



Utrecht University

MBI graduation project:

Introducing the customer journey in architecture visualisations to support decision-making

Aligning business and IT with the customer journey through enterprise
architecture

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Abstract

Both Information Technology (IT) and the service industry have developed greatly over the past years. Where IT is becoming a part of every department in an organisation. Service design is valued more as a critical success factor for organisations. Enterprise architecture tries to bring business and IT aspects together in an understandable and manageable way. This can help business and IT stakeholders in their decision-making for the organisation. In this research, the customer perspective from the service industry is combined with enterprise architecture to bring new insights and help the decision-making. Customer journeys (CJ) are an important instrument for visualising and managing the customer perspective, however, vary from architecture visualisations. This research looks at what information can be combined to effectively create an overview that combines the CJ with business and IT aspects. Through various data collection methods, information has been gathered to create an artefact that can solve this problem. The artefact, a visualisation framework, combines important information sources in a structured way and at an understandable complexity level for different stakeholders. Through overlays, the artefact can create interesting insights and answer questions stakeholders may have. Validation of the framework proved the perceived effectiveness for alignment and decision-making. However, there are still adaptations that can be made to the framework in future iterations.

Keywords: *Enterprise architecture, Customer experience, Customer journey, Visualisation, Decision-making, Alignment, Business, IT, Service industry, Airline industry*

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1. Introduction

These days Information Technology (IT) is not only part of organisations in the technical sector, but it affects any organisation in all sectors. This is the result of the rising use of computers and the internet that have changed the world permanently. Because of this change, organisations need to know what IT is and understand what impact it can have on many facets in an organisation. By integrating IT solutions in the daily work of a business improved results can be achieved. With larger organisations, we see more complexity in the IT-infrastructure, due to the increased amounts of IT hardware and software components. To control this infrastructure it needs to be effective and flexible (Schmidt & Buxmann, 2011). Enterprise architecture (EA) gives organisations the possibility to create structured overviews of the IT on a business level. By combining IT with business aspects, they can create new insights for the organisation. Using relatively simple representations of complex architectures make them more easily understood and manageable. It is an indispensable instrument in controlling the complexity, processes and systems (Lankhorst, 2005). Therefore, it is widely used by organisations for their decision-making in IT and business projects. Figure 1 shows how EA sits in the middle between the various stakeholders in an organisation, how it helps them through overviews like: metrics, views and reports but also plays a part in getting input, feedback and reflection.

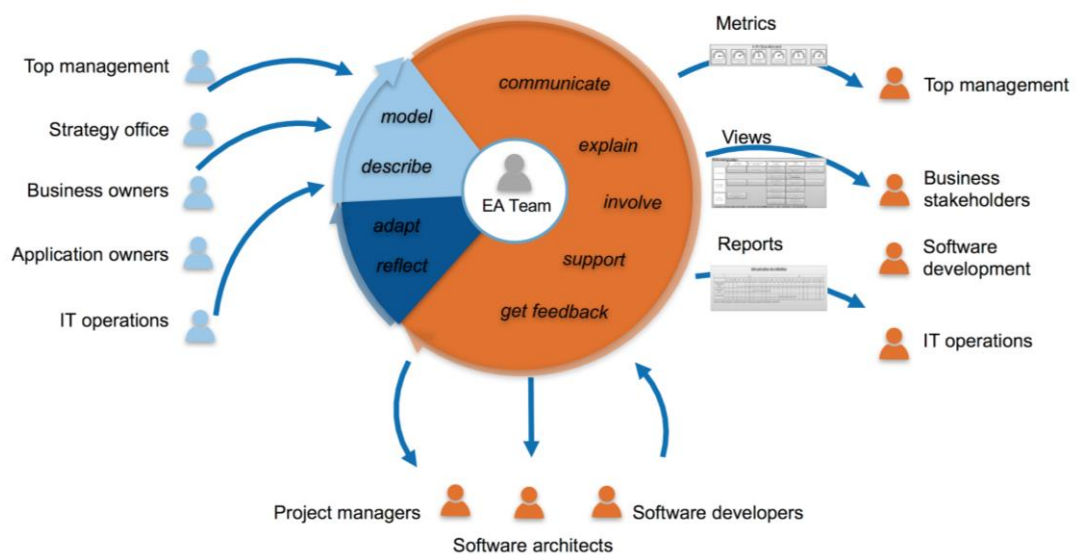


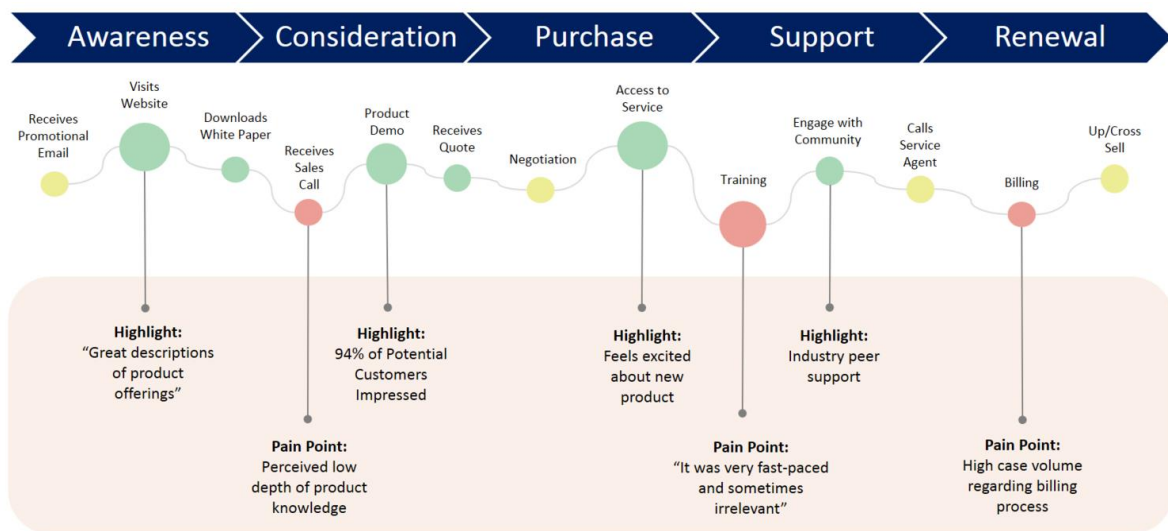
Figure 1. How EA helps IT and business stakeholders in organisations (Sebis, 2017)

In 2014 Gartner examined, the importance of EA in delivering strategic business and IT value by aligning the business and IT visions and strategies with the linked business drivers, through a global survey on enterprise architecture (Burton, Allegra, 2014). An article by Gartner also predicts how the practice of EA is evolving to the point that it is key in translating the demands of the business into business value using digital and strategic technological decisions (Brand, et al., 2018). Showing the value and relevance of EA for any organisation.

The service industry has also greatly developed over the last years. Service design and service thinking are taking a centre stage in businesses all over the world. Focussing on the customer experience is seen as a strategy for success (Boswijk, Tijssen, Peelen, 2007). The

main goal of tracking the customer experience is to comprehend how this experience can be improved (Katherine, Lemon, Verhof, 2016). The concept of customer journeys (CJs) has become a core instrument for businesses. A CJ mapping visualises the flow of service and their interactions from the perspective of a customer, reflecting the customer’s emotional and behavioural drives. An example is given in figure 2. The mappings are used in the business fields of: marketing, sales, customer support, product management and especially customer experience. They can be used to analyse how a customer experiences every step interacting with an organisation, also known as the touchpoints with the organisation (Richardson, 2010). Seeing the products and services from a customer perspective, identifying pain points where improvements could be made. These insights can be used to optimize the products and services the organisation delivers.

Figure 2. Customer journey example (Kredo, 2016)



Both the business and IT play a big role in optimizing products and services, adding in the insights from service design thinking can improve this process, as the wishes of the customer are reflected more. Where EA can help create the necessary insights to better understand the infrastructure and manage the changes.

1.1 Problem

Focusing heavily on the customer's perspective is a new experience for many companies. Especially for well-developed companies with highly functional departments. The task of representing the customer is often given to a single department, such as marketing or customer experience (CX). They then have the task to create the best experience for their customers. This can lead to misalignment between departments. As the CJ goes through many systems and processes executed by different departments it is crucial for the departments be aligned. When departments do not use the created CJ or the customer experience varies greatly within different processes this makes it difficult for a company to create one consistent experience. This makes it difficult to increase customer satisfaction and loyalty.

Another problem is that many organisations have been stunned by the complexity of the business and technology because of the rate in which business and technology change (Schekkerman, 2004). This makes decisions that have to be made on IT and business aspects challenging. Adding in the customer journey can then be very overwhelming. EA is the party assigned to make this understandable and manageable. However, the CJ mappings and service blueprints used in marketing and CX, differ greatly from system mapping, process models and other visualisations in EA. Creating a holistic overview in EA must effectively align customer, business and IT processes and resources. Many decisions need to be guided to ensure effectiveness and efficiency. Think of decisions related to vision, strategy, business goals, information, data mapping, selection of products and systems or software development.

For an architect, there is the problem that there are no guidelines or tools to describe how to create such a holistic overview in EA. It is unclear what relevant information should be connected or in what way they can visualise the overview. Nowadays enterprise architects will have to create such visualisations from scratch whilst also communicating the needs and constraints of the infrastructure to the business. That process can be time consuming, having specific lingo and constructs, the visualisations can end up very complex, while sometimes still missing important details. This should be addressed to give the business more consistent overviews, making it easier for stakeholders to make decisions with the customer's perspective in mind.

A paper by Yoo and Pan (2014) proposed a framework that connects the CJ through a system to the system mapping in order to visualise the connection between customer, service and the physical system. However, it only focused on the flow of actions within one system, was limited by length, complexity, and visualised only one single service. This research did highlight the effectiveness and need for a combination of CJ mapping and EA and showed us the insights it could create. Research on how to perform this at a strategic or project level has not yet been done.

The goal of an enterprise architect is to enable business goals within the constraints and risks set by the business. To accomplish that, the As-Is situation needs to be defined and the

To-Be situation needs to be decided on. Communicating the right information within an organisation is always challenging, stakeholders have different knowledge levels of certain subjects, processes and IT. Combining the CJ with EA can give organisations new insights and can show the impact of decisions on IT and the customer. This can greatly improve mutual understanding within different departments and help further decision-making. Creating visualisations that all stakeholders can understand and that also contain the right complexity is the goal of this research. Figure 3 shows how the customer experience can be taken into account, where the views will include the customer journey to visualise and communicate that to other stakeholders.

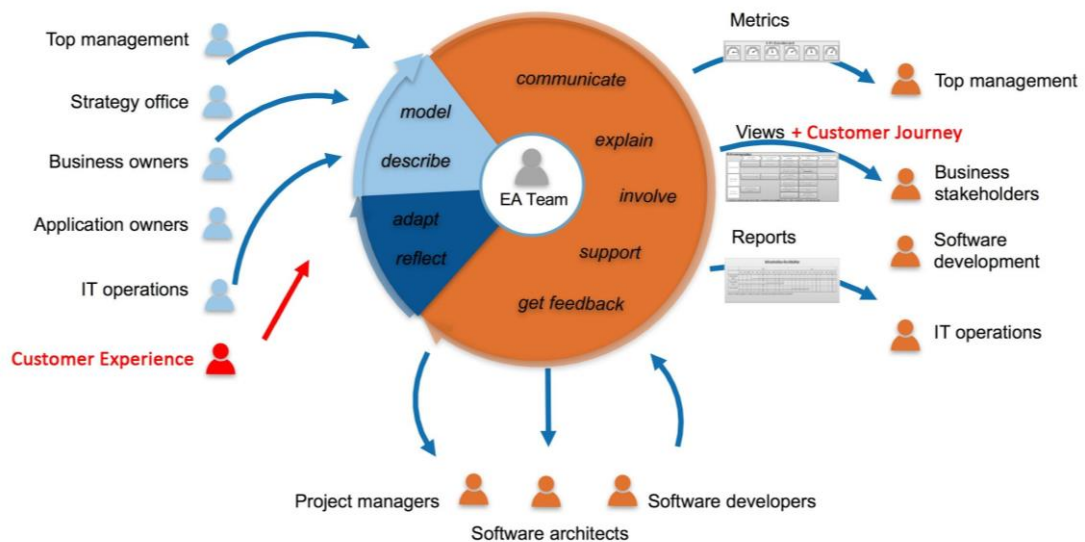


Figure 3. How EA can help align the CJ to IT and business stakeholders. Adapted from Sebis (2017)

1.2 Motivation

The CJ is the process a person goes through when interacting with a company, product, or service. An organisation should help them get to their goals as easily and effectively as possible. For an organisation, the customer journey can create a competitive advantage by creating a customer experience people come back for (Nenone, et al., 2008). This research hopes to find a way to help organisations improve the way they look at their CJ, helping in decision-making on a strategic and project level. Decision-making is often focused on costs and benefits, due to them being easily measurable for the business. On a strategic level this could be about visions and objectives. On a project level it can concern building software solutions or purchasing systems. On an infrastructure level it concerns maintaining flexibility and mitigating the risks in the current IT landscape. Communicating about these goals, understanding impact and constraints, should create an alignment between stakeholders. At this point we also want to look at creating the best experience for the customers. Bringing in the customer perspective through the CJ as a new stakeholder.

Mutual understanding between stakeholders is key to effectively make the right decisions, but this is not an easy task. Visualisations can help organisations to achieve better overviews and understanding. EA can bring the stakeholders together and make it understandable and

manageable through visualising the overviews placing the business and IT in context. This research aims to answer questions on how bringing information and insights from the CJ and EA together can improve decision-making.

1.3 Air France-KLM

The airline industry is a great example of a service-oriented industry. Even more so in the airline industry the CJ is highly important, as the customer is experiencing a real journey with many points of interaction with the organisation. All these touchpoints within that journey have an influence on the customers overall experience. The process is long and complex; which brings many challenges. This makes for an interesting case to research and is why the problem has been researched at a front running airline company: Air France-KLM (AFKL). Air-France KLM is the 5th largest airline in the world (Forbes, 2017), serving in more than 85 countries with headquarters in the Netherlands and France. They strategize to be on the forefront of European airlines, by making smarter decisions than their competition. This is achieved by having good partnerships, great destinations and using the best technological developments. Their goal is to have a strong brand that people want to choose first and come back to. AFKL's strategy is that of customer intimacy (Hundepool, 2016; Treacy & Wiersema, 1993). Since the merger in 2004 between Air-France and KLM they follow the concept of one AFKL group, with two airlines and three core businesses (passenger, cargo business and engineering & maintenance). In this research the focus will only be within the passenger business, which is also the focus of the customer journey.

The current situation at AFKL is not in line with their goals for 2019. Customer experience is becoming increasingly important; a new CJ was introduced last year and is fulfilling an important role within the company. More projects and products are taking the customer perspective into account, especially on a strategic level; but for this to work effectively communication and mutual understanding needs to improve. This is affecting the decision-making during projects, many stakeholders have questions about the CJ and IT, asking about the flow of actions, data quality, component compositions or vision for the next few years. These questions are not easily answered, but impact the final decision to go with a certain solution for a problem or project. These decisions affect IT solutions such as: building a new system component, adding in an API (Application System Interface), buying a new module for a software product or sharing systems/data with partners. Enterprise architecture comes in at this point, answering these questions, setting the boundaries, guiding these changes and decisions. To do this visualisations are used to make the solutions understandable. These visualisations are often created by and for one specific project. But these visualisations can be too complex or miss the insights needed by the other stakeholders. Adding in the customer perspective is something new to this discipline. Having no standardizations or guidelines to follow. Thus the effort needed can be lowered and quality can be improved on different fronts.

The IT teams plays a big role in creating these solutions, they build the improvements and make sure everything keeps running smoothly, and are often responsible for the products themselves. The enterprise architects have developed reference models of the IT

infrastructure showing the constraints and To-Be situation. However, these visualisations are not always helpful to every stakeholder. They can be too complex, too detailed, or miss the right details. Having useful visualisations where the right information on IT and business is connected to the CJ, should help improve the situation at AFKL. It should help answer questions from different stakeholders, align stakeholders and stimulate discussion that helps the decision-making on a strategic and project level. In the end this should result in a better product and service for their customer thus aiding the customer intimacy goals of AFKL.

1.4 Thesis outline

- Chapter 1: The problem is introduced and a short description of the host company for this research is given. The context of this problem at Air France-KLM has been explained.
- Chapter 2: Looks at the research questions and methods of investigation, describing the process of the research.
- Chapter 3: Describe the relevant literature to this subject, creating a base of information for the research.
- Chapter 4: Presents the collection of data needed to design the artefact. This design will also be elaborated.
- Chapter 5: Presents the case study and the evaluation of the artefact.
- Chapter 6: Analyses and evaluates the results.
- Chapter 7: Discusses these results, the limitations and future research.
- Appendix: Containing an interview protocol, visualisation designs, artefact validation forms.

