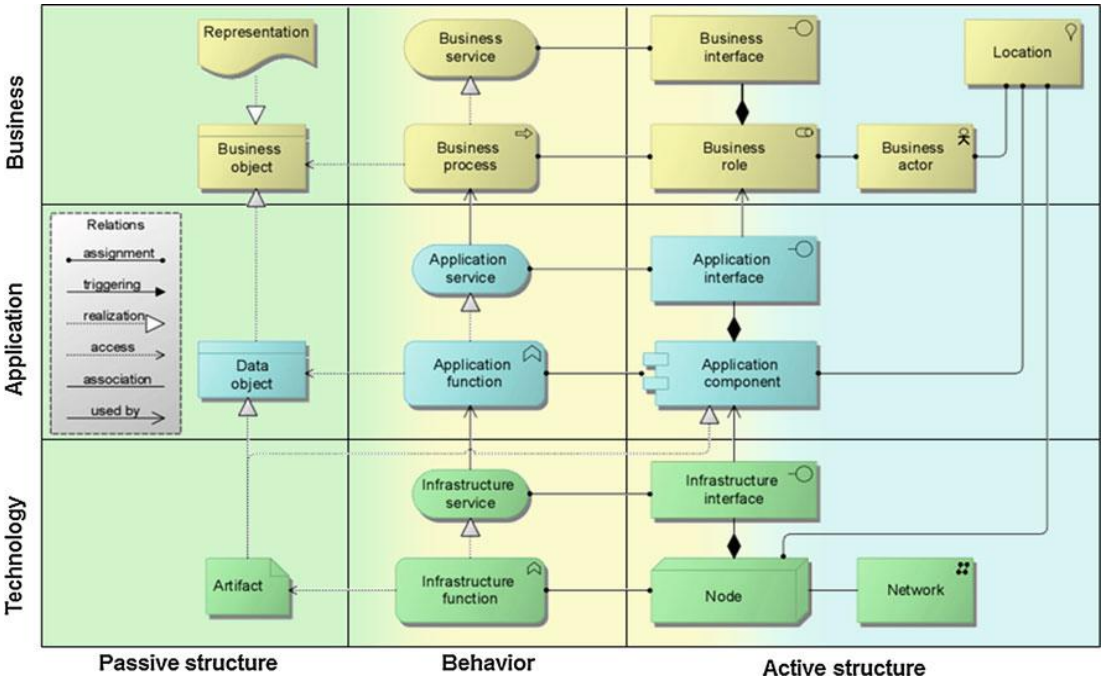

Figure 14.2: Simplified ArchiMate meta-model (Iacob, 2012)