2. Research plan

2.1 Research objectives

The main goal of this research is to find an effective way of visualising the connections between the CJ, IT and business at a strategic level, helping stakeholders in mutual understanding and their decision-making. Where EA traditionally combines the aspects from IT and business we add in the CJ aspect. For this research we need to clarify what information is of importance to the stakeholders and find a way of visualising this in different scenarios, creating different insights that can aid them in making decisions to act on their concerns. We need to find a level of complexity and detail that is understandable to the different stakeholders, creating mutual understanding and promoting discussion. This is achieved by designing a framework that helps visualise the information and that is adaptable to the needs of the stakeholders. This framework will also help enterprise architects easily create the visualisation and include the right information.

2.2 Research questions

To stay ahead in the service industry companies face many challenges. To face these challenges organisations have to make the right decisions on strategic and project levels. Combining the business, IT and the CJ can create a competitive advantage. Different stakeholders take part in this and enterprise architecture tries to create a bridge between them. This research aims to find a way to help their decision-making. We try to find an answer to the main question: *“How can the customer journey help in architecture visualisations to support decision-making?”*

Several sub questions have been defined, these are divided in knowledge and design questions (KQ/DQ). A KQ is about obtaining theoretical and empirical knowledge, a DQ is about designing something useful (Wieringa, 2014):

SQ1 - “What information from the business and customer journey can be used to support decision-making in an organisation?” (KQ) Finding what information is relevant to the concerning stakeholders is the first step in creating the right visualisations. The customer journey can be visualised from front-end to back-end, connecting all systems on various detail levels. It should be possible to present this information to different stakeholders such as business and IT decision makers, with the right details, insights and complexity. How these visualisations are used and what information is needed to make decisions on a strategic and project level will be researched through expert interviews and literature research.

SQ2 - “What is an effective way of visualising the architectural information of a customer journey for different stakeholders?” (DQ) Having to make decisions that impact the customer journey can happen at various levels for different stakeholders. These stakeholders have different interpretations and use of this visualisation. A visualisation

should be effective for the type of decision made and the stakeholders involved. Stakeholders need to have a mutual understanding of what the situation is and what impact a decision can have. How these visualisations can be designed will be researched to answer this question. Creating an artefact in the form of a visualisation framework. Through interviews and an artefact validation we answer this question.

SQ3 - “What tools can be used to visualise and maintain architectural information of a customer journey?” (KQ) To collect all information for creating a good visualisation of the CJ, multiple sources of information are needed. Many different systems are used during the customer journey and these are constantly changing, different API’s or services are used to connect to each other, all in all, it can be difficult to create a quick snapshot with up-to-date information. For an organisation it is important to be able to create an up-to-date overview of the situation, as accurate information can improve the decisions being made. What tools can be used to create these visualisations and bring the sources of information together will be research through literature and expert interviews.

2.3 Design science research

In order to answer the research questions and to realise a framework for visualising the customer journey, a design science project (Wieringa, 2014) is conducted. The design science method is a problem-solving process which focuses on investigating and designing artefacts. The design science cycle consists of three tasks: Problem investigation, Treatment design and Treatment validation. This is combined with theory from the Canonical Action Research approach (Figure 4). This aims to address problems from an organisational perspective, by combining scholarly observations with practical interventions. In the problem investigation step of the cycle, the literature and the current needs from industry are investigated through instrumental theories (Lewin, 1945). As a proof of concept, the current visualisations of AFKL give us an As-Is situation to analyse. In the Treatment design step, the artefacts that treat the problem are designed. In the treatment validation step, it is validated if the designed artefacts treats the problem and thus creates the desired To-Be situation based on the focal theories. To prove this, a qualitative evaluation is conducted to gain insights on how the artefact is perceived by the stakeholders.

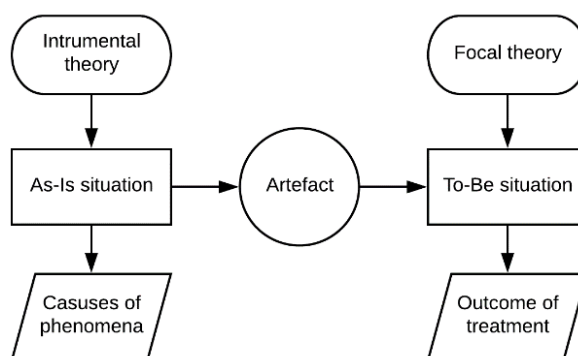


Figure 4. Canonical Action Research (Susman & Evered, 1987)

2.4 Research process

The process of this research is illustrated in figure 5. Following the three design science phases as described in paragraph 2.3. Each phase containing several activities for this research as described below. Figure 5 illustrates these activities and connects them to the chapters in this thesis that provide the results. These results together will answer the main research question.

1. Problem investigation

- a. Literature study: existing literature and information is examined to find starting points and orient for the subsequent stages. Providing answers for SQ1 and SQ3.
- b. Expert interviews: through a semi-structured interview experts in the organisation are interviewed. Questions on several subjects have been prepared: needs and concerns, decision-making, visualisation, project examples.
- c. Analyse data: the interviews are transcribed and coded to extract the relevant data. The data of the interviews is then analysed. Answering SQ1.

2. Treatment design

- a. Artefact creation: the artefact is created based on the connecting the acquired data from interviews and literature. Combined with the use of popular frameworks/visualisations.
- b. Develop use case: based on the interviews and data from the organisation a realistic use case is setup to be used in the next phase.
- c. Develop scenarios: within the use case several scenarios have been created to be applied to the artefact.

3. Treatment validation

- a. Validate the artefact: The setup for validation will be defined, applying the scenarios to the artefact and setting up a questionnaire to evaluate the artefact on effectiveness, usefulness, intent to use.
- b. Performing validation: the validation is performed with experts in the organisation coming from different stakeholder groups.
- c. Analyse the results: the data from the validation is analysed. Answering SQ2.
- d.

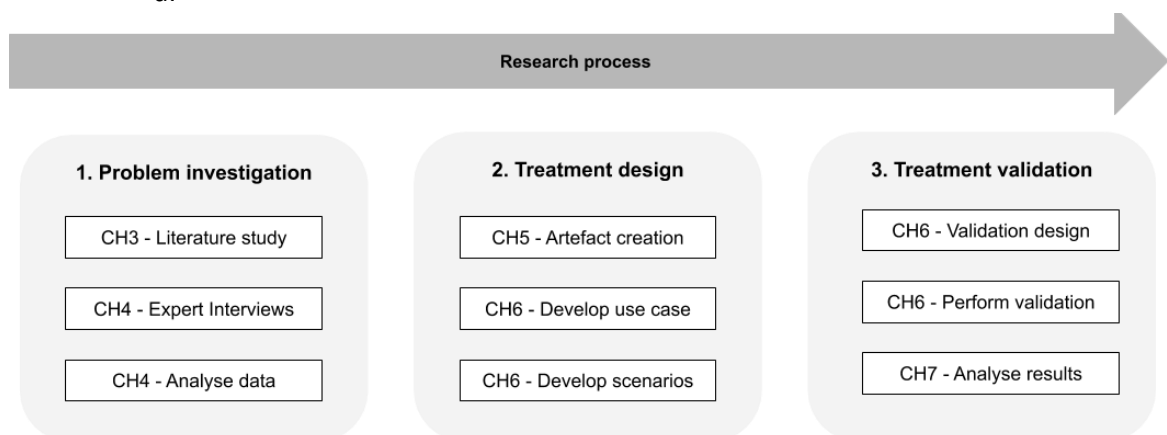


Figure 5. Steps of the research process and chapters where the results can be found

2.4.1 Literature study

To get insights into the background and current research a literature review is conducted on CJs, EA and visualisation. The results of this review are input for the design of the artefact and use case. To conduct this literature review, two methods are used: The systematic review and the snowballing technique.

- The systematic review is based on the theory of Kitchenham. When making use of the systematic review, the quality of evidence increases (due to completeness based on the described review protocol). In this way, the given definitions are more robust (Kitchenham, 2009), this will mainly be used to support the design of the artefact.
- The snowballing technique is used for papers with at least 100 citations. It will go more into the details and backgrounds of the information used in these papers (Greenhalgh & Peacock, 2005). The literature review is performed for the background information, descriptions of elements and the alignment between the CJ and EA.

2.4.2 Expert interviews

The expert interviews are of an exploratory nature, this is why a semi-structured approach is used (C. Robson, K. McCartan, 2016). In preliminary meetings and interviews initial concerns of multiple stakeholders have been defined, as seen in table 1. Some stakeholders are grouped and others such as IT operations have not been taken into account due to limited involvement at AFKL.

Table 1. Stakeholder concerns and problems

Stakeholder	Concerns	Problems
Customer Experience (CX)	Are in direct contact with the customer, created the customer journey, work with flight attendants and clients. Want an optimal customer experience.	To reach their goals they need input from different stakeholders, creating features for them. Difficult to make needs clear and understand all possibilities of IT.
Digital (IT)	Owner of IT products, over 50 teams including software developers. Want to create optimal online channels by creating new services and features.	Understanding needs from other stakeholders to build a solution that fits the business goals, with the IT landscape while supporting their own product.
Senior IT management	Keeping IT within budget, with the right quality within time constraints. To add value and support the business.	Understanding of complex situations, being able to make good decisions and anticipate future changes.
Enterprise Architecture (EA)	Realising the business needs into value for the business through IT.	Communicating the needs and concerns to other stakeholders while controlling the architecture.

Three experts from each of the four stakeholder groups have been interviewed. Through the expert interviews we tried to get in depth answers on several subjects in correlation with this research:

- Needs and concerns: Find out what goals the stakeholders have, how they want to achieve these, what limits them and how architecture could help them. What they find is needed from architecture and how visualisation can help with that.
- Decision-making: Find out how architecture is used as a tool for decision-making during meetings. What the dynamic between different stakeholders is when discussing subjects. The types of decisions made and types of insights needed from architecture.
- Project examples: With a practical example given by the stakeholder we try to put the previous answers into perspective. Have them explain issues with architecture, IT or business.
- Visualisation: Show the stakeholder a few visualisations that have been used in the past, discussing with them what they find good or bad about them. Lastly the initial idea/ direction we thought of going was explained, and their initial reaction to this captured.

The interviews will follow a predefined protocol, to ensure the answers can be further analysed and compared to each other. The interviews will be transcribed and coded using the Nvivo tool. To further analyse the interviews parts of the text will be labelled, these can then be connected to the main themes of the interview and research questions. By then connecting the interviews to each other we can analyse the results, looking at similarities and differences between interviewees.

2.4.3 Artefact creation

Using the input from the expert interviews and literature research on visualisation and architecture, a framework for architecture visualisation has been designed. Looking at I industry standards and frameworks that can be applied in enterprise architecture. But also visualisations used in Marketing and customer experience. Connecting data from the CJ to business and IT aspects.

2.4.4 Validation

To validate the designed artefact, we create a use case as described by the theory of Yin (Yin, 2011). For the use case a proof of concept for the visualisation of EA in combination with CJ is realized. Based on the proof of concept, a validation in the form of testing a simulation is done during this project. Three scenarios from the use case are applied to the designed artefact simulating the real world. The validation is fulfilled by doing individual evaluations (Morgan, 1997). The individual evaluation are done through a questionnaire, and a discussion after testing the simulated scenarios. By validating the use case, we check what the strengths and issues of the designed artefact are. In this way, improvements can be made on the artefact in a new iteration.

In the evaluation the effectiveness of the created artefact has been measured. This artefact is a framework that helps visualising architecture. This can also be seen as a new method for visualising architecture by combining CJ, business and IT information. Therefore, the method evaluation model (MEM) by Moody (2003) has been used as seen in figure 6. In this model we see three categories, actual and perceived efficacy; whether the method improves performance of the task. And the adoption in practice; whether the method would be used in practice to realise its benefits. Efficacy can be defined as the performance of an intervention under ideal and controlled circumstances, whereas effectiveness refers to its performance under 'real-world' conditions.

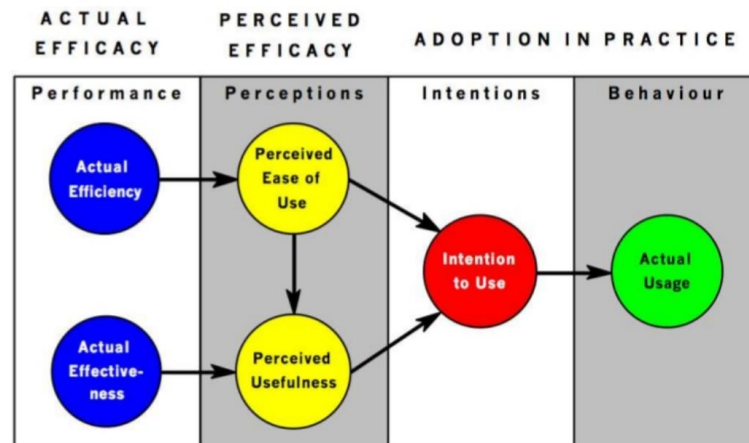


Figure 6. Method evaluation model (Moody, 2003)

In this case the task is to use EA visualisations to improve decision-making by better alignment between stakeholders and promoting discussion on CJ, business and IT. But it is difficult to measure the actual efficacy (fig. 3); whether the quality of the decisions is better and the effort less than in the current situation. Because the methods in use now are not specifically designed to combine CJ and EA, but also the methods vary per architect and the situations they are applied to and the decisions made are on a high/strategic level, measuring the impact would have to take place over a longer period of time. This makes comparing the new method to the current ways too difficult, thus the actual efficiency/effectiveness will not be measured. However, the perceived efficacy and the adoption in practice can still be evaluated. With experts from the different domains both quantitative and qualitative results can be realised for these measurements and conclusions can be drawn for the effectiveness in practice.

3. Literature review

In this chapter the concepts related to this research are explored. To gain insights, and information that can be applied in this research.

3.1 Customer journey

A customer journey is the process a person goes through when fulfilling a specific goal at an organisation (Halvorsrud, Knut, & Følstad, 2016). The customer journey is also referred as a visual, systematic approach to analyse people's experiences. The customer journey describes the whole experience of being a customer. Consumers can experience the customer journey cognitive, affective, emotional, social and physical (Verhoef, et al., 2007). This journey consists of several main phases, starting with need recognition and ending at the purchase or even after sales services (Engel, Blackwell & Miniard, 1995).

The customer experience is based on the interaction with the organisation. The moments of interaction are the touchpoints of the customer journey. The amount of touchpoints has been increasing in past years (Gurvardar, et al., 2016) and are used by customers in many different ways physically and digitally (Peltola, Vainio, Nieminen). Because of this the use of customer journeys is becoming increasingly important for organisations. In 2016 Gartner predicted that in the coming years, 60% of all large organisations will develop in-house customer journey capabilities (Daigler, 2016). Through customer journey analysis, organisations can gain knowledge on how potential and current customers experience and feel the various channels and touchpoints, highlighting how much this experience differs compared to their expectations (Nenonen, et al., 2008). By making use of a systematic approach, the organisation wants to create an optimal experience that meets the customers' desires and assists the fulfilment of the company's objectives, achieving competitive advantage (Nenonen, et al., 2008).

3.1.1 Customer journey mapping

To get an overview of a customer journey, an organisation can map that specific customer journey. Customer journey mapping is seen as a method to identify the processes that the customer goes through. The Customer Journey Map (CJM) is a linear, time-based representation of the stages that a customer goes through in interacting with a company or a service (Mangiaracina, et al., 2009). The customer journey mapping has the potential to create streamlined, easy to use services allowing customers to have the most effective use of the services (Andrews & Eade, 2013). This results in higher satisfaction, increased revenue and lower costs for the organisation (Rawson, Duncan, & Jones, 2013).

Bernard and Andritsos (2017) describe the elements used in mapping a customer journey. An overview of these elements is seen in figure 7.

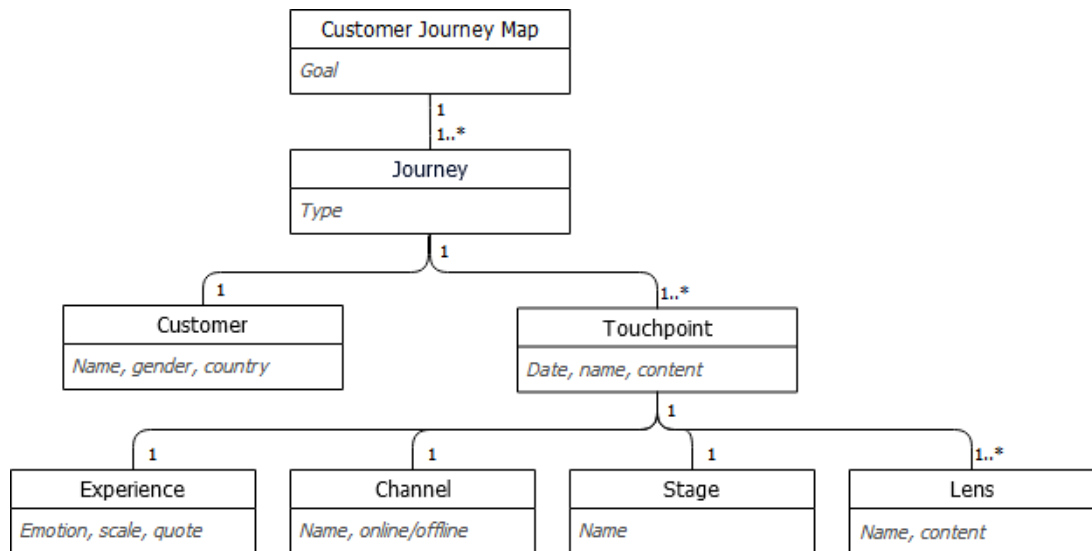


Figure 7. Elements of a customer journey mapping (Bernard & Andritsos, 2017)

Starting from the top; a customer journey map can contain one or more different journeys. The Journey is the path a customer or stakeholder follows. Theoretically every customer has their own journey, the customer also known as the ‘persona’ of the journey. In the journey there are various touchpoints. A touchpoint is the interaction between a customer and the products/services of the company. All the touchpoints together create the customer journey. A set of touchpoints can be seen as a stage in the customer journey. Each touchpoint can only belong to one stage, but touchpoints can be repeated in different stages. When a customer goes through the journey, this creates an experience. The experience can be seen as the emotional and behavioural drives during the journey. Experiences in the a touchpoint can affect the touchpoints that follow (Lemon & Verhoef, 2016). A customer receives this experience via a channel, this is seen as the method in which the customer interacts with the organisation. Examples of channels can be a skype call, social media or a mobile application. When organisations integrate their channels they can create a seamless experience over the whole journey (Lemon & Verhoef, 2016). When an organisation wants to view the customer journey in a specific context or domain it is possible to create different views or layers of the journey, this is called a lens.

3.1.2 Customer journey analysis

Organisations can gain knowledge on how potential and current customers experience their products and services by analysing the journey. Two types of customer journeys are available: The expected (or generic) customer journey and the actual customer journey. The expected customer journey is a theoretical journey created by the organisation based on their research, mission, vision and goals. The actual journey is specific to each individual customer having their own experience. To analyse the experience, the journey can be linked to experience assessments. This method is often part of a customer journey mapping. Organisations can analyse the journey to find the most effective journey patterns, find dropouts and to identify new journey segments (Bommel, Edelman, & Ungerman, 2014). To map the actual customer journey, organisations have to investigate customer data (Følstad, Kvale, & Halvorsrud, 2013). This can be done with the customers' reported experience

ratings (Stickdorn and Zehrer, 2009). Or it can be based on researchers' interpretations of qualitative data gathered (Crosier and Handford, 2012). The journey can also be a part of a more specific service analysis as in service blueprinting, where the delivery of one service is fully expanded. A service blueprint is a mapping or flowchart of all transactions in the service delivery process (Shostack, 1984: 134; Fitzsimmons and Fitzsimmons, 2001). This includes customer, employee and backstage actions. It highlights the potential pain points in the service process and what systems and process support the service (Shostack, 1984).

3.2 Enterprise architecture

Enterprise architecture tries to deliver value to an organisation by giving recommendations to the business and IT manager to achieve their targeted business outcomes. Helping stakeholders in their decision making process to adjust their projects for better results. It can help to identify the future state as well as opportunities and constraints of the project and IT landscape (Gartner, 2012). Zachman can be seen as one of the founding authors of enterprise architecture. The Zachman framework (Zachman, 1987) suggest that it enables: alignment, integration and change in the organisation (Zachman, 2001). After the Zachman framework several other models were introduced. The most popular being the The Open Group Architecture Framework (TOGAF). TOGAF gives a detailed process approach on how to develop enterprise architecture and produce the viewpoints. They defined standard ways to take these steps and enable architects to redesign an organisation and its supporting IT (Lankhorst, 2005). Even though TOGAF is updated frequently (last release in 2018) it does not combine well with the Agile working methods used in many companies. It is very extensive and creates bulky documents. Because of this lighter architecture approaches are emerging, the “Just Enough Architecture” (Fairbanks, 2010) and Risk and Cost Driven Architecture (RCDA) approach are great examples of this. They are more flexible and adaptable to short iterations and no longer view architecture as mainly a design discipline but also to control risks and deal with uncertainty (Poort, 2013). Instead of delivering a big system design, it delivers a continuous stream of improvements to a system. Gaining control of risks and uncertainties step by step.

Several studies have been done to confirm the benefits organisation will have from EA. A study by Aziz and Obitz (2007), shows that organisational benefits are: reduced IT costs, enabling business and process flexibility, improved customer satisfaction and enabling business and process change. These benefits are related to the increased knowledge about the organisation, its goals, processes and IT. The organisational benefits, should be outcomes that contribute directly to organisational performance (Tamm et al., 2011).

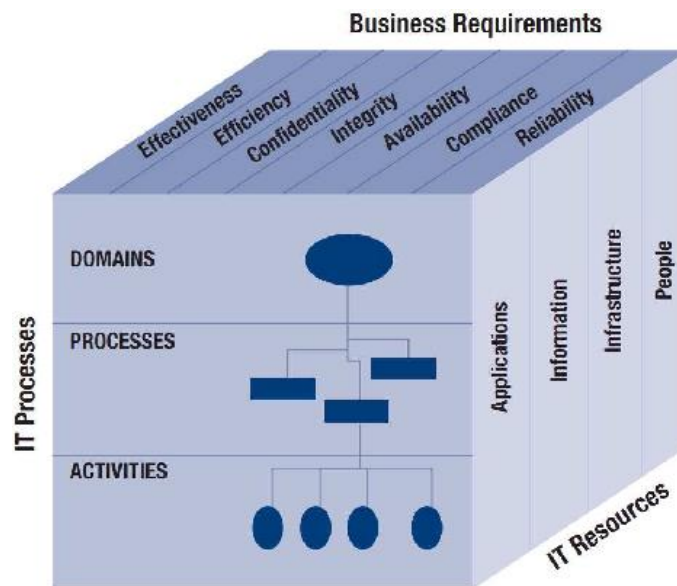


Figure 8. Enterprise Architecture relevance and governance COBIT cube (Becker, 2011)

Figure 8 depicts how EA can be seen as a force creating a collaboration between business and IT aspects. Aligning with business planning, goals, visions, strategies, and governance (Becker, 2011). It does this using aspects of the business such as organisational structures, processes and data, aspects of technology such as information systems, applications and databases and aspects of infrastructure such as networks and security. Capturing the vision of the entire organisation including all its dimensions and complexity (Schekkerman, 2004). Using the information from EA makes it easier for the organisation to respond to the forces of change and make better decisions. A successful architecture representation provides maps business drivers to significant architectural solutions. The mapping should eliminate any ambiguity that exists. The alignment will provide basis construct for building the business case and justification. Schekkerman defined five guidelines architect can follow (Schekkerman, 2004):

Holistic in scope: It must address the enterprise and extended context. External values are of growing importance. Include customers and key business partners. Misaligned architectures can lead to lost opportunities for gaining a competitive advantage.

Collaboration based: The effort must include representatives of all key stakeholders. This is key for ongoing support, and business alignment.

Alignment driven: It must align the business and technology drivers in a way that is understandable and transparent to the stakeholders. Continuously tracing initiatives and the business strategies.

Value driven: It must provide a way to define the business cases demonstrate the value of proposed solutions.

Dynamic environments: It must include methods that support the development of architectures that are flexible and dynamic while mitigating risks and within the restraints of the budget and organisation.

3.3 Visualisation

Visualisations made with architecture languages contain complex structures and elements using different symbols and representations that connect to another in various ways. They are often not fit for non-technically inclined people, but we do still use UML, BPMN, Archimate pictures in our presentations (Schulenklopper, 2015). Leading to situations where architects have to explain what elements mean. Instead of talking about the problem they try to solve. One of the problems in visual perception relates to what constitutes a visual stimulus (Gordon, 1989, p. 233). Whilst a part of what we perceive comes through our senses from the object before us, another part always comes out of our heads (Gordon 1989). When more variables are required simultaneously, more complex paradigms must be used. This is increasing the possibility of unwanted visual side-effects. In order to produce a 'good' visualisation of all the information, it is necessary to reason about the combined impact that all the properties will have (Maeder, 1997).

In architecture we often see these complex visualisations, providing a compact stimulus space where a large number of variables are represented together within a single scene. The goal is, that an overall pattern may become evident (Beshers and Feiner 1993). But these architecture visualisations needs to be understandable to be effective. Ideally an organisation would co-create a language or notation internally with the different stakeholders that suits business and IT stakeholders on complexity and understandability (Schulenklopper, 2015). Moody states that a clear design goal needs to be identified before a visual notation can be developed. Common design goals are e.g. simplicity and expressiveness. To effectively create visual notations Moody defined 9 principles (Moody, 2010):

1. Semiotic clarity: There should be a 1:1 correspondence between semantic constructs and graphical symbols.
2. Perceptual discriminability: Symbols should be clearly distinguishable from one another.
3. Semantic transparency: Use symbols whose appearance suggests their meaning
4. Visual expressiveness: Use the full range and capacities of visual variables.
5. Complexity management: Include explicit mechanisms for dealing with complexity
6. Dual coding: use text to complement graphics.
7. Cognitive integration: Include explicit mechanisms to support integration of information from different diagrams.
8. Graphic economy: Keep the number of different graphical symbols cognitively manageable.
9. Cognitive fit: Use different visual dialects for different tasks and/or audiences.

Other guidelines for architecture visualisation come from Schulenklopper. In his article he highlights the challenges architects face in communicating their visions and ideas to their stakeholders (Schulenklopper, 2015). These guidelines try to highlight improvements to visualisation not commonly applied, which can result in great benefits and create clarity.

- Placement of elements: Placing an element in the middle of a view can mean it is in the heart of the organisation, thus being the most important.
- Use different colours: Each colour has a different meaning, various colour associations exist, that need to be taken into account.
- Use overlays: In a large overview overlays can be useful to show flows of information or bottlenecks. This can be done up or downstream. Upstream would be, impact from a process down into all systems. Downstream would be data coming from a database, visualising where it ends up.
- Sizes of elements: The size of the same element can vary per view because an element is more important in different cases.
- Short description of elements: Elements need to be described in the business language.

Issues architects will immediately think of when applying such various visualisation guidelines are: Non-ambiguity, Completeness, Maintainability, Clarity, Soundness, Cost-effectiveness, architecture repository. But Schulenklopper argues these drawbacks can be accepted, because it is more important for stakeholders to talk about architecture, business and IT while understanding what is visualised (Schulenklopper, 2015).

3.4 Service and Airline industry

Service quality is considered to be a critical aspect of competitiveness in the service industry (Lewis, 1989). Providing excellent service quality and high customer satisfaction is a challenge many organisations face (Hung et al., 2003). Service quality is the extent to which a service meets or exceeds customer needs and expectations (Lewis and Mittchel, 1990). During the past two decades, service quality has become a major area of attention to practitioners, managers and researchers because of its strong impact on business performance, lower costs, return on investment, customer satisfaction, customer loyalty and gaining higher profit (Baker, 2013).

Air travel has always been classified as one of the more intangible service industries (Kloppenborg and Gourdin, 1992; Shostack, 1977). Customer satisfaction has been at very low levels in the past years according to American Customer Satisfaction Index, the airline industry scores were the lowest out of 47 industries in 2012. Because of this customer satisfaction in airline operations has become critically important. (Bennett, et al., 2000). Airlines support large, complex hub-and-spoke operations with thousands of employees and hundreds of aircraft of various types, with flights to destinations all over the world (Baker, 2013). The complexity of systems supporting this business quickly add up, with legacy systems being one of the bigger issues to tackle being the foundation of communication between airlines and aircrafts.

3.5 Decision-making

In any organisations decisions are made every day. On a high strategic level, but also project level or in smallest sub levels. These decisions have to be made to minimize concerns about a certain subject. Resulting in an action for that specific subject, creating a solution to the concerns. Multiple solutions may exist to a specific concern, all attempting to create a better situation for the organisation. Determining the best solution may need different opinions and scenarios to be taken into account, making a trade-off between quality, risks, cost and time as mentioned by (Johnson, et al., 2007). A solution may be a set of actions to be taken, resulting in an action plan, but may also be a product or a service that needs to be adapted or the purchase of new products and software. For an organisation it is very important to have qualitative and quantitative information for that decision-making. Quantitative information can help with calculations and estimations to see if a decision will turn out well. Qualitative information is more difficult to measure like the risk of something happening in the future, or the value it will bring, but is just as important to be taken into account. Horngren, Datar & Rajan (2012) describe a five-step decision making process which may be used as a decision-model for decision makers: (1) Identify the problem and uncertainties, (2) Obtain information, (3) Make predictions about the future, (4) Make decisions by choosing among alternatives (5) Implement the decision and evaluate the performance.

As enterprise architecture plays a big role in visualising a situation, its problems and solutions they are an important instrument in decision-making. Therefore we often see methods like mentioned Horngren, Datar & Rajan describe applied in architecture. A good example is the RCDA method (Poort, 2013) combining Agile methodologies with enterprise architecture. It clearly containing similar steps aiding in decision-making: Requirement analysis and prioritisation, Stakeholder workshop (to obtain information), Solution shaping and selection, Cost-Benefit analysis, Strategy application, Decision documentation. By adding in the trade-offs that have to be made between cost and risks during Agile development cycles, this method provides well argued solutions that can be applied.

3.6 API and services

API's and services are an integral part of a service oriented architecture. Creating API's and services is a strategic way to solve data access and reusability and maintain their quality. The acronym API comes from Application Programming Interface. An API is a set of functions and procedures that fulfil one or many tasks for the purpose of being used by other software. API can be implemented to gain access to those functions without programming them again (Smith & Nair, 2005). They are used to transform information into relevant output that can be visualised in front-end systems such as websites and applications. An example would be an API used for handling all order information. API's can be shared with external partners to have a secure way of giving partners access to selected information, these are referred to as Open API's. In architecture services or the service layer creates the connection the back-end systems like databases and repositories. Services contain functions that are used to retrieve data and transform data into information (Erl, 2016). These are also meant to be used by other software. API's can be part of a service layer, and do data and information transformation all together. But often we see a split between APIs and services where the API's control the front-end communication, and services the back-end communication. The services are optimised for obtaining data and transforming this into information, where API's are often optimised for transforming information into relevant output for applications. An example can be seen in figure 9.

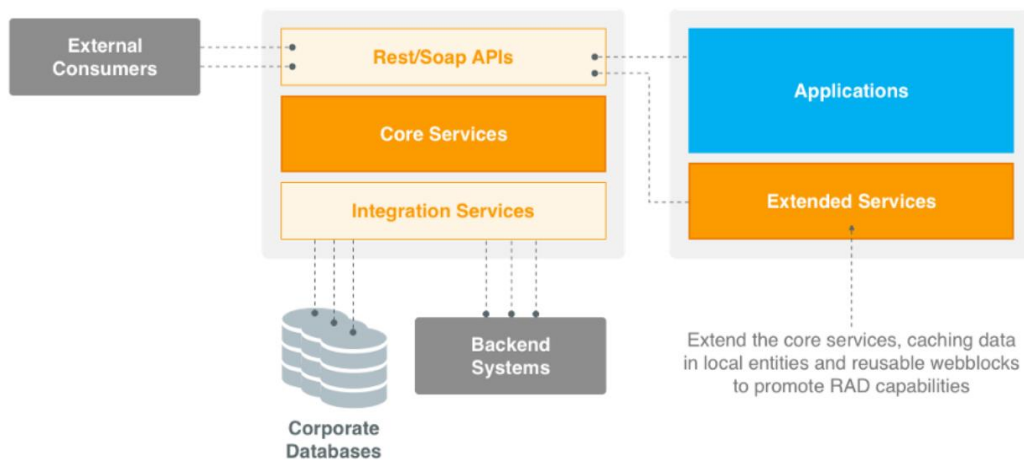


Figure 9. Use of API's and services in microservice architecture (Schmeddes, 2018)

4. Data collection

This chapter will explain what and how data has been collected. Followed by the creation of the artefact based on this data. The literature is also be seen as a part of data collection, as this contains inputs and guidelines used for the artefact.

4.1 Expert interviews

For the data collection semi-structured interviews have been held with the concerning stakeholders at AFKL. This interview is of an exploratory nature, as there many problems and uncertainties, including many connections and relations. Although the direction is clear a solution is yet to be found. Through these interviews the perception and opinions of the stakeholders has been captured to see their process of thinking, acting and their attitude towards the current situation in the organisation (T. Zorn, 2010). Questions on the use of architecture and customer journeys have been categories in to four subjects (as described in chapter 2.4.2): (1) Needs and concerns, (2) Decision-making, (3) Project examples, (4) Visualisation. The questions have been checked to be concise, without bias and without positive or negative association. Probing questions have been added to the main questions, these can be used to steer the interview, or elaborate more on certain subject in case the interviewees deviate from the subject. Through a pilot we have tested this interview beforehand and made slight adjustments. The interview is recorded then transcribed and analysed.

4.1.1 Interview protocol

The interview protocol has been setup as follows (the full interview protocol can be found in appendix A):

- Beforehand the interviewees have been asked to think of a past project concerning the business, customer journey and IT to elaborate on during the interview.
- The interview will start with a re-introduction of the subject, what has been done so far, what this interview is for and what types of answers/participation is expected from the interviewees.
- The interviewees will then get an informed consent to sign, stating they are allowed to stop at any point, their data will be anonymised and can be withdrawn. The interview will be recorded and they are allowed to take back any of the data gathered.
- Then the interview will be started and the recorder turned on.
- Next to the predefined (open) questions the probe questions can be used by the interviewer.
- The 4 subjects and concerning questions will be performed in order.
- The interviews will be transcribed and coded with the Nvivo tool afterwards.

4.1.2 Interview pilot

Through a pilot beforehand the interview protocol has been tested. Because of this pilot several changes had to be made to the protocol. The following adjustments have been made:

1. In the last segment (visualisation) we wanted the experts to point out good or bad parts of current visualisations in use, this has been changed slightly, to more loosely discuss and compare current visualisations and get their reaction.
2. The last segment now also includes a short discussion on my first idea/direction for the architecture visualisation. Doing so to obtaining their initial thoughts.

4.2 Interview results

Here the results of the expert interviews have been summarised, it will be mostly about the insights and problems found as this impacts the next phases of research the most. After the interviews the answers were labelled as one of the following subjects: Goal of the stakeholder, Problems, needed Insights, their vision on: Architecture, the Customer Journey, Visualisations, Decision-making, the Organisation. With this labelling the information was grouped and analysed, during this process many new sub categories appeared.

Overview

Throughout all interviews it became clear that the stakeholders have a need for a good overview of the architecture and CJ. Something that can show the connections between components such as: Applications, systems, API's, databases, but that also shows the vision, goals, or reasoning behind it. This can be difficult because of the complexity and size at AFKL. The relevance of such an overview will be different for each stakeholder. Different levels of detail need to be available to get the right discussion started. More detailed visualisations can go into quality and status of components. The context of the whole is important when creating such overviews, including information on the vision, strategy, scope, business capabilities, features and solutions. Where are we going, how are we doing this, and why. It would be great if architects can visualise these bigger lines so they can be discussed and governed.

Insight

These overviews need to create new insights useful to the business. Showing current and future IT. We want to have insights in current and past projects, how they relate to each other. But also on technology trends and opportunities and how architecture is prepared for implementing those. On a high level overview this can help align and govern projects better. Quality and dependency questions are common to be asked of architects. These questions can concern data or components and are again used to govern the IT landscape. Enterprise architects have the important position to control the long term situation and prepare the infrastructure for it, how and why needs to be communicated.

Customer perspective

Connecting the customer perspective can greatly improve many projects. But these discussions should start at an earlier phase, showing impacting on larger parts of the landscape, on a higher overview than a project. It is difficult to visualise transversal subjects or multiple projects and all their connections to IT. It needs to be simplified in a way. The business and IT need to work together more, and architecture should support them. Especially on a higher strategic level. Managers need to know the context and content. Knowing what goal we have and how it affects the customer experience. Architects should make it insightful for them to make the right decisions. One of the challenges is that that journey is dynamic/changing so there should constantly be discussions on how to improve.

Discussion

Discussions with architect should start at an earlier stage, their insights can help on a higher/strategic level. For project managers it is important to be able to substantiate their initiatives. This can be done by linking initiatives to the global goals and strategy, explaining why and what is going to happen. That helps in the discussions and can improve the budget and time constraints. Especially for the CJ related subjects this is still difficult. Architecture can help in that discussion.

Alignment

Getting together, understanding one another to get to a decision is very important. But alignment is one of the biggest bottlenecks. Every stakeholder has his own goals, there are many teams and departments that want to have a say in a discussion. Aligning them on the bigger picture, would improve the situation, the details are less important at this stage. Again with the CJ it is especially difficult to get everyone to see that vision. Creating links to our strategy and vision is something we can improve on. This can then help us better prioritize and set up business capabilities, features and initiatives.

Transparency

One of the issues with alignment is that there is little transparency. We are missing transparency why we apply strategies or solutions, how do we want to reach out, what our goals are, what is behind it all. This can be in projects but also on systems or applications. Why build a new API or why purchase a new system.

Information source

The source of information for architecture are not in one place, and is reliant on the documentation of many different teams, how well changes to architecture are documented varies highly. This is mainly because the teams are autonomous and roles or responsibilities are not always clear.

There is the issue of not having one tool that has all the information or can combine all of it and that a lot of information is in the head of our employees. This needs to be connected and documented. How and what information architects should visualise could be supported with a visualisation framework.

We also see that systems and touchpoints all have their own logic and information source. Instead of one central point guiding the customer through the whole journey with the right/same information. This creates situations where many connections have to be upheld between systems to serve the customer.

Understanding

For business people it will always be hard to fully understand architecture. Talking with architects should clear up some of their questions, but this can be difficult at times, as they do not fully speak the same business language. Often architecture needs to be explained in a simple way. And sometimes business people will have to do their best to dive into the technical bits as their decision can have a mayor impact. Then there is the problem of people talking past another. Because they might not speak the same language terms can be misinterpreted, architects should communicate using more business terminology. Architects could spend more time listening to the business.

Visualisation

Visualisations have an impact on the decision making, and so a bad visualisation could lead to a bad decision made. Overlays can create interesting insights or answer questions in the architecture. But the visualisations need to be more consistent/recognisable. It would be great to see the customer perspective (from service design) connected to systems and applications in our IT landscape. There are many layers in between that could yield interesting insights, including business perspectives. Crating a very detailed enormous picture can create many insights and interesting details, but these not usable for almost anyone and are very difficult to maintain. Creating the visualisations should not be a difficult task, but be done in a relatively short time, it only has to contain the necessary elements creating insights on a higher level.

Architecture

Enterprise architects need to create these bigger overviews, no one else in the organisation. It would be great if the business sees these visualisations are available and more request these insights more often. Have architect participates in earlier stages and in a more proactive way can also improve the situation. Business capabilities are great tool at an early stage, they can show what direction has been set, what is achieved and what still needs to be achieved as it is more factual. It helps with alignment and understanding in a business language. Architecture should show what the business impact will be, as without that no solutions can be decided on.

Decision-making

Decision making is different in every case, stakeholders can play a bigger or smaller role. They are taking at different places on different levels. They can have varying needs of a visualisations. Having more stakeholders around the table is usually harder. In the end everything is always a trade-off, usually between value, risks, costs, time and quality. We should start by looking at what we want for the customer, then we will look at budgets, time constraints, IT teams, architectural constraints, etc. Architecture can bring the concepts together and visualise the trade-off.

Solutions

In projects the first thing that people think of is a solution, instead of looking at the bigger picture. There is a lot of value in looking at current and past initiatives, learning from them or reusing them. Multiple projects could be doing the same thing, it would be useful if they work together, sharing resources, saving time. On a level above that we see that departments need to work together more, instead of in their own silos. Improvements are definitely being made, but there is still a long way to go. The customer journey is a great tool that brings the customer perspective on the table and forces people to work together on creating one seamless journey.

External parties

In the future we want our IT to be able to open up to external parties. Open API's are a key component here. Our API's do not always match that of our partners, and need more standardization. Combining our customer data with that of partners can greatly improve the whole customer journey. Stakeholders expect architecture to provide insights, solutions and constraints for applying the Open API's.

4.3 Tooling

It is one thing to visualise the IT, and business information within architecture, it is another thing to create these visualisations and keep them up-to-date. This is where tools have an advantage. There are several big architecture tools that are used all around the world, but there are also more simplistic tools that can get a similar jobs done. Examples of simpler tools are: Microsoft Visio, PowerPoint, or free online modelling tools such as Draw.io. From a study by Gartner (M. Kerremans, S. Searle, 2018) we have found three well known and highly rated architecture tools: Sparx (Enterprise Architect), Software AG (ARIS and Alphabet) and BiZZdesign (Enterprise Studio and Horizzon). At AFKL all of the tools except BiZZdesign are available to use, but are used for different goals and by different departments or architects. They all have their own sources of information which are not connected to another. Below is a summary of these tools, what possibilities these tools can offer and if they can solve the needs of a large organisation like AFKL.

Sparx enterprise architect: An enterprise tool for designing, construction, testing, deploying and managing systems and processes. Its goal is to support a business in implementing architecture at any stage of a development lifecycle. It supports many popular architecture frameworks such as TOGAF and Zachman and can use multiple languages as ArchiMate, BPMN and UML. They have the possibility of including customer journey maps, this can easily be achieved with the above mentioned languages and thus can also be connected to other architecture. It includes a data miner to extract data to automatically change models and overviews and can be easily integrated with other office tools.

BIZZdesign Enterprise Studio/HoriZZon: Is one of the few certified ArchiMate v3 architecture tools, which is the standard modelling language for enterprise and business architecture. It can show heat maps, charts and graphs for business-relevant data and includes scenario planning tools to analyse project changes. It integrates with many of the popular architecture frameworks like TOGAF, Zachman, ArchiMate. It can visualise, analyse and document enterprise architecture across business units. It can import data from many office applications and even supports automatic data collection. It has a dedicated tool for customer journey mapping and analysing. Their new tool HoriZZon can integrate architecture models with business capabilities, and can analyse for a broad audience of business stakeholders. Supporting IT alignment and collaboration, helping in decision making.

Software AG Alphabet/ARIS: This tool can combine different architectures like business, information, technical and application architecture. The tool has been created to help organisations make better business decisions, inform enterprise of needs, develop solutions and identify the best services for the business. It includes many different types of analytics to achieve this. It can manage many different aspects, with separate features such as: API or database manager, IT/business transformation, GDPR compliancy. Alphabet can be used in combination with their modelling tool ARIS, which can be integrated with a wide range of other products. ARIS also has specialised features to be used for customer journey mappings. It has the possibility of automatic process discovery and mining, used for business management and insights.

Microsoft PowerPoint: Is still the most used tool for presenting and documenting within many organisations. It features many possibilities to create diagrams and models whilst being able to add extra information on the side. Slides are easy to read through, and can quickly explain many facets of a subject in a simple way. It is, however, completely up to the skills of the author to make this readable and understandable. It can be integrated with many tools, having the possibility to explain models created in other tools with extra information on the side.

Draw.io: Is a free, open source, online modelling tool. This tool easily integrates with Google and other cloud services such as Dropbox, Confluence or Microsoft teams. It is widely used by many organisations, for whom the integration with other tools and service is a paid feature. It has all the basic modelling tools you could need for creating simple models and diagrams, but also contains template for more strict modelling languages such as UML and BPMN.

4.3.1 Conclusion

The three main architecture tools are all very capable of implementing the customer journey. By converting the customer journey to a business process very similar results to traditional enterprise architecture can be obtained. Also adding in automatic data collection in several forms and the possibility to analyse and easily create different views. However, adding in information on vision, strategy, goals, business capabilities, or connecting projects

is more difficult. Some of these tools have the possibility to model these subjects in a separate view, but connecting them to the architecture is not always an option, if it is this will create very complex and large overviews. Being difficult to navigate and understand. Especially for larger organisations with complex infrastructures. Creating a more simple overview with the right sources of information is still challenge in these tools. The strength of the three architecture tools is that they work from one source, and this source can be maintained to always have the most up-to-date information. How to maintain the source is another challenge to larger organisation. Having many teams al working on different parts of the IT infrastructure can lead to many problems. But also adding information on why changes are made will still have to be documented elsewhere.

The simpler modelling tools like are still very capable of creating good models. They will keep the overviews at a more simplistic but easy to understand as well. However, they do not have a source that can be used to easily retrieve views or part of the IT infrastructure. Models will have to be made from scratch. Documentation will be important to keep track of all changes and models.

The EA tools can also be combined with the simpler tools. Where the EA tool provides the architecture of a certain view in PowerPoint or other tools, overlays can be added to highlight elements. Additional information can be added freely on vision or related projects which is not possible in the other tools. Using PowerPoint makes it easy to present to other people immediately and can be used as a form of documentation.

5. Artefact creation

With the data collected from the interviews, an artefact can be created to solve some of the issues and problems found. This led to the creation of a visualisation framework for architects. This framework will help architects create an overview of a subject, project or scenario, connecting business, IT and customer journey elements. Creating an overview of the whole situation should help with; creating new insights, stimulating the discussion between stakeholders, create mutual understanding on the context and show the impact of decisions. This together should help stakeholders make better decisions in the end.

The visualisation coming from the framework does not have to show a fully detailed solution to a problem, it should sketch the main lines of the initiative. To make sure all stakeholders are aligned and understand the big picture. The insights from combining the different elements should provide new insights on a high level that stimulate strategic discussion and decision-making. More detailed/specific solution and views will still be supplied through the traditional ways such as: business architecture, data architecture, application architecture, technical infrastructure architecture, security architecture.

Creating a visualisation with the framework should be possible in a short amount of time, it might miss information in early stage of an initiative, this is okay as it can be used to clarify subjects in meetings. Through the discussion in meetings, the visualisation can be changed along with the development of the initiative. Promoting stakeholders to understand, discuss and align over the bigger picture in every meeting.

The visualisations have been created with Draw.io as this sufficed for all the basic needs of modelling that has to be done for the designed framework. It can easily be used in combination with PowerPoint which is the most used tool at AFKL, thus being easily recognised or adapted by the stakeholders. There is also the possibility to create a template in PowerPoint for architects to use, with this you create a ready to use design with elements that can be connected.

5.1 Visualisation framework

Here we will discuss the designed framework, as seen in figure 10 below. The use and purpose of the elements and boxes will be enlightened.

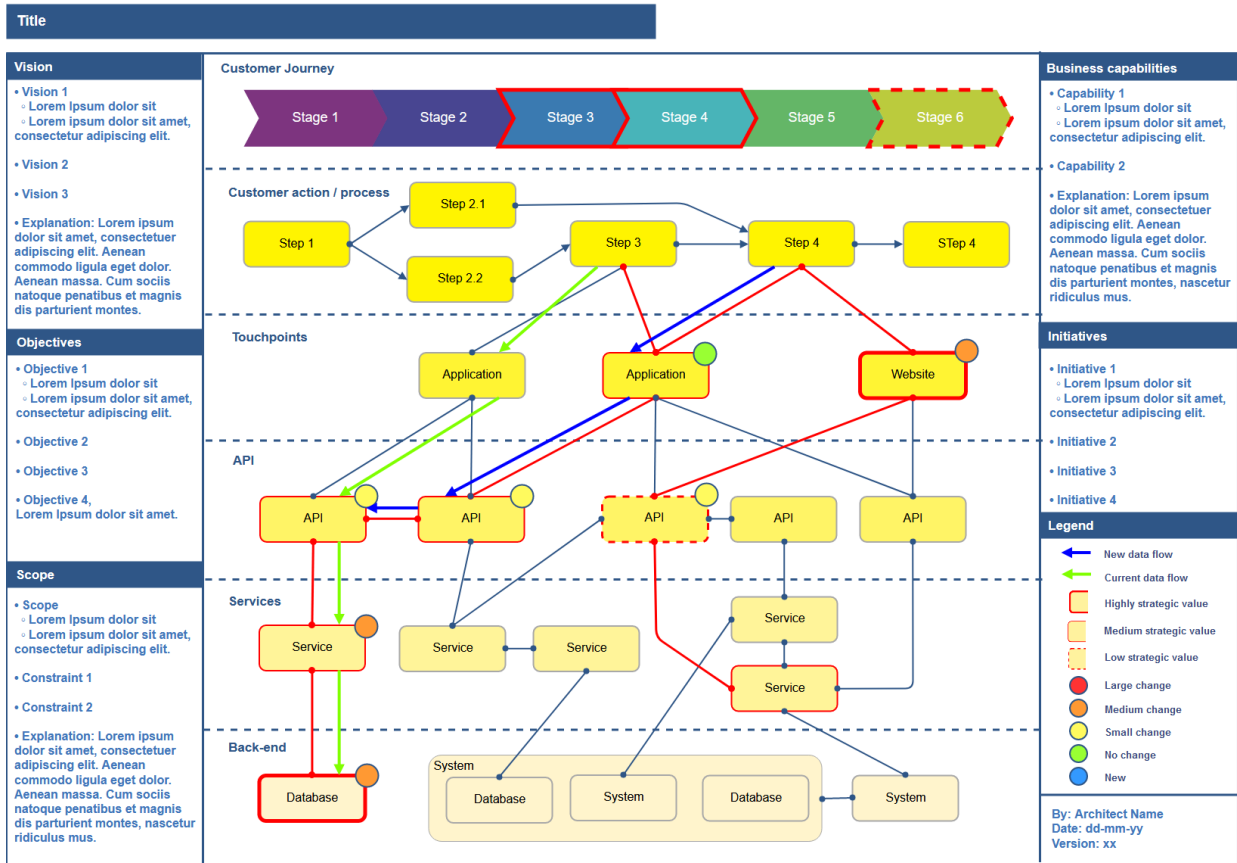


Figure 10. Visualisation Framework

On the left side we see three business aspects that help visualising the full context:

- **Vision:** This should describe what the future goals are for the subject at hand. This can also include the goals of the customer. This vision might not be fully realised by just one initiative or within one iteration, it can be a 3 year plan. By adding in the vision stakeholders can directly align on the bigger lines of the subject, creating part of the context. Inputs come from the various stakeholders and should be aligned to the company vision and mission. These visions can be based on market studies or a proof of concept. SWOT Analysis or CJ Gap Analysis are tools that can provide some of these inputs as well.

- **Objectives:** This should explain what this particular initiative should achieve. From the vision goals can be set to achieve, the objectives are the key results for those goals. Where the vision is broad in scope, the goals are narrow in scope. The objectives will help aligning the vision of the initiative to the IT approach and solutions as seen in figure 11.



Figure 11. Strategic planning and alignment (The Spurs Group, 2018)

- **Scope:** It is important to set boundaries for an initiative. What problems will be addressed and which will not be. What activities are included in this project and what belongs with other projects. Setting clear boundaries can help align the initiative within a larger context. It can also help placing projects within organisational constraints such as costs and time. Delivering argumentation why what will be done.

In the middle of the framework (figure 10) we see the architecture. This overview is connecting the customer journey to the IT infrastructure. Creating this overview should include the affected components but also the surrounding components are of importance as they contribute to clarifying the context. Modelling the customer journey related parts is based on customer journey mapping as seen in figure 2 and service design blueprints. The architecture modelling is based on the Layered Viewpoint from the industry standard language Archimate (The Open Group, 2013).

- **Customer journey:** On top the customer journey is visualised. Showing what steps customers follow, highlighting what steps are affected by the initiative and the strategic value of these steps. Highlighting of these steps connects the gaps found in the customer experience to the value for the project. Providing evidence why solution should be adapted to the customers perspective. Doing this we realise the customer perspective and can improve their experience.

- **Customer actions/process:** Another part of the customers perspective is the actions they and employees take during the selected part of the journey as seen in Figure 12. Including this creates a better picture of the services received by the customer. This is where an organisation can directly impact and support the customer by implementing and optimizing IT solutions.

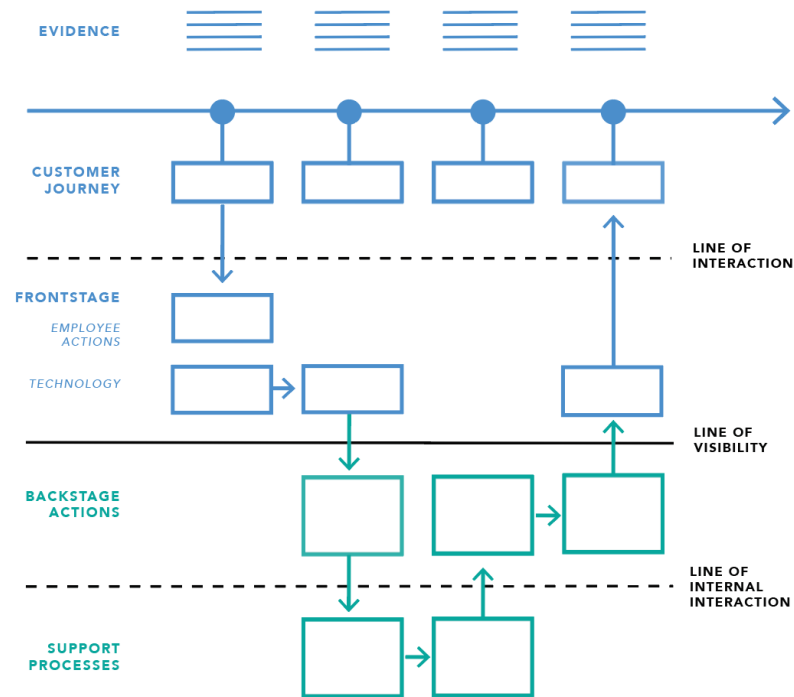


Figure 12. Service Blueprinting (Nielsen Norman Group, 2017)

- **Touch points:** This layer in the framework visualises the direct points of interaction with the company, they can be digital or physical. Think of a website, or a kiosk. These touchpoint will always be supported by IT in a way. Here we make the connection between the customer and IT. Also seen in the service blueprinting, figure 12.

- **API's and services:** In this framework the API and service layer have been split up. In other literature these are sometimes called front-end and back-end API's, but we also see them being combined to one layer being, service or API layer. At AFKL a distinction between API and service has been made where an API performs tasks for other pieces of software in the front-end (the systems and applications used at the touchpoints) and a service extracts data from databases and back-end systems.

- **Back-end:** Here we find the databases and other systems that are the backbone of an organisation. They provide and control data, keep systems and process running for employees.

This layering created in the framework is quite similar to other architecture frameworks, not just the Layered Viewpoint from Archimate as seen in figure 13. However, in the top layers the customer is clearly represented differently. Frameworks often start at the stakeholders, which are connected to a business process which is connected to IT services and then to IT systems and databases. We changed the top layers to focus on the customer perspective and process expanding it with customer journey mapping and service blueprinting. Combining this new layering with the overall context is what sets this framework apart.

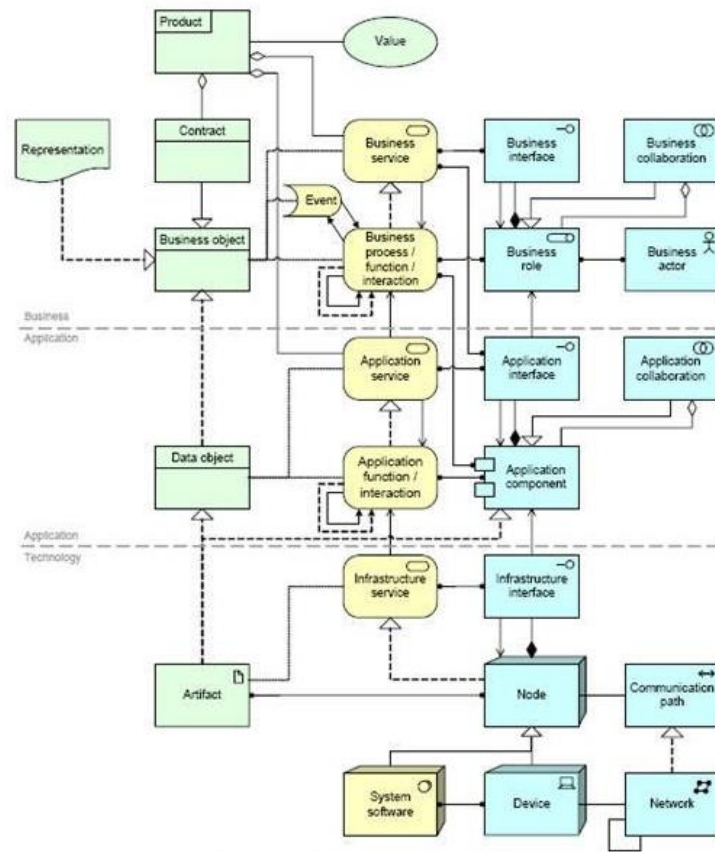


Figure 13. Layered Viewpoint (The Open Group, 2017)

- **Overlays:** By using overlays on the architecture we are able to show: flows, impact, bottlenecks, strategic value, the amount of change needed. Using overlays will help create new insights, highlight components, focus attention or can answer questions from stakeholders.

Impact: It is important to highlight the components that are affected. They can be highlighted simply by marking them in the architecture. Or more specified showing their added strategic value and the amount of change needed to that component.

Strategic value: By use different outlines for components we can differentiate between high, medium, low strategic value.

Bottlenecks: Instead of strategic value you can highlight the main bottlenecks: high, medium, or low, this should be specified in the legend.

Amount of change needed: Mark components with an orb in the top corner, showing the amount of change needed being: large, medium, low and mark new components/additions.

Flows: Various flows can add valuable information. Like a data flow from the customer process to all applications in use. Combine it with bottlenecks or strategic value for new insights.

These overlays are based on the needs and concerns found during the interviews, but other overlays can be thought of, as long as they create useful insights to the business.

Lastly on the right side we bring more business and practical aspect to the framework.

- **Business capabilities:** Describing what existing functions are fulfilled and new functions that should be fulfilled by the initiative. It describes how an organisation is able to perform a business activity (Ray, Barney, Muhanna, 2004) It helps business and IT stakeholders visualise which resources need to be combined to execute their strategies. In this way the IT landscape can be transformed to optimally support the business. It connects the strategy and approach, as seen in the strategic planning pyramid, figure 11. Being at a high level that is easily discussed while connecting to more detailed solutions. An example would be: 'Ordering', the possibility to order something is dependent on many factors and resources. What and why can be discussed on a high level, but also the how; possible solutions, can be clarified.

- **Initiatives:** This is listing initiatives that are connected and could impact one another. Or initiatives that have had a similar goal in the past so that can be reused and/or learned from. Creating more insight into the projects in the past, current and future. Creating an overview what is going on in the organisation and where the current initiative places between them.

- **Legend:** Here we describe the elements used in the architecture part of the visualisation. Making architecture more understandable for business and IT stakeholders and understanding the meaning of the overlays.

- **Version information:** Here we add a version number and by whom it is made. This way we keep track of the changes made, as this visualisation can be adapted to the decisions made in each meeting. It also makes sure people know who to contact for questions or feedback, helping with alignment.

6. Use case and validation

To evaluate the designed visualisation framework it is applied to a business use case based on past and current projects within AFKL. From this use case three hypothetical scenarios have been visualised using the framework. Those visualisations are used as a simulation of the real world and are tested for effectiveness. The participants of the validation test are different stakeholders at AFKL.

6.1 Use case

To sketch a realistic situation for testing the visualisations in this validation we have taken information from old and current projects to create a hypothetical business use case. The expert interviews have helped to gather this information. We want to have an accurate and realistic use case that sketches a real situation as best as possible. For the participants of the test this will make the use case easier to understand, whilst not interrupting any real projects, or disclosing any information that is confidential. The use case template is based on similar templates at AFKL.

Table 2. Use Case - Improved lounge experience

Use Case: Improved lounge experience
In 2019 we want to make several changes to AFKL lounges to improve the airport and recovery experience of our customers. Business capabilities have been aligned with the objectives of stakeholders and several features and functionalities have been thought of to be implemented over the span of the next year(s). Next to this there are also overarching initiatives that can impact the lounge capabilities in the future.
Actors
<p>Front-end systems: Websites, Loyalty program, Mobile apps, Push channels, Customer assistance application, Kiosk, Lounge pillars.</p> <p>API's: Lounge API, Customer assistance API, Loyalty API,, Reservation API, Order API, check-in API.</p> <p>Services: Lounge data service, Lounge eligibility service, Check-in service, Order service, Loyalty service, Passenger service.</p> <p>Back-end systems: Reservation system, Travel database, Ancillary product catalogue, Loyalty database, Customer management system, Departure control system.</p> <p>People: Customer, Lounge personnel.</p>
Departments and goals
<p>CX: Personalization and customer intimacy in all touchpoints</p> <p>Digital: Optimal sales through of products</p>

<p>IT operation: Easy upkeep, live insights, scalable systems. EA: Simple integration of elements, flexibility, minimise risks, scalability IT management: Open up API's to partners so we can cross sell products</p>
<p>Scope</p>
<p>Only lounges in the main airports of AFKL are affected at this time: Paris-Charles de Gaulle and Schiphol.</p>

6.1.1 Scenarios

From the hypothetical business use case we derived 3 scenarios that could be part of the use case. These scenarios are more loosely described projects or features that, management, business or IT want to create to reach the goals of their business use case. These scenarios have been visualised using the framework. The description can be found below and visualisations can be found in Appendix B1, 2, 3. For every scenario a potential question from stakeholders has been included, this will be answered in the visualisation through overlays. The questions in each scenario requires a different overlay to give a certain insight.

Table 3. Scenario 1 - Implement NDC for cross selling with partner airlines.

<p>Description</p>
<p>Due to limitations in the back-end systems it is hard and too complex to cross sell products with partners. More airlines want to make a move to NDC as a standard for distribution between airlines. This project is in an early stage, not all the details are known yet. As it is overarching almost everything in the architecture landscape, big architecture changes are sure to happen.</p>
<p>Question</p>
<p>What is this NDC changes about, and what would happen to the current architecture?</p>
<p>visualisation</p>
<p>The overview shows the impact of the proposed implementation to inform and align on a high level.</p>

Table 4. Scenario 2 - New feature: Mobile lounge service queuing system.

Description
Customers can order services in the lounge through klm mobile app. By adding a digital lounge queue to the mobile app. Customers can see the approximate place in the que for their requested service. On their turn an agent will find the customer based on location service.
Question
What impact would this queuing system have on the current architecture and if it worth the effort?
visualisation
Will visualise the impact of implementing the new feature in the current architecture.

Table 5. Scenario 3 - Increased access speed to lounges.

Description
CX identified that customers are annoyed that accessing a lounge takes a long time, when placing boarding pass on scanner it takes more than 10 seconds for the system to react. Customers are waiting longer than they are used to. We want it to instantly show if customer is eligible to enter the lounge. First we have to identify why it takes this long, and what solutions could potentially help. Is biometric access an option?
Question
What does the flow of data look like for a customer that wants to enter a lounge?
visualisation
Visualises the flow of data for accessing a lounge.

6.2 Artefact validation

A test has been setup to validate the artefact. The three scenarios have been visualised with the framework and will be evaluated on effectiveness. As described in the MEM model from Moody, see chapter 2, the effectiveness will be evaluated by looking at: the perceived ease of use, usefulness, and the intention to use. These results can be used to evaluate the effectiveness of the framework for alignment and decision-making when used in real practice. The participants are asked to explain their answers and thoughts when testing the artefact.

6.2.1 Test setup

The validation setup is as followed:

- The test will start with an introduction to the problem, what has been done to design the artefact and how we want to test this artefact. This is done in an online form, making it easy to collect all the data.
- The interviewees will then sign the informed consent, stating they are allowed to stop at any point, their data will be anonymised and can be withdrawn.
- Then the test will start, they will be introduced to the framework, what it contains and how it works.
- This will be followed by an introduction to the use case and the 3 scenarios the framework is applied to.
- The first scenario and it's visualisation is shown followed by 5 questions on a Likert scale.
- The second and third scenario and it's visualisations are shown each followed by the same 5 questions.
- This is followed by 8 questions about the visualisations in general.
- And at last by 4 open questions that are discussed with the researcher.
- The online form is submitted and are automatically collected.

6.2.2 Subjects

The stakeholders mentioned in chapter 2 will also be used in this validation. The stakeholders being: Architects, Higher IT management, Digital (IT) and CX. From each stakeholder group at AFKL two most suited/experienced members were asked to participate in the validation. In total this resulted in 8 participants. As they are considered to be experts in their domain, this gives us valuable results on the effectiveness of the framework in practise. These stakeholders are known with the subject of this research and have participated in the previous expert interview and other meetings as well.

6.2.3 Context

The validation took place in two different contexts. One is a physical room with a screen for the visualisations and a second screen for the online form. The second context was necessary due to AFKL being an international company having many stakeholders in many places around the world. Because of this some test took place using video conferencing. The participants were asked to share their computer screen(s) to ensure the test went smoothly whilst the participants are still able to communicate their thoughts with the researcher.

6.2.4 Objects and instrumentation

For the validation several objects will be used. The validation this is done through an online form made in Google forms, this can be found in Appendix C1. It contains the following objects:

- An introduction to the test.
- An informed consent, to be signed digitally.
- A framework description.
- A use case and scenario description.
- Three visualisations of scenarios.
- A questionnaire with each visualisation, containing 5 questions on a 5-point Likert scale (from totally agree to totally disagree).
- A questionnaire for the visualisations in general containing 8 questions using a 5-point Likert scale.
- 4 open questions, to be discussed with the researcher and filled in the text box on the form.

The questionnaire has been aligned with the measurements for the validation as seen in table 6. The questions are based on the MEM descriptions of Moody (Moody, 2003). The full questionnaire and elaboration one each question can be found in Appendix C2.

Table 6. Validation through questionnaire

Questions	Evaluate
Visualisation 1/2/3	Perceived Usefulness: <ul style="list-style-type: none"> - For alignment - For architecture insights - For discussions - Of context overview - Of the detail level
General	Perceived Ease of use <ul style="list-style-type: none"> - Placement of elements Perceived Usefulness: <ul style="list-style-type: none"> - Of the framework - Of using uniformity Perceived Effectiveness: <ul style="list-style-type: none"> - For decision-making - For alignment Intent to Use
Open	Perceived Usefulness Perceived Effectiveness Intent to use

6.2.5 Data collection

The data is automatically collected by the Google forms and can then be exported to be used in google/excel sheets for analysis. The collected data has been put in one master sheet, divided into several subgroups that could yield interesting results.

- The questions on each visualisation are grouped and can be compared between the three visualisations.
- Combining the questions on each visualisation and general questions, shows the results on each measurement.
- The answers are also divided into the 4 stakeholder groups to see if their answers differ.
- Lastly the open questions will be processed manually giving more substantiation to the results on each measurement.
- Also notes by the observer during the validation are written down manually.

Some of the results had to be cleaned, questions 4 and 5 from the visualisations questionnaire had been asked negatively instead of positively, meaning: 5 - fully agree would be agreeing to a negative statement. Where other are positive statements. Thus, the scores for these answers have been flipped.

6.3 Validity

Four kinds of threats are addressed in the research project: Conclusion validity, construct validity, internal validity and external validity, clarified in the next paragraphs. To increase the strength of the validation in this research, we use two types of triangulation, providing a broader picture for the research by looking at multiple perspectives:

- Data triangulation: 8 participants of AFKL with 4 different backgrounds will be part of the research, creating a mixed source for data collection.
- Methodological triangulation: Different types of data collection methods are used, being the expert interviews and artefact validation.

6.3.1 Conclusion validity

Threats that concerning the drawing the right conclusions are:

Low statistical power: This does not apply here, the quantitative results only address the mean score in a qualitative way, no statistical analysis is applied.

Violated assumptions: It is assumed that participants are free to say anything they want in data collection and validation. Not held back by the organisation or other stakeholders.

Triangulation: Answers need to be enlightened from multiple perspectives in the research, but this does not mean that other answers are not valid.

6.3.2 Construct validity

Threats to the generalisation of the results based on concepts and theories around the subject of the research. This includes the design of research and selection of subjects.

Inadequate explanation: The interview protocol and validation design took into account that the participants need to be well informed. Also the procedures and expectations from the participants are explained.

Mono method: Different types of data collection are used: the expert interviews, the questionnaire and the open questions discussed in the treatment validation.

Restricted generalizability: Reduce risk that artefacts affect each other.

Researcher expectations: The researcher was not affiliated with other stakeholders. The researcher influencing the test subjects with his vision and opinions.

Generalisation variables: Multiple measurements are discussed and affect the final outcome

6.3.3 Internal validity

Refers to threats affecting whether the treatment makes the difference and if there is enough evidence to support that.

Time: For each test 1 hour was allocated, where only 20-30 minutes were necessary for the test and extra time was used to further discuss. No issues resulting in time pressure occurred.

History: Each validation was individual but participant did not influence another outside of this. Neither between the interview and artefact validation there have been occurrences that could impact another.

Selection bias: an equal amount of test subjects divided over 4 groups have been selected. They have been selected based on having a high level expertise in their domain, not based on suitability for a desired outcome.

Experimenter bias: It is assumed that pleasing or annoying the researcher, affecting the answers given, did not happen. Participants have been reminded to give honest answers and that no answers are wrong answers.

Instrumentation: No changes to instruments, observer or scores were performed, the framework itself has a slight learning curve but is well explained beforehand and was well understood.

6.3.4 External validity

Refers to the generalizability of the results across individuals, setting and time.

Reactive or interaction effect: Interaction with the validation has not influenced the results have been performed, it did not teach or react to any information.

Population: The 4 stakeholder groups are equivalent and represent the population that would make use of the artefact. Both through using diverse groups and the level of expertise of the participants.

Multiple treatment interference: Most participants took part in both expert interviews and artefact validation. But these two do not affect one another.

7. Results, analysis and evaluation

In this chapter the results from the validation will be analysed and discussed. Looking into the separate visualisations, the general questions and open questions from the artefact validation.

7.1 Results

In table 7 we see the average results for the questions on the visualisation used in each of the three scenarios. All questions addressed the usefulness of different aspects of the artefact. Initially we see visualisation 2 score the highest everywhere, where visualisation 1 and 3 have varying results per question. We also see question 4 and 5 have the lowest results compared to the other questions. Question 3 scores the best overall. All results are scored 3 or higher meaning neutral to positive and some scoring over 4 going to very positive.

Table 7. Results validation of each visualisation.

Question / Scenario	1	2	3
1 Useful for the right context	3.75	4.25	3.50
2 Useful architecture insight	3.88	4.13	4.00
3 Useful / promote discussion	4.00	4.25	3.88
4 Useful information	3.88	3.88	3.13
5 Useful / right detail level	3.00	3.63	3.00

In table 8 we see the average results of the general questions on the visualisations, addressing several measurements used to validate the artefact. All questions scored very positively only question 3, 4, 6 scoring between neutral and positive. Question 3 was often misunderstood during the test and had to be elaborated by the researcher at that moment. After evaluating, this question was more directed to the quality of architectural representation, and had little to do with the validation of the artefact itself. It evaluates the skills of researchers in creating a good/complete architecture visualisation. As it does not bring much valuable information to the research, this question has not been used in further analysis.

Table 8. Results validation of visualisations in general.

General question	Score
1 Is it easy to understand	4.38
2 Placement of elements makes sense	4.38
3 Does it represent the data well	3.50
4 Effective for decision making	3.88
5 Effective for aligning with other stakeholders	4.13
6 Useful in future to create insights	3.88
7 Useful to use uniform visualisations	4.50
8 Would you use this in the future	4.25

Combining these results gives us an overview of the total average scores in the validation. In table 9 we see the average score for each measurement. Perceived usefulness was measured for the specific parts of the artefact, 5 questions on each visualisation and 3 questions in the general questionnaire. Together having a mean score of 3.95, being the lowest but also most grounded result. Mean scores for perceived ease of use and intent to use are based on 1 or 2 questions, but still important as they are influenced or influencing the other measurements, as described in the evaluation model by Moody (figure 3).

Table 9. Results for each measurement.

Measurement	Score
Perceived Ease of use	4.38
Perceived Usefulness	3.95
Perceived Effectiveness	4.00
Intent to use	4.25

In table 10 we see the average scores for each stakeholder group. Demonstrating the differences between them. The IT management scores the highest and Customer experience the lowest. Reasons why will be discussed in the next paragraphs.

Table 10. Results for each stakeholder group.

Stakeholder group	Score
Architects	4.00
IT management	4.22
Digital (IT)	3.86
Customer Experience	3.75

Lastly the open questions are summarised:

1. Missing information sources

Several information sources have been mentioned that could possibly add useful information to the framework, helping to answer questions from stakeholders:

- A list the main requirements of the project
- A component catalogues: explaining every element and their use.
- Libraries for the different layers: explaining the use and the source of information.
- Use an industry standard language/ meta-model (like Archimate).
- The use of data objects can be improved; showing the use of data in a process or system.
- Add security highlights; solutions or constraints.
- Include project information: for example the business owners.
- Add the digital channels: the way the communication takes place.
- The problem being solved could be clarified, explaining the situation in a few sentences.
- Add clear gaps on the journey, more than just strategic value, to include the needs of the customer.

2. Questions that have not been answered or are difficult to answer

- What is the architecture decision made?
- What person to go to if I want to talk about component X.
- What is added value to the customers?
- What component a causing long response times in the dataflow?

3. General remarks

- Depending on the stakeholder different views and information is necessary, communicating to an IT developer requires a different language that talking to business representatives.
- Make more use of colours to highlight or take away attention from elements. This can reduce information overload; in the current situation everything seems just as important.
- Good structure and good effort, take a step back, what is the essence you want to bring over?
- Good initiative for business proximity.
- Could take even more of the customer perspective into the design.
- Think about the use of vision, what vision is leading, strategic vision from the organisation, customers vision or visions from a specific department?

4. Perceived value in digitising this framework

- Yes it adds value, but it is a challenge. Drilling down (clicking through) into views and systems, zooming out to see the position in a broader context would be a good digital adoption. For architects the digitized framework could become a tool box, for others stakeholders a catalogues.

- No this adds no value, it should be included it in project and architecture documents where it can add that context/overview to reinforce the discussion and decisions.

7.2 Analysis

Here we will analyse the results from the validation. Looking at the results for visualisation 1, table 7. We see that the usefulness of the detail level scored the lowest being a neutral score of 3, followed by the usability of the context a 3.75. The scenario tried to visualise a high level overview using architecture to envision the direction of a project. Reactions participants gave are: A layer underneath the customer journey could be used to: show the gaps in the CJ being addressed or a more detailed process could be visualised. The reasoning for this solution is from an architectural perspective not a customer perspective. This might be due to the nature of the project at hand being a heavily architecture focused problem, but one that will still impact the customer. We are also missing information on the channels used (online/offline) that would improve the context. Going into the details for this subject is difficult at this moment in time, for instance on the use of API vs NDC is not clarified.

Looking at the results for visualisation 2, table 7. We see positive results with the usefulness of the detail level again the lowest score being 3.63. We see above positive results for the usefulness of the architecture insight, the context shown and promoting discussion on the subject. In this scenario the impacted components in the architecture were highlighted, based on a new mobile feature introduced for customers to use. Reactions are that the detail levels are better than in the first visualisation, but it could have had a few extra details adding to the flow of actions. A data model approach could have been used as well, visualising the architecture from a different perspective, while still being able to keep elements that are used in the framework. It could use a bit more clarification on what systems facilitate which step in the CJ. The link to the customer process is a lot better and the specific details do make the whole a useful visualisation. The highlights clearly add useful insights by using strategic value and change needed.

Looking at the results for visualisation 3, table 7. We see the usefulness of detail level score low again being 3.0 and the usefulness of information being 3.13. The visualisation visualised the data flow through the systems delaying the process of the customer. Reactions are that the flow of data could have been expanded on. For instance adding what the processing time for each step in the data flow is, making it clear what systems are a bottleneck. Make sure that the legend makes sense, in case of highlighting a bottleneck the word 'strategic value' in the legend does not make complete sense. The flows visualize a useful thing, but are more dynamic, it might be possible to make it less one dimensional. With some mores space you can more clearly highlight elements. The problem and benefit

for the customer are not clear from this visualisation alone. Again showing the processing times could clarify this. The issue for the bottleneck might be data availability or data related, this could be used/added in this visualisation.

Looking at the general results in table 8. We see that in general the artefact is received positively, where some answers are slightly less positive and some toward very positive. Easy to understand and placement of elements scoring 4.38 and use it in the future 4.25. Meaning the framework is well understood and usable for the stakeholders. Using uniform visualisations also scored high, promoting the use of a framework like this instead of new visualisations per case. Useful insights for future cases scored 3.88, reaction on that being that some of the architecture views and insights that could have been demonstrated better. The questions on effectiveness scored a 4.0 on average which is positive, this is a good indicative score for the application in real use.

Lastly we have the open questions, as summarised in chapter 7.1. First the information sources are discussed; what other information sources could be added to the framework. Many sources have been brought up. Some aiding to the goals of individual stakeholders, wanting to see more of their domain. Others more in general expanding the possibilities with the architecture. Not all these information sources have to be a part of the framework itself, but could be part of the guiding document for the framework. Then we discussed what questions are hard to answer through this framework. 4 questions came up that are actually in line with some of the information sources mentioned. Next, in general remarks, almost every one made positive remarks on the framework, but there was also some criticism. The information possibly being an overload and more effective depending on the concerning stakeholders. The customer perspective could have been used even more. The use of vision needs to be clarified.

Lastly we discussed the digitalisation of the framework and opinions are split on this subject. Some stakeholders see value in digitising a framework, others want it to be used in projects and architectural documents.

7.3 Evaluation

Keeping visualisation 1 simple and at a high level was the goal, but has proven to be less useful to the stakeholders. Not bad enough to receive a score below neutral, but lower than in the other visualisations in some regards. More details/information on the subject can help this case and the possible solution proposed in the project. The framework itself provided enough information for it to be useful for showing the context and helping in discussion, but the execution on the architecture part can clearly be improved. This is a skill that is particular to architects, but can always be improved on. The architecture views have been created by the researcher for this validation. Having the visualizations created by architects could provide better results.

Visualisation 2 scored well because of the more specific and detailed solution/architecture insights created. Noticeably participants understood the visualisation a bit better, this could be because they had seen it once before. The research started with a simpler visualisation to ease into the complexity that is possible with this framework. This could have affected the answers, but looking at visualisation 3 we see that results are a bit more critical again, while the complexity is similar to visualisation 2. Overall the information and context are well received and provided good insights into the scenario.

Visualisation 3 scored similar to visualisation 1. Mainly the context could have been improved. Not having information on all the essential parts that could highlight the problem and solution better, resulted in the whole not come together well. Again we come to an issue more related to the execution on the architectural view, and less on the elements from the framework. The framework is actually received well and scores for given information and supporting discussion are positive.

The questions on the framework in general are positive sometimes leaning towards very positive. Having seen the three scenarios and some of the possibilities made participants better understand the added value the framework can bring. Easy to understand/placement of elements scoring 4.38 is very good as this influences the other measurement values. If it the framework would not have been easy to use it would have never scored high on usefulness of intent to use. Two questions directly asked if the participants think the framework to be effective it alignment and decision-making, with a score of 4.0 being a positive.

The usefulness on average scored a 3.95, being near positive, but the observations show that this score was impacted to a degree by the fact that the architectural views were not always complete/done right. Due to the researcher not being a professional architect but having applied the framework to hypothetical situations himself, has affected this outcome. The architecture views have been checked roughly by one architect, but not in detail. Possibly having professional architects apply this would result in very positive scores. Even though it was made clear that the participants are expected to comment on the framework and not the content itself, this still happened. The introduction to the validation could maybe clarify it even more, or the researcher could steer participants off that thought pattern.

Scores for perceived effectiveness were positive. Perceived usefulness being near positive having a side note that this result could have been better. Together with the ease of use, intent to use and uniformity the framework can provide. This is a great result for this research validating that the framework can be effective in its use for alignment, discussion and decision-making.

It is interesting to see that the stakeholder groups scored differently but this is only marginally. Customer experience scored the lowest, mainly due to them wanting to see more of the customer views and process included; leaning on their own practices they understand and use. Arguably the whole framework is more architecture and business focused, having more placeholders for those elements. IT management scored the highest,

being positively surprised overall, not having scored any element really low throughout all questions. This is a good result, as they are key decision-makers.

From the open questions a lot of information has been found that could improve the framework in new iterations. Some of the information sources discussed could definitely be a part of the framework, but the complexity level needs to be kept at a minimum for it to be easily usable and understandable. Bringing in flexibility in the framework is a possibility here. Especially when the framework is used within other documents. These documents can describe the more fixed settings of the initiative or parts that need more elaboration. For instance business capabilities can easily require a whole page to describe them. The framework can then include the highlights from that page, or this space in the framework is used for an other information source such as requirements or architectural decisions. The framework could adapt more to the changing options and possibilities. From the business context the vision and objectives are most important as these strongly align business and IT. Listing other initiatives can not always be done, or might not bring much relevant information, so could be left out to create space. The legend should be adapted to the elements and overlays used in the architecture, not showing anything that is not used. Lastly the version information is not always important to put on the visualization it self. When the visualization is part of a larger document, that document should include the version and author information, tracking the changes over time.

There are split opinions on digitalisation of the framework. It could be a useful tool for both architects as other stakeholders to bringing information together, look up architecture and business aspects. But also for architect to create the overviews with. However, it requires quite a lot of work to create the tool it self. If the framework is only to be used in project and architecture documents, the existing EA tooling (discussed in chapter 4.3) is sufficient for creating the visualisation. It can even be achieved with a PowerPoint template. The EA tooling available brings a lot to the table for the architectural part of the framework. The architectures can be documented in all complexity, with possibilities to generate views at different levels. Having connected databases to keep data up-to-date, in some tools this can even be automated. But bringing in the overlays and business information in one holistic overview is something they cannot do well. This is where the tooling and framework can be combined. Using the simple tools such as Microsoft PowerPoint or Visio to combine all aspects of the framework to then be applied in presentations and documents.

8. Conclusion, limitations and future research

This chapter will conclude the results, talk about the limitations of the research and how future research can improve future developments.

8.1 Conclusion

To improve the decisions made in an organisation, we use enterprise architecture visualisations in combination with the customer journey. A framework has been designed that helps architects visualise the needed information that combine EA and the CJ in an understandable way. The visualisation can help aligning stakeholders and promotes discussion on, the CJ, business and IT, leading to better decision making. Different data collection methods have been applied to find out what information is needed in the visualisation framework. The framework has been tested using simulation of real world scenarios. Results from these tests have been positive. Showing that the framework can be effective for alignment, discussion and decision-making, answering the main research question: *How can the customer journey help in architecture visualisations to support decision-making?*

To create the visualisation framework research on various aspects has been conducted. Through expert interviews and literature research data has been collected, combined with knowledge from enterprise architecture and customer experience the framework has been formed. To validate the artefact the framework has been applied to three scenarios. During the validation of the framework extra information sources and issues came up that have been discussed in the evaluation. Using this information could improve the framework in future iterations. The possibility of adding more flexibility to the framework has been discussed to adding value and practicality for the use in real world scenarios. The data collection together answers sub question 1: *What information from the business and customer journey can be used to support decision-making?*. Giving us information on what the needs of the stakeholders are. This includes creating a good overview of the whole context by including business information such as: Vision, objectives, scope and business capabilities. But also listing connected initiatives and connected components in the architecture. The customer journey needs to be visualised on several layers: the journey itself with highlights of the gaps that need to be addressed, the process/actions the customer (and employees) for a service or product and the touchpoints with the organisation where the connection to IT can be made. Architecture needs to have information on the API's and services, but also back end systems and databases.

The validation of the framework answers sub question 2: *What is an effective way of visualising architecture information on the customer journey?*. For this a holistic architecture overview had to be created. Showing a context containing CJ, IT and business aspects. The customer journey has been created in a layered approach based on customer journey mappings and service blueprints. The architecture is created based on a more common layering from front-end to back-end as used in other architecture frameworks, keeping the

complexity low and understandable. Creating the rest of the context has been done using textual information using several placeholders around the architecture. On top of the overview overlays are used to highlight elements, create new insights and answering questions from stakeholders. Validation of the usability of context elements were positive to very positive, where the architecture and overlays were positive. Observations during the validation showed that the usability scores for each visualised scenario were influenced by the participants judging the accuracy/completeness of the architecture views and insights. Instead of just on the usefulness of those specific parts in the framework. Nonetheless the qualitative results are positive for the validation of this artefact. Other results showed possible improvements for the framework, such as: adding in flexibility to framework or using industry standard languages for the architecture.

Sub question 3 was briefly researched. *What tools can be used to visualise and maintain architectural information of a customer journey?*. It quickly became evident that a lot of EA tooling is supporting the use of customer journeys in some way, but these do not necessary tackle improving the decision making of stakeholders. This is where the created framework will add value. Visualising the context around the architecture, using overlays to highlight or add valuable information, such as: indicators of change needed, strategic value or data flows. The EA tools are less suited to be used in presentations, documentation or discussion, but are great to maintain architectural information and analyse data.

This research showed an effective way to combine the customer journey within enterprise architecture. By creating a holistic overview of the context using business, IT and CJ elements, stakeholders have the information that can help them in alignment and decision-making. Using a visualization framework to structure and combine the information from different domains, creating an easy to understand overview. By applying overlays on this overview more insights can be created, answering questions stakeholders might have. By validating the framework at AFKL we have shown it is positively perceived usability in real world scenarios.

8.2 Limitations

The biggest limitation of this research is not testing the actual improved efficiency and effectiveness; whether the quality of the decisions is better and the effort less than in the current situation. This limits the results of this research, being a mostly qualitative outcome. Due to the difficulty of testing the actual decision-making this has not been done in this research, but there are possible ways to approximate this. What could have been done is using a focus group to bring together stakeholders and observe how they interact and come to a decision, as in general this is not done by just one person. It would be best to apply this in a real case at a company. Using a hypothetical case might not be sufficient as stakeholders could lack incentive to fight for their goals to come to a mutual decision. To improve that even more this could be compared to the current ways decisions are made, comparing it to a very similar case where the framework is not applied. Difficulty is the varying scenarios

and decisions made, stakeholders having different concerns and having more or less interest in certain initiatives.

Another limitation could be globalisation. During this research a lot of information comes from experts at AFKL. The validation has to be applied to real scenarios at AFKL for it to create a realistic simulation but arguably this is also very company specific. Applying the framework at different companies in multiple scenarios and being companies of different sizes and industries can greatly enhance the generalisability.

8.3 Future research

First of all, more research into the actual efficiency of decision-making can be done, as discussed in the limitations of this research. But next to this there are several other aspects that can be interesting in future research.

New thoughts and improvements have come up during the artefact validation, in new iterations of the framework these could be applied and evaluated. One important being the flexibility of the framework. When using the framework in presentations and documents a lot more flexibility can be created as some information is better to be elaborated separately or more specific information needs can be used to sketch the context depending on the stakeholders and initiative at hand.

In this research we used the customer journey as a new input that can bring valuable insights by combining it with business and IT aspects. But there are domains that do not have any customer interaction or touchpoints. A new trend is to document the employee journeys. It would be interesting to see if adding an extensive employee process in to the business and IT context has a positive impact on decision-making.

In future research the artefact can be applied to tooling or digitized into software. In this research we have looked at multiple tools that have the possibility of combining the CJ and EA information. Digitizing the whole context using the organisational information of the framework around the architecture is a challenge that can be researched where also the flexibility as discussed before can be applied.

More questions and architecture views can be simulated and tested for efficiency. In what cases does this framework work best, and what cases less. Research the differences between stakeholders, creating the possibility to make changes based on the concerning stakeholders. And how does it apply to organisations of a smaller or bigger size, with less or more developed architecture departments.

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Appendix

A. Interview protocol [Dutch]

A.1 Introductie: Customer journey visualisatie en besluitvorming

Het doel van dit onderzoek is het creëren van een visualisatie framework die de business nieuwe inzichten kan bieden in de achterliggende IT, dit is specifiek gericht op de customer journey. Hiermee hopen we discussie te stimuleren, te zorgen dat stakeholders elkaar beter begrijpen en dat zij hiermee betere beslissingen kunnen maken en de implicaties daarvan kunnen inzien. De afgelopen maanden heb ik veel informatie verzameld binnen de organisatie door met vele stakeholders te praten. Hierdoor heb ik het probleem duidelijk gekregen en begrijp ik de situatie van verschillende stakeholders beter. Ook van een wetenschappelijk perspectief is gekeken naar de kloof die nu bestaat en hoe die onderzocht kan worden. De customer journey is interessant voor KLM door de sterke relatie aan de NPS score, maar ook is dit interessant van een architectuur perspectief want dit snijdt door een hoop afdelingen en IT systemen heen wat interessante inzichten kan bieden. Een aantal voorbeelden van visualisaties die nu bestaan zal ik later laten zien.

Het doel van dit interview is te achterhalen welke inzichten helpen in het adresseren van de problemen in jouw domein. Maar ook het begrijpen van welke en hoe beslissingen worden genomen. Hiermee kan achterhaald worden hoe we dat kunnen ondersteunen met visualisaties vanuit architectuur. Daarnaast wordt ook informatie verzameld om een generieke casus van te maken, die verder gebruikt kan worden in volgende tests. Omdat ik deze data in mijn scriptie wil gebruiken zal ik het interview opnemen en wil ik je vragen een toestemmingsformulier (informed consent) door te nemen en tekenen. In het kort staat hierin dat de verzamelde gegevens geanonimiseerd gebruikt zullen worden en dat dit interview op elk moment gestopt kan worden en de verzamelde data terug getrokken kan worden door jou.

A.2 Interview vragen

Behoeftes/belangen

We willen duidelijk krijgen wat de belangen, behoeftes en grenzen zijn er binnen jullie domein en hoe architectuur daar een rol in speelt.

1. Wat is de doelstellingen van de afdeling voor 2019?
2. Als je denkt aan deze doelstellingen, wat zijn de belangrijkste succesfactoren?
3. Wat zijn hierbij de grootste knelpunten en/of grenzen?
 - a. PROBE: Bijvoorbeeld organisatorische constraints.
4. Hoe speelt architectuur daar een rol in?
5. Welke behoeftes hebben jullie van architectuur?
 - a. PROBE: Hoe kan architectuur jou helpen, welke informatie heb je nodig?
6. Wat is jouw ervaring met visualisaties van de architectuur?
7. Hoe zouden visualisaties jou kunnen helpen?
8. Welke wensen heb je van zo een visualisatie?
 - a. PROBE: Welke elementen denk je aan als je een visualisatie van de architectuur wilt zien?

Besluitvorming

We willen duidelijk krijgen welke strategische beslissingen jullie maken waarbij architectuur visualisaties zouden kunnen helpen. Hoe ben je afhankelijk van andere stakeholders en waarop worden beslissingen gebaseerd. Als je terugdenkt aan voorgaande projecten waar discussie over architectuur, IT en de business plaatsvond.

1. Welke rol(len) speel jij in de besluitvorming?
2. Wat is de rol van andere stakeholders in die besluitvorming?
 - a. PROBE: Hoe zou je de dynamiek tussen stakeholders beschrijven?
3. Wat voor een (type) besluiten worden hier gemaakt?
 - a. PROBE: Vraag betreft strategische business en IT besluiten.
 - b. PROBE: Voorbeeld van type besluiten: haalbaarheid, risico's
4. Welke aspecten spelen volgens jou een rol in besluitvorming?
 - a. PROBE: Voorbeeld: Budget, time to market, NPS
5. Wat is moeilijk aan die besluiten maken?
6. Welke architectuur inzichten/modellen zijn nodig om een beslissingen te nemen?
 - a. PROBE: Voorbeeld: Capabilities, processen, IT, architectuur, informatie model.
7. Welke dialoog wil/ga je dan met architecten andere/of stakeholders aan?
8. Wat is jou ervaring met visualisaties tijdens de besluitvorming?
9. Hoe kan een visualisatie jou hier in helpen?

Voorgaande project

Kun je een er specifiek project bijhalen of uitleggen waarin business/customer journey, IT en architectuur een rol speelde. Dit is nuttig om om nog eens de vragen van hiervoor in een echte situatie te kunnen inzien. Maar ook om een generiek casus/beeld van te kunnen maken voor latere tests.

1. Waar ging dit project over?
2. Waar ontstond discussie over?

3. Waarover zijn besluiten genomen?
4. Welke inzichten waren hier wel of niet aanwezig die helpen met de beslissingen?
 - a. PROBE: Doorvragen waar kwamen die inzichten toen vandaan?
5. Welke visualisaties waren hier aanwezig?
6. Wat vond je van de visualisaties en wat kon daar beter aan?

Visualisaties

Ik wil je een aantal visualisaties die nu worden gebruikt/verspreid laten zien. En laten zien waar ik denken naar toe te kunnen gaan met mijn ontwerp.

1. [Oude visualisaties voorleggen] Ben je geïnteresseerd om op dit niveau een discussie te voeren?
 - a. PROBE: Elke hokje en pijltje kan uitgelegd worden, vind je dat nuttig?
2. [Nieuw idee voorleggen] Ben je geïnteresseerd op hierover discussie te voeren?
3. Geeft zoiets inzichten waar je op te wachten zit?
4. Zou dit helpen bij het nemen van besluiten?
5. Op welk niveau vind je dat uit een nieuwe visualisatie moet zijn?
 - a. PROBE: terugkijkend naar de oude visualisaties

[Oude visualisaties]

1. *eConvergence (2 views)*
2. *API overview (CJ+API)*
3. *Offer/Order overview x2 (2 views)*

[Nieuw idee] hoe dit er uit zou komen te zien is een visualisatie met de volgende lagen:

- *Doelstellingen*
- *Overzicht van customer journey process met:*
 - *Inzicht wat er moet veranderen*
 - *Uitzetting welke features er moeten komen*
- *Inzicht in business capabilities die daar bij horen en de waarde van de capabilities*
- *Link naar hoe dat vertaald naar IT / architectuur (front-end, services, back-end, data modellen)*
- *Met daarbij: Inschatting wat hiervan de impact / risico's /kosten van kunnen zijn (zoals in EPICS)*
 - *Ook de constraints zowel van architectuur of organisatorisch zouden opgenomen kunnen worden.*

B. Visualisation designs

B.1 Visualisation design 1

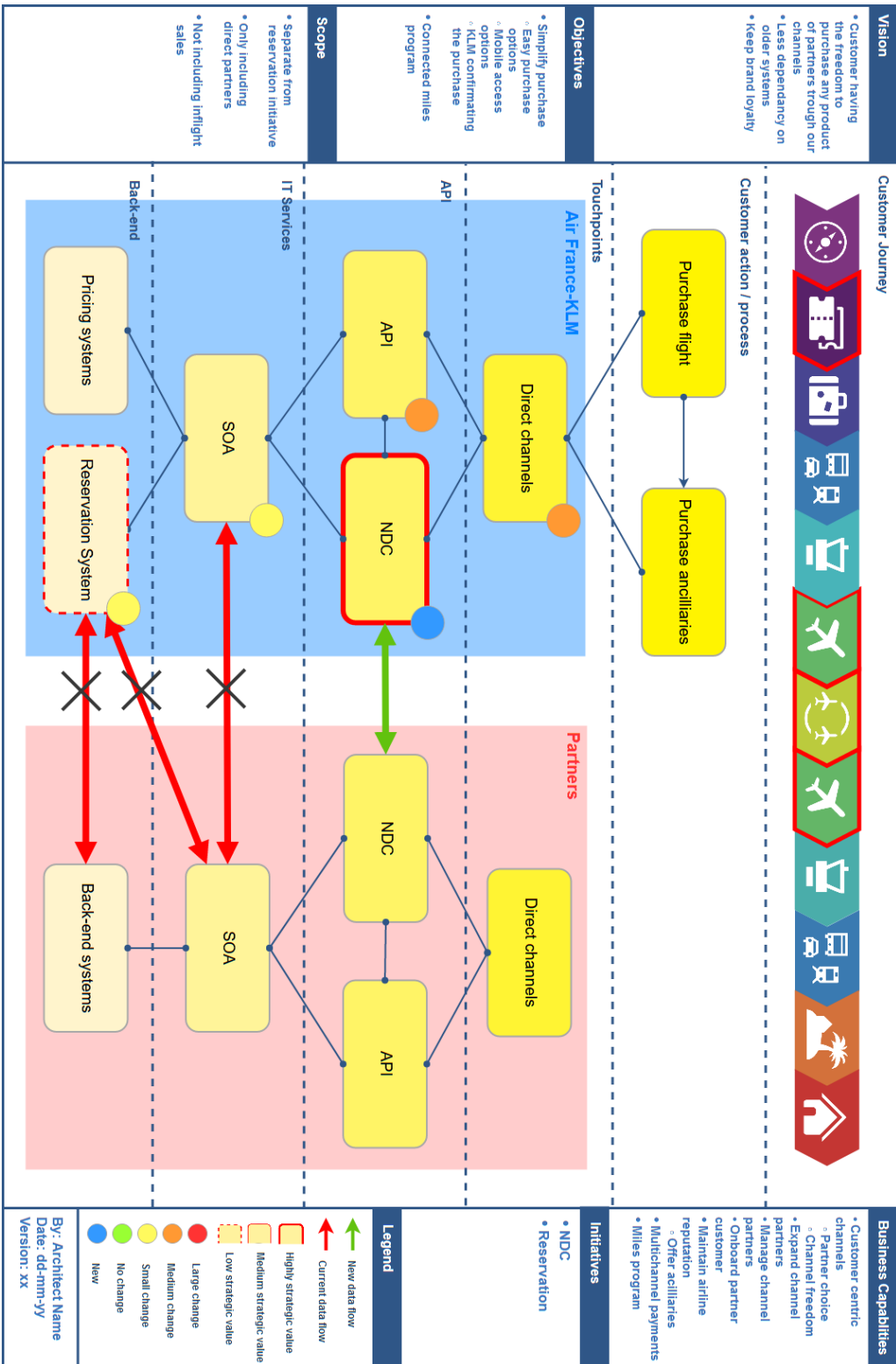


Figure 14 – Implement NDC for cross selling

B.2 Visualisation design 2

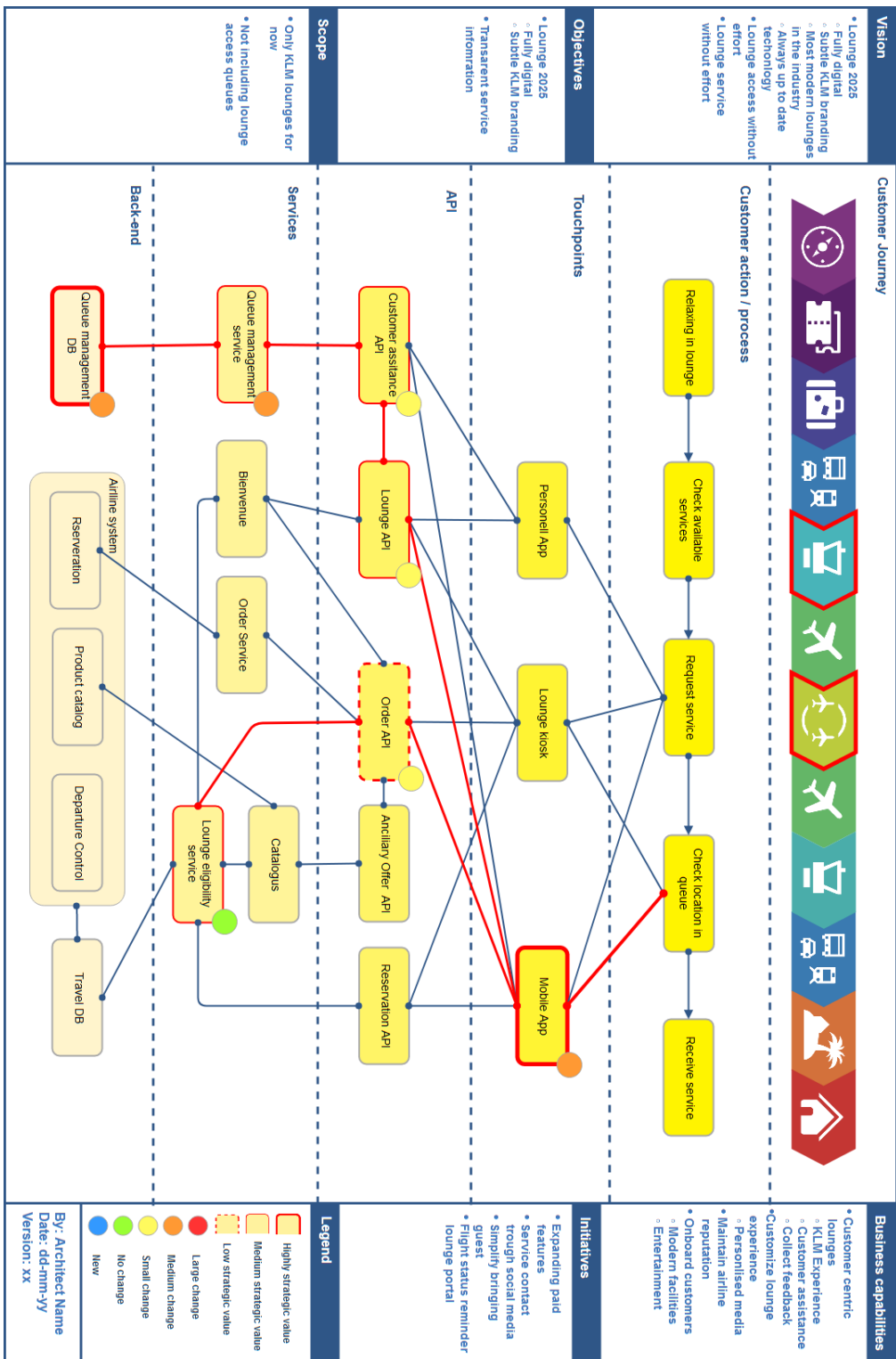


Figure 15 – New Feature: Mobile lounge queuing system

B.3 Visualisation design 3

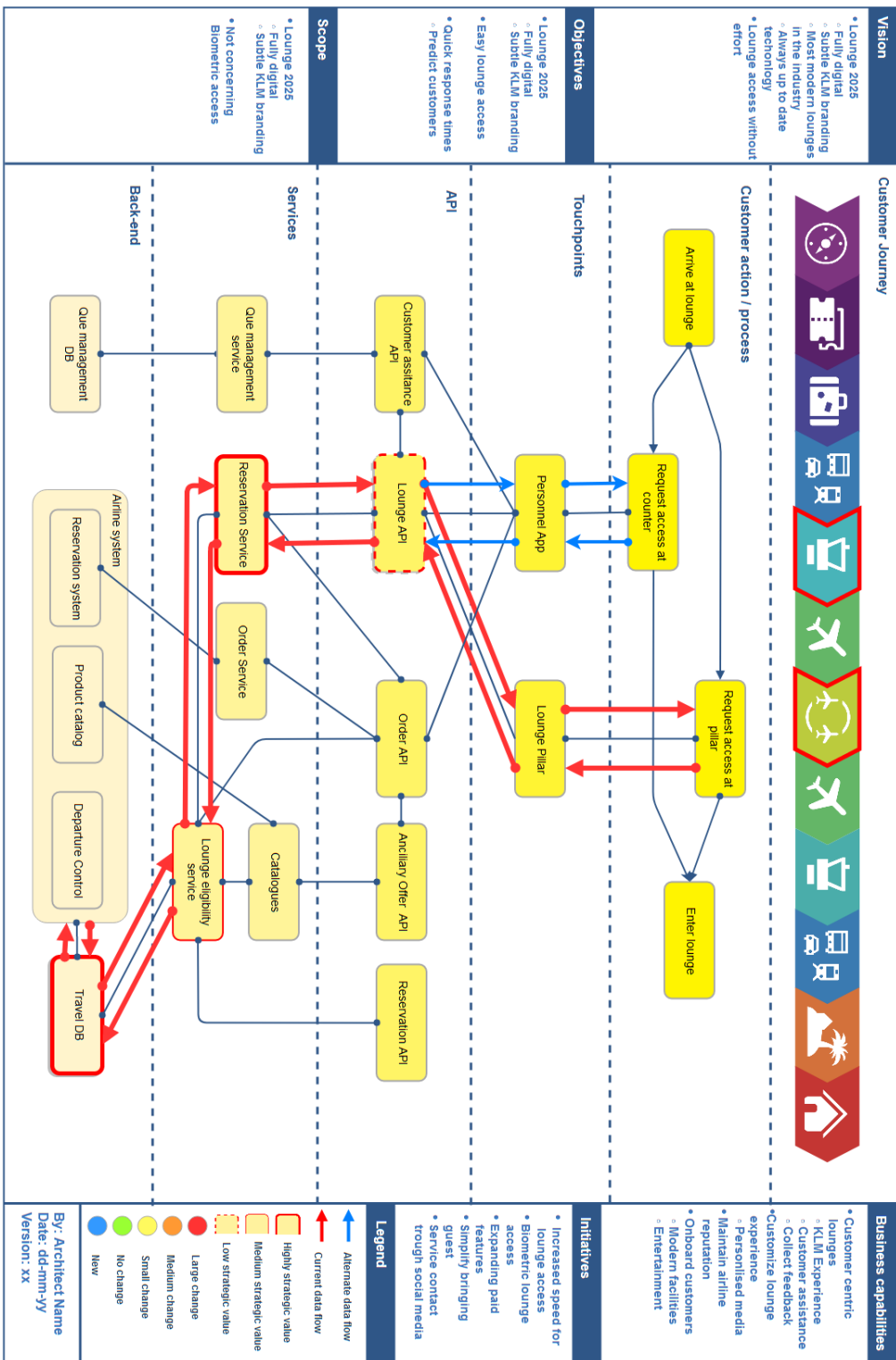


Figure 16 – Increased access speed o lounges

C. Artefact validation

C.1 Google forms

Testing customer journey architecture visualisations

*Required

Informed Consent

The goal of this research is to create a visualisation framework for architects. This should help them create an overview of a subject/project/case that connects the business, IT and the customer (journey). With the visualisation we hope to create new insights, stimulate discussion between stakeholders, create mutual understanding, show impact and help stakeholders make better decisions. In this test we will look at 3 visualisation examples made with the framework, each a different scenario. Every visualisation will be followed by 5 questions to be answered on a scale of 1-5. After we will have a 10 questions about the visualisations in general and a few open questions to discuss. During the test I will be present to observe the test, answer any questions and discuss any feedback at the end. All information gathered will be handled confidentially. The people that have access to the data are: Roald van der Aa (me), Eric Valent (KLM) and Christof van Nimwegen (University of Utrecht). Any personal information will be anonymized, and in case this is published the AFKL name will also be removed. This project will end in July 2019. By entering your name below you agree to participate in this test. Note that you can take back your participation at any point without giving any reason.

First name + surname *

Visualisations

A hypothetical use case has been setup, based on past and current developments within the organization. Three related scenarios have been visualised. In each visualisation an overlay has been created to answer a potential question from a stakeholder. These visualisations will each answer different types of questions and create different insights. You must imagine that this visualisation is used in other documents that include more details surrounding the case/scenario. For instance: the ITAS document, that describes architecture changes, where this visualisation should sketch the whole situation, and the rest of the document describes all the details. - The visualisation is not meant to show a fully detailed solutions with the exact specifications or implementations. It should sketch the main lines of the initiative, to make sure all stakeholders are aligned and understand the big picture. - The visualisation is meant to align stakeholders by creating a full overview of the context, the impact of the scenario, including the customer (journey) impact. - It should provide high level insights that stimulates strategic discussion and decision making. - The visualisations might miss information in early stage of an initiative. It is supposed to change along with the development of the initiative through/with stakeholder feedback. Promoting stakeholders to understand, discuss and align over the big picture.

Explanation of the visualisation framework

The visualisation framework contains the following sections: Left-side: - Vision: Describing what the goal for this subjects is in the future, this might only be partially fulfilled by the initiative at hand. - Objectives: What we want to achieve with this particular initiative. - Scope: What is or is not included in this initiative. Middle: - Architecture: An overview connecting the customer journey to the customer actions/process to the front-end, the API's and the back-end. - With overlays able to show: flows, impact, strategic value, amount of change needed. Right-side: - Business capabilities: Describing what existing capabilities this fulfils or new capabilities that should be fulfilled. - Initiatives: Lists other initiatives that are connected and could impact each other. - Legend: Describing the elements in the architecture. - Version information: describing what version and by whom it is made, so people get more easily give feedback.

Use Case

Lounge improvement: In 2019 we want to make several changes to KLM lounges to improve the airport and recovery experience of our customers. In brainstorm sessions several improvements and problems have come up that have been translated into features and functionalities to be implemented over the span of the next year. From this new initiatives have been started to create these features. Next to this there are also overarching initiatives that will impact the lounge capabilities in the future. The following three scenarios have been visualised to illuminate the situation. 1. Implementing NDC for cross selling products with partners 2. Adding a new feature: mobile lounge queuing system 3. Increasing access speed to lounges In each scenario certain question came up that has been visualised over the architecture.

Scenario 1 - NDC implementation

Description: Due to limitations in the back-end systems it is hard and complex to cross sell products (like lounge access) with partners. More airlines want to make a move to NDC for a standardised way of communication. This initiative also fits in with a new reservation initiatives. This project is in an early stage, not all details are known yet. As it is overarching almost everything in the architecture landscape, big architecture changes are sure to happen. Question: In this initial stage we want to know what the NDC changes are about, and what would happen to the current architecture? visualisation: Shows the impact of the proposed implementation to inform and align on a high level.

Please note that the information on the visualisation might not be accurate, it is more important you see what it could possibly look like. I recommend you look at the visualisation in full size, the images can be found in the email attachment.
[Visualisation 1, appendix B1]

Visualisation Questions

1.1 I find this visualisations gives me the right context for the scenario *
Markeer slechts één ovaal.

1 2 3 4 5

Strongly Agree

Strongly Disagree

1.2 I find this visualisations give me the right architecture insights for the scenario *
Markeer slechts één ovaal.

1 2 3 4 5

Strongly Agree

Strongly Disagree

1.3 I find this visualisation can help me in further discussions on the subject *
Markeer slechts één ovaal.

1 2 3 4 5

Strongly Agree

Strongly Disagree

1.4 I find there is a lot of information in the visualisation that I don't need *
Markeer slechts één ovaal.

1 2 3 4 5

Strongly Agree

Strongly Disagree

1.5 I find this visualisations needs more details *
Markeer slechts één ovaal.

1 2 3 4 5

Strongly Agree

Strongly Disagree

Scenario 2 - Mobile lounge queuing

Description: A new feature where customers can order services in the lounge through the mobile app. By adding a digital lounge queue to KLM mobile app. Customers can see their approximate place in the queue for the requested service. On their turn an agent will find the customer based on location services. Question: What impact would this queuing system have on the current architecture, is that worth the effort?
visualisation: The impact of implementing the new feature in the current architecture is shown.

Please note that the information on the visualisation might not be accurate, it is more important you see what it could possibly look like. I recommend you look at the visualisation in full size, the images can be found in the email attachment.
[Visualisation 2, appendix B2]

Visualisation Questions

2.1 I find this visualisations gives me the right context for the scenario *
Markeer slechts één ovaal.

1 2 3 4 5

Strongly Agree

Strongly Disagree

2.2 I find this visualisations give me the right architecture insights for the scenario *
Markeer slechts één ovaal.

1 2 3 4 5

Strongly Agree

Strongly Disagree

2.3 I find this visualisation can help me in further discussions on the subject *
Markeer slechts één ovaal.

1 2 3 4 5

Strongly Agree

Strongly Disagree

2.4 I find there is a lot of information in the visualisation that I don't need *
Markeer slechts één ovaal.

1 2 3 4 5

Strongly Agree

Strongly Disagree

2.5 I find this visualisations needs more details *
Markeer slechts één ovaal.

1 2 3 4 5

Strongly Agree

Strongly Disagree

Scenario 3 - lounge access speed

Description: We identified that accessing a lounge takes a long time, when placing boarding pass on scanner it takes more than 5 seconds for the system to react. Customers are waiting longer than they are used to. We want it to instantly show if customer is eligible to enter the lounge. First we have to identify why it takes this long, and what solutions could potentially help. Question: What does the flow of data look like for a customer that wants to enter a lounge and what are critical applications?
visualisation: Visualises the flow of data for accessing a lounge.

visualisation 3

Please note that the information on the visualisation might not be accurate, it is more important you see what it could possibly look like. I recommend you look at the visualisation in full size, the images can be found in the email attachment.

[Visualisation 3 , appendix B3]

Visualisation Questions

3.1 I find this visualisations gives me the right context for the scenario *

Markeer slechts één ovaal.

1 2 3 4 5

Strongly Agree

Strongly Disagree

3.2 I find this visualisations give me the right architecture insights for the scenario *

Markeer slechts één ovaal.

1 2 3 4 5

Strongly Agree

Strongly Disagree

3.3 I find this visualisation can help me in further discussions on the subject *

Markeer slechts één ovaal.

1 2 3 4 5

Strongly Agree

Strongly Disagree

3.4 I find there is a lot of information in the visualisation that I don't need *

Markeer slechts één ovaal.

1 2 3 4 5

Strongly Agree

Strongly Disagree

3.5 I find this visualisations needs more details *

Markeer slechts één ovaal.

1 2 3 4 5

Strongly Agree

Strongly Disagree

General Questions

4.1 I find the visualisations easy to understand *

Markeer slechts één ovaal.

1 2 3 4 5

Strongly Agree

Strongly Disagree

4.2 I find the placement of sections and components in the visualisations logical *
Markeer slechts één ovaal.

1 2 3 4 5

Strongly Agree

Strongly Disagree

4.3 I find these visualisations represents the data well *
Markeer slechts één ovaal.

1 2 3 4 5

Strongly Agree

Strongly Disagree

4.4 I find this visualisations can help me make better decisions together with other stakeholders *
Markeer slechts één ovaal.

1 2 3 4 5

Strongly Agree

Strongly Disagree

4.5 I find this visualisations can help me align with other stakeholders *
Markeer slechts één ovaal.

1 2 3 4 5

Strongly Agree

Strongly Disagree

4.6 I find this visualisations can create useful insights in future cases *
Markeer slechts één ovaal.

1 2 3 4 5

Strongly Agree

Strongly Disagree

4.7 I find using uniform/similar visualisations in different projects useful *
Markeer slechts één ovaal.

1 2 3 4 5

Strongly Agree

Strongly Disagree

4.8 I see myself to use these visualisation in the future *
Markeer slechts één ovaal.

1 2 3 4 5

Strongly Agree

Strongly Disagree

Open questions

Did you miss important information sources that would support the decision making or alignment?

Can you think of questions that should be answered in an overview like this, but have not been?

Do you have any general remarks?

Do you see a visualisation like this being digitized (into software). What kind of interaction or possibilities would you like to see?

C.2 Questionnaire

Table 11. Questions for each visualisation

	Question	Goal	Evaluate
1	I find this visualisations gives me the right context for the scenario.	visualisation must sketch a useful context to better align stakeholders.	Usefulness - aligning
2	I find this visualisations give me the right architecture insights for the scenario.	Creating the right insight is crucial for decision making.	Usefulness - insight architecture
3	I find this visualisation can help me in further discussions on the subject.	To encourage stakeholder discussion it needs to show information relevant for a discussion.	Usefulness - discussion
4	I find there is a lot of information in the visualisation that I don't need.	Does it contain information that is irrelevant to the question or context.	Usefulness - context
5	I find this visualisations needs more details.	Does it need more details to be useful?	Usefulness - detail level

Table 12. General questions

	Question	Goal	Evaluate
1	I find the visualisations easy to understand.	Visualisations must be understood by different stakeholders.	Ease of use
2	I find the placement of sections and components in the visualisations logical.	Is the layout of the visualisation easy to use/ does it make sense.	Ease of use - layout
3	I find these visualisations represents the data well.	Does it visualise information they way they expect?	Not used
4	I find this visualisations can help me make better decisions together with other stakeholders.	The visualisation must be effective for making decisions.	Effectiveness decisions
5	I find this visualisations can help me align with other stakeholders.	The visualisation must be effective for alignment.	Effective aligning

6	I find this visualisations can create useful insights in future cases.	Is it useful in other situations?	Usefulness - framework
7	I find using uniform/similar visualisations in different projects useful.	Stakeholder might expect different visualisations per question, do they actually want a more uniform way.	Usefulness - uniformity
8	I see myself use these visualisation in the future.	Willingness to use it in the future.	Intent to use

Table 13. Open questions

	Question	Goal	Evaluate
1	Can you think of questions that should be answered in an overview like this, but have not been or are difficult to?	Did we miss any relevant sources or insights?	Usefulness
2	Did you miss important information sources that would support the decision making or alignment?	Effectiveness for decision making.	Effectiveness
3	Do you have any general remarks?	Anything that is relevant.	Any
4	Do you see a visualisation like this being digitized (into software). What kind of interaction or possibilities would you like to see?	Future developments for this visualisations.	Intent to use